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Temporal and Spatial Analysis of Ground waters Quality of Minab Plain

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Abstract

Quality of ground waters has an important role in water resources management. In the present study, ground waters quality and assessment of hydrochemical status in aquifer of Minab plain was investigated by study of chemical elements in the ground water and considering of geological characteristics. GIS techniques were used to prepare maps, tables and diagrams. Information of sampling of wells that provided by Regional Water Company was used for hydrochemical studies of Minab plain in a 10 year period. These data were collected in dry (summer) and wet (winter) seasons during 1996 – 2006, which only electrical conductivity and chlorine had been measured in most years. Temporal and spatial variations of water quality in sampling wells were examined by study of available data and then related curves and tables were prepared. In the present study, different study, different usage of ground waters was investigated.

Key word: Minab, hydrochemical, electrical conductivity, ground waters, sustainable development

Introduction

Iran is located in desert and semi-desert region. The annual average rainfall in this country is 250 millimeters. Therefore, the lack of water has existed from long ago, Hormozgan city which is located in the south part of Iran, in one of the driest regions of Iran. The annual average rainfall in Hormozgan is 160 millimeters. Most of the rivers in this city are seasonal, because they have water in rainy seasons. On the other hand because of ground water limitation in quality and quantity aspects, most of the agriculture and drinking water is used from underground water. Therefore underground water resources management is necessary in this city. In this research the main hydro chemical parameters of Minab plain located in 100 kilometers east of Bandar-abas, has been analyzed.

There are many studies, in relation to micro, chemical, physical quality of city drinkable water, including:

The relation between standard plate numeration and other parameters in water distribution system in 1983 by Mark, Agvashko et el. In this research, the relation between density and Kliforms and other quality parameters was studied using non-parabolic Kandle and Spirman statistical and para-electric of Pierson methods (Nadri Shirin, 1381). The other study was executed under the topic of micro, chemical, physical study of

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drinkable water from low wells by Chadr et el, in Malavi country, 2007. The water quality results from micro standpoint showed that almost 100 percent of low wells are not in accordance with international hygiene organization standards for drinkable waters.

Chao et el (2003) studied the micro, chemical quality of Den Ji Yang river in Hong Kong. Koron Prabaha ET el (2004) studied the chemical qulity of water and its effects on Shorb water in Thailand.

In Iran different people study the quality of city waters including

Quality and quantity study of Tehran water and sewageT (1374), studying bacro-biology of drinkable water distribution network in Hamden in 1371 by Ali-reaza Rahmani and Khosro Kashani, comparing the physico-chemistry quality of Zayande-Rood river using biological parameters (Bijan Bina et el. 1376), studying the relation between micro pollution and physico-chemical parameters in part of Zayande-rood water (Roha et el 1375) in a one year period, studying the pollution of Tehran drinkable water to bowel Patogens (Hosein Zade, 1381), the influence of city expansion on underground water quality of Zahidan (Khazayi, 1380), study of pollution level of drinkable network water of Damghan city to Nitrate by Mahdi Niav et el, 1382 and finally erosion study in sediment producing of drinkable waters on Rasht city wells (Ramezani, 1380).

The study location

The study location approximately 800 square kilometers in located 100 kilometers east of Bandar Abas city. The study region is 56 degree and 48 minutes to 57 degrees 15 minutes of east longitude and 1 degree to 27 degrees and 27 west degrees. From east, north and south-east the Minab plain is surrounded by level heights. The highest height of the region in located in Zendan Mountain with the height of 1000. The average height of plain is variable from about 30 meters in eastern periphery of plain to lower than zero in Oman Sea and Hormoz canyon periphery (figure 1).

