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Full length Research paper

Analysis of Groundwater Quality Variation from Liwa (Mizaira'a) to Madinat Zayed and Ghayathi, UAE

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During the span of 2014 – 2015 groundwater samples from various regions of Abu Dhabi i.e. from Liwa (Mizaira'a), Madinat Zayed and Ghayathi regions were collected to carry out the subject research work. Seven to eight samples used to be collected from specified regions during full discharge flow of bore well. The collected samples were analyzed keeping in view different physico-chemical parameters special attention was focused on electrical conductivity (EC), Total Dissolved Solids (TDS), pH, Chloride, Hardness, Salinity, and Nutrients. The results revealed that the quality of groundwater in Liwa (Mizaira'a) aquifer is slightly better than Madinat Zayed and Ghayathi regions as the EC and TDS was found less. The aquifer condition in Ghayathi region was found somehow worst having high EC and TDS. This may be due to the sea water intrusion from the Arabian Sea in this region. The detailed physico-chemical results of groundwater samples collected from Liwa (Mizaira'a), Madinat Zayed and Ghayathi regions are elaborated in Table: 01 and Table: 06 respectively.

Keywords: Groundwater, EC, TDS, Salinity, Hardness, Greenhouse, Liwa, Madinat Zayed, Ghayathi, UAE.

INTRODUCTION

Water is the most abundant substance on earth, the principal constituent of all living things, and also a key factor in air-conditioning the earth for human existence and in influencing the progress of civilization. The importance of groundwater is growing based on an increasing need and decreasing rainfall in arid lands (Mohamed et al., 2012). UAE is one of the most water scarce countries in the world. Meeting water demand is challenge, and managing water resources is imperative. UAE being an arid land gets experiences paucity of rain less than 100 mm per year due to which groundwater reserves is also on the lesser side i.e. less than 4% (Mohamed et al., 2015 and Murad et al., 2012). Due to less rainfall and vegetation reliable resources of surface water cannot be put in place. Agriculture, forest, and parks sector cannot flourish without the availability of irrigation water. In arid areas like UAE, only the groundwater is a magnanimous source for agriculture, drinking use, industrial requirements and socio-economic development (Mulla et al., 2011).

Availability of reliable water resources and the skillful management of the resources place a pivotal role to uplift the water usages. The annual groundwater abstraction from the shallow aquifers is about 2200 million m^3 which is about 63.6% of the total Emirate water production whilst the aquifer annual natural recharge ranges from 50 to 140 million m^3 (Sherif et al., 2011 and Ahmed et al., 2010). Most of this water is used for agriculture and forestry sectors. Therefore, development of water resources is required to satisfy the increasing demand on water. Groundwater is considered as the major conventional water resource in UAE. The present research work was conducted in the western region of Abu Dhabi in various cities i.e. Liwa (Mizaira'a), Madinat Zayed and Ghayathi; to check the quality of groundwater used for irrigation purpose and to evaluate the influence of sea water on the groundwater quality.

MATERIALS AND METHODS

Groundwater samples from Liwa (Mizaira'a) were colle-

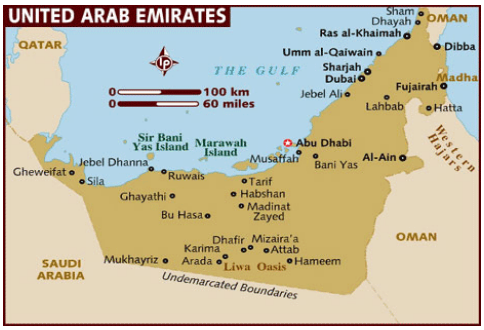

Figure 1. Map of United Arab Emirates.

Table 1. Physico-Chemical Analysis of Groundwater Samples collected from Liwa (Mizaira'a) on 15th April 2014

S. No	Parameters	Sampling Stations			
		Zayed Mohamed Farm	Ghubaishah Abdullah Farm	Saif AL Falahi Farm	Eisa Khadem Mohamed Farm
1	Temperature of air °c	34.3	34.3	34.1	34.3
2	Temperature of water °c	31.5	30.5	33.7	34.7
3	pH values	7.7	7.5	8.2	8.5
4	EC in µS/cm	2758.7	2674.3	2955.8	3040.2
5	TDS in ppm	1509.2	1463.0	1617.0	1663.2
6	Salinity in gm/lit	1.1	1.0	1.2	1.2
7	Hardness in mg/lit	535.1	518.7	573.3	589.7
8	Chloride in ppm	413.6	400.9	443.1	455.8
9	Potassium in ppm	15.7	15.2	16.8	17.3
10	Calcium in ppm	73.5	71.3	78.8	81.0
11	Magnesium in ppm	70.6	68.4	75.6	77.8
12	Sodium in ppm	313.6	304.0	336.0	345.6