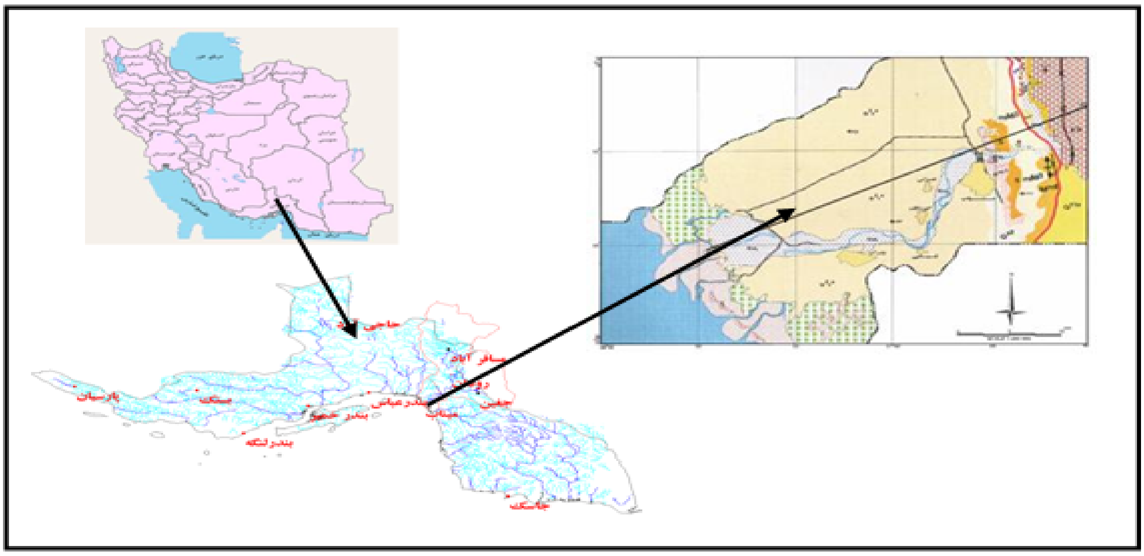

Figure 1: the under study region in Iran and in Hormozgan

Material and methods

In the beginning of library information collection by referring to relative departments, the necessary principal data regarding to region was studied and the quality and quantity results of well water was collected.

Then, using field observation in several stages and in several times, area information was collected and necessary maps were provided, and also the artificial feed dams, agricultural wells, Pizometery and Shorb water was visited. In order to measure the electrical conductivity (EC), transmittal dry survivor (TDS), Chloro, (main hydro chemical parameters). The water of wells was sampled. Since it seems that the chemical data analysis resources (samples) were not the same, for this reason in order for accuracy in analysis the data was studied by conventional and scientific methods so that the false samples become correct.

Also the required maps (transmittal and arena description TDS) was provided using ArcGIS software. Also comparison diagrams of salty development of water (EC and Chloro) and diagram methods of water leveling (Wilkolks, Stif and Payir) was provided using Excel and G. W. W software from 1375 to 1385.

Finally using the final results the electrical conductivity of wells, the study plain was studied.

Statistical analysis of quality data

In order to study the general status and the changing behavior of chemical quality, was calculated using obtained samples, and statistical parameters for each quality parameter (table 1)

Table 1: important statistical parameters for each quality parameter of Minab plain

minimum	maximum	average	deviance	Range	Quality parameters
756	14689	3755/68	2001/87	13933	EC(μ/cm)[1]
8/16	9401	2341/76	1253/66	9392/84	T. D. S(mg/lit)
6/82	9/07	8/02	0/33	2/25	PH
0/05	5/40	1	0/74	5/35	CO3(me q/lit)[2]
0/5	16/25	4/63	2/64	15/75	HCO3(me q/lit)
2/75	138	24/81	18/69	135/25	Cl (me q/lit)
0/02	32	7/87	4/21	31/98	SO4(me q/lit)
0/79	1596	6/53	69/56	1595/21	Ca(me q/lit)
0/78	26/05	5/15	3/31	25/27	Mg(me q/lit)
3/8	101/44	28/95	15/29	97/64	Na(me q/lit)
0/95	1956	17/71	84/90	1955/05	S. A. R
10/24	2280	435/05	294/44	2269/76	hardn(mg/lit)

3. micro siemense on second
4. milli ekyvalan on liter

Calculating required parameters from experiment results of chemical breakup

One of the study methods of underground water nature and identifying the probable resource of them is to use available Ion ratio in them. For this, the ratio between Ions and Cathodes of underground waters are calculated and studied using chemical experiments of selected wells.

Electrical conductivity: water electrical conductivity is briefly showed by EC and is one of the most important quality indexes of underground water. This index is easily measured and generally is relative to the total material solved in water; in a way that as solvents increase, the electrical conductivity increases. The highest and lowest electrical conductivity in Minab Plain are respectively 14689 µ/cm and 756 µ/cm, which are respectively for well number 13 in Banzarak country in 84 and well number 139 in Tiror country in 1375. The information for beginning and end of era is different regarding sample number and the information between these years are also different, therefore the electrical conductivity variations are not correctly obtained in this plain.

The remaining dry: the amound of remaining dry (TDS) in study region is between minimume of 8/16 to maximum of 9401 milligrams in liter. The average remaining dry is 2341/76 milligram in liter and this parameter changes are also like electrical conductivity of underground waters.

Acidic (pH): this parameter shows the acidic state of water. In Minab plain in the period of 10 years (1375-1385) is between minimum of 6/82 and 9/07. Only in one sample the acidic state of water is below 7 that is for well number 374 in Kamali country. In result the sampled well waters all have acidic pH except for one.

Chloride ion: the Chloride status in one region is always as a determinant of salt water situation. Chloride has the highest effect in electrical conductivity increase of water and generally as chloride increases, the electrical conductivity increases. In underground waters of Minab plain, the average and deviation and variance range of ion chloride changes are respectively 24. 81 me q/lit and 18/69 me q/lit and 135/25 me q/lit. Also, the lowest amount of chloride ion in 2/75 and highest is 138 mili Ekivalan in liter.

Sulfate ion: is one of the influencial parameters in increasing electrical conductivity of Sulfate ion. Sulfate is made of solution of sulfate combinations like Jips or Inidvit in underground waters and its influence in increasing the electrical conductivity is lower that chloride. According to obtained results of hydro chemical experiments the sulfate amount in underground waters of Minab plain is between minimum of 0. 20 to maximum of 32 mili Ekyvalan in liter. The average amounts, the deviance and change range of ion sulfate is between 7. 87, 4. 21 and 31/98 mili ekyvalan in liter.

Bicarbonate ion: the lowest and highest bicarbonates in this plain are respectively 0. 50 and 16. 25 mili ekyvalan in liter. The change range of divergent amount and the average of this ion is respectively 15. 75, 2. 64 and 4. 63 milli ekyvalan in liter. Because the solvent capacity of this ion in water is limited, the amount of bicarbonate ion in underground waters can not be higher than a specific amount.

Sodium ion: The Sodium ions show the salty level of water. Sodium ion is generally from salt. In underground waters of this region the minimum amount of sodium ion is 3. 80 milli ekyvala in liter and maximum is 101. 44 milli ekyvalan in liter. The average amounts of deviance and change range of Sodium ion in this region are respectively 28. 95 mili ekyvalan in liter and 15. 29 mili ekyvalan in liter and also 97. 64 mili ekyvalan in liter.

General hardness: water hardness is a parameter of magnesium and calcium ions existing in water. The water hardness amount for Carbonate Calcium is measured from [5]TH=2. 5Ca + 4. 1Mg formula in which Calcium and magnesium are milligram on liter. From hardness standpoint waters are classified into four groups of light, semi hard, hard and very hard. In light waters, hardness is less than 75 milligrams in liter (in terms of CaCO3), in semi hard waters it is between 75 to 150 milligrams in litter and in very hard waters it is more than 300 milligrams in litters. Studying underground waters of Minab plain show that only one sample of all measured samples are classified in light waters (well number 22 in 76/8/18 in Sarbaran country) and the rest samples are accounted for semi hard and very hard waters (from 525 samples, 17 were in semi hard waters and 177 in hard waters and 330 in very hard waters.), the minimum hardness observed in samples in the study region is 10/24 and the maximum is 2280 milligram in liter is calculated in terms of Carbonate Calcium. The average, deviance and change range are respectively 435/05, 294/42 and 22699/76 milligrams in liter in terms of Carbonate Calcium.