cted on 15th April 2014 and 15th April 2015, from Madinat Zayed groundwater samples were collected on 16th April 2014 and 16th April 2015, respectively. Likewise, samples of groundwater from Ghayathi were collected on 17th April 2014 and 17th April 2015. Samples were collected from four various greenhouses from each region in order to obtained precise results. Samples from the following greenhouses farms were collected Zayed Mohamed Obaid Farm, Ghubaisha Abdullah Farm, Saif AL Falahi Farm, Eisa Khadem Mohamed Farm, Mohamed Saif Abdullah Farm, Zaal Alfalahi Farm, Mohamed Al Masood Farm, Mubarak Salhoom Alqubaisi Farm, Salem Jaaed Farm, Salem Bakheet Farm, Abdullah Ali Saif Farm, and Haji Sultan AL Qubaisi Farm, respectively. All the samples were collected from the fully flow of water from bore well.

All the collected samples were mixed together and a mixture of 2.5 liters was poured in to the cleaned glass bottle. Simultaneously, the temperature of water and air was also recorded. Various laboratory tests were carried out to find out Electrical Conductivity (EC), Total Dissolved Solids (TDS), pH, Chloride, Hardness, Salinity, and Nutrients. All these parameters were analyzed by (U.S. Salinity Lab. Staff standards,. 1954). TDS and pH were recorded with the help of TDS and pH meters. Chloride, alkalinity, and hardness were determined by titration with standard silver nitrate, hydrochloric acid and E. D. T. A. respectively. Sodium, potassium,calcium, and magnesium were determined by air acetylene flame using atomic absorption spectrophotometer at the conditions recommended by the producer. The analysis was carried out in triplicate with integration time of 3 second and delay time 3 sec respectively.

RESULTS AND DISCUSSION

The subject research was carried out to check the quality of groundwater and to evaluate the influence of sea water on the groundwater quality at western region of Abu Dhabi, UAE. The outcome of the study revealed that the pH, electrical conductivity, TDS and hardness was found

Table 2. Physico-Chemical Analysis of Groundwater Samples collected from Liwa (Mizaira'a) on 15th April 2015.

S. No	Sampling Stations Parameters	Zayed Mohamed Farm	Ghubaishah Abdullah Farm	Saif AL Falahi Farm	Eisa Khadem Mohamed Farm
1	Temperature of air °c	34.7	34.7	34.6	34.7
2	Temperature of water °c	31.8	30.8	33.4	34.3
3	pH values	7.8	7.5	8.2	8.4
4	EC in *µS/cm*	2786.9	2702.4	2927.6	3012.1
5	TDS in ppm	1524.6	1478.4	1601.6	1647.8
6	Salinity in gm/lit	1.1	1.1	1.1	1.2
7	Hardness in mg/lit	540.5	524.2	567.8	584.2
8	Chloride in ppm	417.8	405.1	438.9	451.5
9	Potassium in ppm	15.8	15.4	16.6	17.1
10	Calcium in ppm	74.3	72.0	78.0	80.3
11	Magnesium in ppm	71.3	69.1	74.9	77.0
12	Sodium in ppm	316.8	307.2	332.8	342.4

Table 3. Physico-Chemical Analysis of Groundwater Samples collected from Madinat Zayed on 16th April 2014.

S. No	Sampling Stations Parameters	Mohamed Saif Abdullah Farm	Zaal Alfalahi Farm	Mohamed Al Masood Farm	Mubarak Alqubaisi Farm
1	Temperature of air °c	33.7	33.5	33.7	33.6
2	Temperature of water °c	32.4	31.4	34.8	35.7
3	pH values	7.9	7.7	8.5	8.8
4	EC in *µS/cm*	3606.4	3496.0	3864.0	3974.4
5	TDS in ppm	2307.9	2237.3	2472.8	2543.4
6	Salinity in gm/lit	1.8	1.7	1.9	2.0
7	Hardness in mg/lit	735.0	712.5	787.5	810.0
8	Chloride in ppm	363.6	352.5	389.6	400.7
9	Potassium in ppm	17.6	17.1	18.9	19.4
10	Calcium in ppm	68.6	66.5	73.5	75.6
11	Magnesium in ppm	66.6	64.6	71.4	73.4
12	Sodium in ppm	302.8	293.6	324.5	333.7

constant for Liwa (Mizaira'a) region and uptill this point no any considerable effect of seawater was observed. Samples collected on 15th April 2014 and 15th April 2015 from Liwa (Mizaira'a) region, the result of chemical analysis did not show much variation during one year study. The maximum pH (8.5) and minimum pH (7.5) was recorded in Eisa Khadem Mohamed Farm and Ghubaisha Abdullah Farm respectively and which was found within safe limits given by (WHO, 1996). Likewise, the samples were having EC in between 2674.3 – 3040.2 µS/cm for the same Liwa (Mizaira'a) region. The overall TDS of water was found in between 1463.0 – 1663.2 ppm which was slight to moderate for the Liwa (Mizaira'a) region. The maximum (589.7 mg/l) and minimum (518.7 mg/l) hardness ($CaCO_3$) was found in same Eisa Khadem Mohamed Farm and Ghubaisha Abdullah Farm respectively. The detailed physico-chemical results of groundwater samples collected from Liwa (Mizaira'a) are elaborated in Table: 01 and Table: 02 respectively.

Similarly, samples collected on 16th April 2014 and 16th April 2015 from Madinat Zayed region did not show much variation during one year study. The maximum pH (8.8) and minimum pH (7.7) was recorded in Mubarak Alqubaisi Farm and Zaal Alfalahi Farm respectively. Likewise, the samples were having EC in between 3496.0 – 3974.4 µS/cm for the same region. The overall TDS of water was found in between 2237.3 – 2543.4 ppm which was moderate to high for the Madinat Zayed Region. The maximum (810.0 mg/l) and minimum (712.5 mg/l) hardness ($CaCO_3$) was found in same Mubarak Alqubaisi Farm and Zaal Alfalahi Farm respectively. For the same farms the amount of sodium Na was found beyond the desired limits prescribed by WHO i.e. 200 ppm. The detailed physico-chemical results of groundwat

Table 4. Physico-Chemical Analysis of Groundwater Samples collected from Madinat Zayed on 16th April 2015.

S. No	Sampling Stations				
	Parameters	**Mohamed Saif Abdullah Farm**	**Zaal Alfalahi Farm**	**Mohamed Al Masood Farm**	**Mubarak Alqubaisi Farm**
1	Temperature of air °c	34.1	33.0	35.8	36.8
2	Temperature of water °c	32.8	31.8	34.4	35.4
3	pH values	8.0	7.8	8.4	8.7
4	EC in *µS/cm*	3643.2	3532.8	3827.2	3937.6
5	TDS in ppm	2331.5	2260.8	2449.2	2519.9
6	Salinity in gm/lit	1.8	1.8	1.9	2.0
7	Hardness in mg/lit	742.5	720.0	780.0	802.5
8	Chloride in ppm	367.3	356.2	385.8	397.0
9	Potassium in ppm	17.8	17.3	18.7	19.3
10	Calcium in ppm	69.3	67.2	72.8	74.9
11	Magnesium in ppm	67.3	65.3	70.7	72.8
12	Sodium in ppm	305.9	296.6	321.4	330.6

Table 5. Physico-Chemical Analysis of Groundwater Samples collected from Ghayathi on 17th April 2014

S. No	Sampling Stations				
	Parameters	**Salem Jaaed Farm**	**Salem Bakheet Farm**	**Abdullah Ali Saif Farm**	**Haji Sultan AL-Qubaisi Farm**
1	Temperature of air °c	36.3	36.4	36.3	36.3
2	Temperature of water °c	32.8	31.8	35.2	36.2
3	pH values	7.8	7.6	8.4	8.6
4	EC in *µS/cm*	4282.7	4153.0	4499.0	4628.8
5	TDS in ppm	7089.4	6874.6	7447.4	7662.3
6	Salinity in gm/lit	2.4	2.3	2.5	2.6
7	Hardness in mg/lit	792.8	768.6	849.5	873.7
8	Chloride in ppm	515.5	499.7	552.3	568.1
9	Potassium in ppm	20.6	20.0	22.1	22.7
10	Calcium in ppm	63.7	61.8	68.3	70.2
11	Magnesium in ppm	80.4	77.9	86.1	88.6
12	Sodium in ppm	308.7	299.3	330.8	340.2

-er samples collected from Madinat Zayed region are elaborated in Table: 03 and Table: 04 respectively.