Studying the internal relations between quality parameters and electrical conductivity

Studying the relation between electrical conductivity amount and quality parameters of underground waters are one of the necessary items in hydro chemical studies. Regarding the fact the measuring electrical conductivity amount is easy and possible in well locations. In case of a relation between electrical conductivity and each chemical parameter of water, obtaining this without laboratory operation is possible. For studying the internal relations between electrical conductivity and different quality parameters of underground water the necessary relations are provided (table 2 and figures 2 to 8).

[5]- total hardnes is calculated from $TH = Ca \times \frac{caco_3}{ca} + Mg \times \frac{caco_3}{Mg}$ reference from Mahdi

Table 2: internal relations between electrical conductivity and different parameters of underground waters

Electrical conductivity and quality parameters	Available relations	Appointed coefficient	Descriptions
Electrical conductivity and general soluble materials in water TDS	TDS = 0. 6212EC + 23. 896	0. 99	Using measurement of water electrical conductivity we can quickly estimate the materials soluble in water (figure 2)
Electrical conductivity and magnesium	Mg = 0. 0014 EC + 0. 0522	0. 7	Only in lower amount of magnesium ion there is a relatively proper relation (figure 3)
Electrical conductivity and chloride	CL = 0. 0085 EC - 7. 3721	0. 95	The coefficient of appointment is a good relation between electrical conductivity and chloride in underground waters of Minab plain
Electrical conductivity and Sodium ion	Na = 0. 0074 EC + 0. 9448	0. 96	In Minab plain the electrical conductivity has a good relation with Sodium amount (figure 5)
Electrical conductivity and Calcium ion	Ca = 0. 0011EC - 0. 7527	0. 72	Only in lower amount of Calcium ion there is a relatively good relation between electrical conductivity amount and calcium ion of samples (figure 6)
Electrical conductivity and Sulfate	SO4 = 0. 0013 EC + 2. 9603	0. 37	There is not a good relation between electrical conductivity and sulfate ion in these samples (figure 7)
Electrical conductivity and bicarbonate ion	HCO3 = -0. 0002EC + 5. 5766	0. 036	In underground waters according to that water saturates faster that bicarbonate ion generally there is no relationship between bicarbonate ion and electrical conductivity (figure 8)