Likewise, groundwater samples collected on 17th April 2014 and 17th April 2015 from Ghayathi region differed much as compared to the other two regions. Impact of seawater was visible at this region. When samples were collected from different points of Ghayathi it has been observed that TDS of water was found beyond the WHO limits i.e. 500 ppm, and it increased within the one year time span from 7662.3 upto 7733.9 ppm which is very high. Likewise, the samples were having EC in between 4153.0 – 4628.8 µS/cm on 17 April 2014 and which was increased upto 410.7 to 4672.1 µS/cm on 17 April 2015 respectively. The maximum pH (8.6) and minimum pH (7.6) was recorded in Haji Sultan AL Qubaisi Farm and Salem Bakheet Farm respectively. The detailed physico-chemical results of groundwater samples collected from Ghayathi region are elaborated in Table: 05 and Table: 06 respectively.

CONCLUSIONS

As a consequence of subject study it can be concluded that the groundwater used for irrigating agricultural land to grow vegetables for Liwa (Mizaira'a), Madinat Zayed and Ghayathi regions was unfit with respect to EC, and TDS aspects. For Liwa (Mizaira'a) region the maximum pH (8.5) and minimum pH (7.5) was recorded in Eisa Khadem Mohamed Farm and Ghubaisha Abdullah Farm

Table 6. Physico-Chemical Analysis of Groundwater Samples collected from Ghayathi on 17th April 2015.

S. No	Sampling Stations				
	Parameters	**Salem Jaaed Farm**	**Salem Bakheet Farm**	**Abdullah Ali Saif Farm**	**Haji Sultan AL-Qubaisi Farm**
1	Temperature of air ^{o}c	36.6	36.6	36.6	36.6
2	Temperature of water ^{o}c	33.2	32.2	34.8	35.8
3	pH values	7.9	7.7	8.3	8.5
4	EC in *µS/cm*	4239.5	4109.7	4542.3	4672.1
5	TDS in ppm	7017.8	6803.0	7519.1	7733.9
6	Salinity in gm/lit	2.4	2.3	2.5	2.6
7	Hardness in mg/lit	800.9	776.6	841.4	865.6
8	Chloride in ppm	520.7	505.0	547.0	562.8
9	Potassium in ppm	20.8	20.2	21.8	22.5
10	Calcium in ppm	64.4	62.4	67.6	69.6
11	Magnesium in ppm	81.2	78.7	85.3	87.7
12	Sodium in ppm	311.9	302.4	327.6	337.1

respectively. The EC was recorded in between 2674.3 – 3040.2 µS/cm the overall TDS of water was found in between 1463.0 – 1663.2 ppm which was slight to moderate. The maximum and minimum hardness ($CaCO_3$) was found (589.7 mg/l) and (518.7 mg/l) in same Eisa Khadem Mohamed Farm and Ghubaisha Abdullah Farm respectively. Likewise, for Madinat Zayed the maximum and minimum pH was recorded (8.8) and (7.7) in Mubarak Alqubaisi Farm and Zaal Alfalahi Farm respectively. Similarly, the samples were having EC in between 3496.0 – 3974.4 µS/cm for the same region. The overall TDS of water was found in between 2237.3 – 2543.4 ppm which was moderate to high. The maximum (810.0 mg/l) and minimum (712.5 mg/l) hardness ($CaCO_3$) was found in same Mubarak Alqubaisi Farm and Zaal Alfalahi Farm respectively. For the same farms the amount of sodium Na was found beyond the desired limits prescribed by WHO i.e. 200 ppm. In general the chemical results describes that the quality of groundwater in Liwa (Mizaira'a) aquifer is slightly better than Madinat Zayed and Ghayathi regions.

samples collected from Ghayathi region differed much as compared to the other two regions. Impact of seawater was visible at this region. The aquifer condition in Ghayathi region was found somehow worst having high EC and TDS. This may be due to the sea water intrusion from the Arabian Sea in this region. The results obtained from the collected samples from different points of Ghayathi revealed that TDS of water was not within WHO limits i.e. 500 ppm, and its increased within the one year time span upto 7733.9 ppm which is very high. Likewise, the samples were having EC in between 4153.0 – 4628.8 µS/cm on 17 April 2014 and which was increased upto 410.7 to 4672.1 µS/cm on 17 April 2015 respectively. The maximum pH (8.6) and minimum pH (7.6) was recorded in Haji Sultan AL Qubaisi Farm and Salem Bakheet Farm respectively. The detailed physico-chemical results of groundwater samples collected from all three regions are elaborated in Table: 01 and Table: 06 respectively. All this research imply that injudicious use of groundwater for irrigation purpose may constitute serious repercussion i.e. the quality of upper layered soil may suffered from salts accumulation, quality of vegetables may suffers, and the drip irrigation lines may chocked. It is therefore, suggested that farmers for irrigation purposes must consume water after the desalination process for the safe keeping and maintaining the durability of their greenhouse.

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