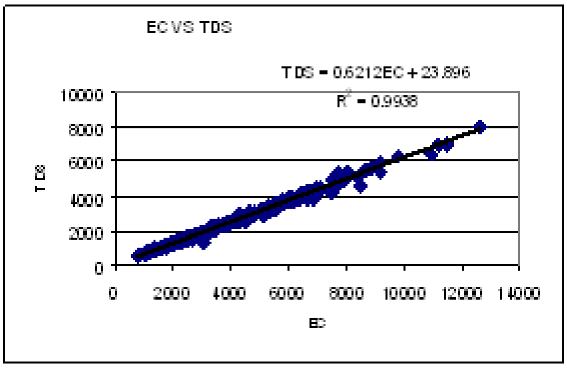

Figure 2: EC via total soluble materials

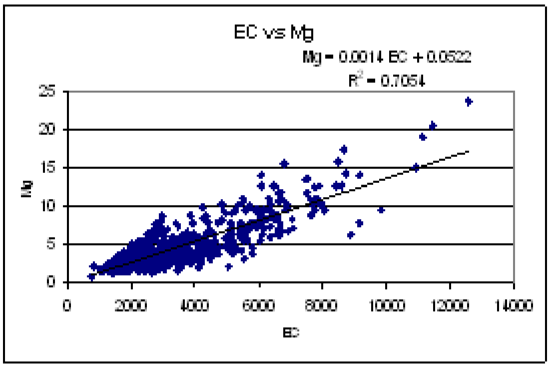

Figure 3: EC via magnesium

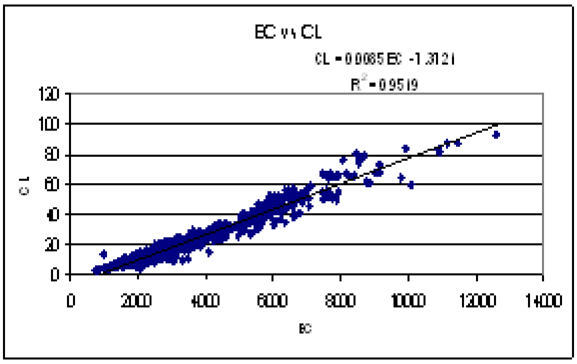

Figure 4: EC via Chloride ion

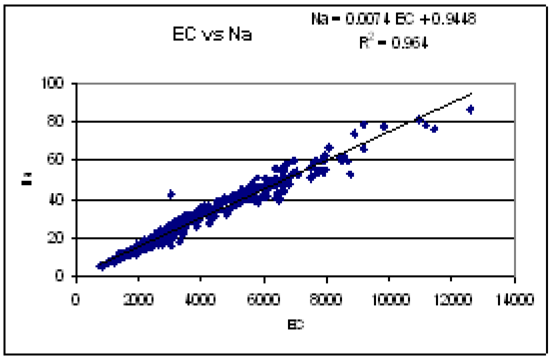

Figure 5: EC via Sodium ion

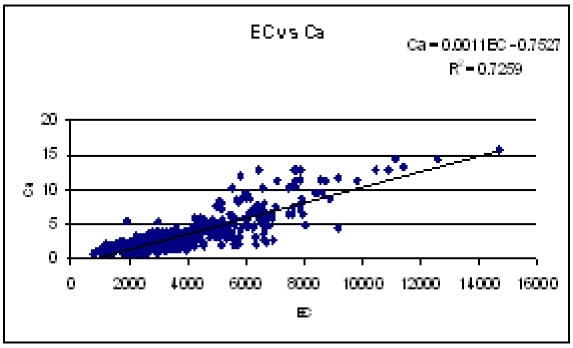

Figure 6: EC via Calcium ion

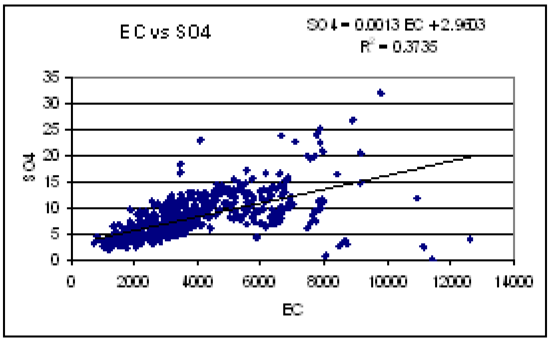

Figure 7: EC via Sulfate ion

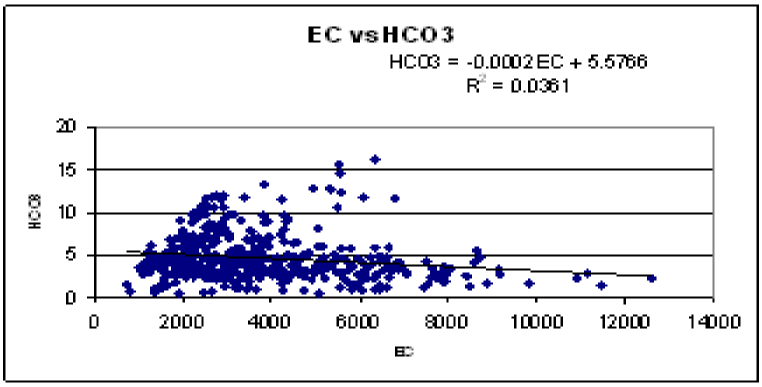

Figure 8: EC via bicarbonate ion

Generally, according to the obtained relation it is showed that electrical conductivity (EC) of underground waters has a very good relation with TDS and by having electrical conductivity amount in hand, with a very good approximation we can estimate the total solvent material. There is a good relation between electrical conductivity amount and Sodium and Chloride ions and in fact by using the electrical conductivity amount and using the provided relations with some error we can estimate these ions. The electrical conductivity has a good relation with magnesium and calcium ion (in lower amounts) but not a good one with bicarbonate ion.

Studying determinant relations

(Mg/Ca), (Na/Cl), (SO4/Cl), (Cl/HCO3), (SO4/HCO3)

We can use the ratio of Sulfate ion to bicarbonate ion to determine one hydro-chemical element in determining the water resource. If the relation is less that 1, it shows that the water resources are much under the effect of lime resources other that plaster makers; but if this ratio is higher that 1, thus the water resource can be plaster or salt makers (Taheri Tizro, 1388).

The width band of Sulfate ion determinant to chloride in under study region show that in most part of the plain, the sulfate ion to chloride ion ratio in the statistical collection period is less that one and only in two wells during the study period it has been more that one, which is negligible. The ratios of sulfate to bicarbonate and sulfate to chloride and chloride to bicarbonate in the design region show that:

1 – The important layers of chloride and sulfate additives in geology of plain periphery do not have a wide development and therefore the amount of these ions in most parts of the plain has been so small that the bicarbonate ion has been known as the dominant Anion in this region. It should be noted that it is said that bicarbonate waters have lime origin but because the lime stones in this plain do not establish so much, the bicarbonate presence is because of breakup of other minerals containing these ions (Hosein-zade, 1387).

2. Existence of high numbers of samples with So4/Cl ratio of less than one show the non existence of layers producing Sulfate ion in the region and Chlore and sodium ions existing in water are frequently from clay minerals present in clay and Shil rocks and also the sea water that is in touch with the mentioned plain (Hosein-zade, 1387).

Because the ratio of Sodium and chloride ions are less affected in ion transfer is constant and it increases were they having the most improvement in drinkable water borders. The samples analysis of plain water shows that the amount of this ratio in most of the samples is more that one and this shows that salty waters has not improved in this and salty fields to this plain (table 3 and 4).

Calculating the quality parameters

One of the methods to study the underground waters nature and determining the probable origin of them is to use the present ions ratio in them. For this reason, the ratio between different anions and cathions in underground waters are calculated and studied using chemical experiments results.

Water quality evaluation is done by various methods regarding agricultural usage which is based on two main parameters including electrical conductivity and ions combination, one of the methods that is more common in classifying the used waters for practical agriculture is Wilkox classification. Wilkox has done this classification based on two important reasons that are electrical conductivity and absorbent coefficient of sodium. The water characteristics of Wilkox diagram that classify the different types of waters regarding to agricultural usage are as follows:

Table 3: ion ratio in well water samples in Minab plain in 1375

Well Number	Na/Mg	Na/Ca	Mg/Ca	SO4/Cl	Cl/HCO3	Na/Cl	SO4/HCO3
14	6. 03	7. 45	1. 24	0. 29	7. 05	1. 11	2. 05
139	7. 56	7. 47	0. 99	1. 15	1. 77	2. 15	2. 03
33	18. 12	4. 82	0. 27	0. 29	8. 83	1. 12	2. 59
77	5. 16	6. 18	1. 20	0. 28	8. 00	1. 04	2. 22
123	7. 64	10. 92	1. 43	0. 28	5. 82	1. 18	1. 60

Table 3 continued

156	10. 64	15. 15	1. 42	0. 38	11. 20	1. 28	4. 23
86	6. 56	7. 18	1. 09	0. 22	7. 56	1. 06	1. 70
176	5. 26	4. 55	0. 87	0. 36	13. 86	1. 02	4. 97
184	7. 75	6. 75	0. 87	0. 63	3. 05	1. 56	1. 92
240	10. 64	10. 52	0. 99	0. 56	7. 84	1. 43	4. 39
242	8. 58	7. 59	0. 88	0. 63	5. 43	1. 46	3. 41
231	6. 63	9. 68	1. 46	0. 38	4. 33	1. 29	1. 65
242	10. 93	11. 73	1. 07	0. 67	3. 49	1. 69	2. 33
326	3. 65	9. 81	2. 69	0. 63	1. 22	1. 82	0. 77
835	8. 49	21. 61	2. 55	0. 33	8. 56	1. 25	2. 82
828	4. 68	5. 65	1. 21	0. 30	25. 85	0. 96	7. 70
823	9. 09	10. 84	1. 19	0. 27	16. 16	1. 11	4. 29
825	8. 30	15. 86	1. 91	0. 34	6. 51	1. 26	2. 23
810	5. 48	8. 27	1. 51	0. 20	16. 85	0. 96	3. 32
630	3. 97	6. 65	1. 68	0. 77	2. 48	1. 56	1. 90
74	9. 65	6. 14	0. 64	0. 38	4. 04	1. 30	1. 54
1	5. 47	7. 61	1. 39	0. 17	33. 33	0. 92	5. 69
392	3. 32	8. 69	2. 62	0. 46	1. 72	1. 46	0. 79
292	2. 89	5. 12	1. 77	0. 53	2. 12	1. 33	1. 12
192	8. 61	6. 09	0. 71	0. 33	14. 64	1. 10	4. 90
875	4. 90	14. 64	2. 99	0. 72	1. 64	1. 88	1. 18

Table 4: ion ratios in well water samples of Minab wells in 1385

Well Number	Na/Mg	Na/Ca	Mg/Ca	SO4/Cl	Cl/HCO3	Na/Cl	SO4/HCO3
243	12. 78	20. 21	1. 58	0. 56	5. 00	1. 58	2. 78
41	5. 87	6. 86	1. 17	0. 16	35. 00	0. 91	5. 74
33	5. 06	6. 26	1. 24	0. 25	9. 09	1. 00	2. 26
74	8. 11	6. 69	0. 83	0. 25	11. 67	1. 05	2. 88

Table 4 continued

242	13. 03	11. 49	0. 88	0. 60	6. 14	1. 53	3. 69
86	7. 82	7. 74	0. 99	0. 23	10. 18	1. 06	2. 33
11	6. 19	9. 19	1. 48	0. 26	14. 57	1. 04	3. 72
176	4. 34	4. 89	1. 13	0. 50	13. 89	1. 10	6. 97
77	7. 92	5. 87	0. 74	0. 20	9. 78	1. 02	2. 00
226	8. 99	13. 36	1. 49	0. 44	3. 64	1. 44	1. 60
290	4. 22	9. 76	2. 31	0. 64	4. 06	1. 44	2. 61
259	5. 44	13. 79	2. 54	0. 42	3. 38	1. 40	1. 42
231	0. 92	0. 79	0. 86	0. 47	8. 82	0. 13	4. 12
193	6. 02	15. 27	2. 54	0. 39	11. 88	1. 20	4. 61
184	8. 16	6. 90	0. 85	0. 50	43. 00	1. 20	21. 33
326	2. 61	6. 60	2. 53	0. 38	1. 05	1. 52	0. 39
361	6. 89	17. 69	2. 57	0. 42	4. 08	1. 42	1. 72
428	5. 26	15. 59	2. 96	0. 40	2. 22	1. 53	0. 89
504	2. 93	5. 77	1. 97	0. 79	1. 22	1. 72	0. 96
608	6. 25	10. 29	1. 65	0. 38	3. 89	1. 34	1. 49
139	7. 15	23. 54	3. 29	0. 61	2. 01	1. 84	1. 23
466	3. 28	8. 10	2. 47	0. 48	1. 37	1. 54	0. 65
392	3. 13	8. 84	2. 82	0. 35	1. 85	1. 32	0. 65
529	3. 63	4. 73	1. 30	0. 61	1. 01	1. 77	0. 62
672	3. 81	12. 49	3. 28	0. 38	3. 86	1. 25	1. 46
654	3. 95	9. 75	2. 47	0. 55	1. 58	1. 64	0. 86
875	3. 99	12. 30	3. 09	0. 39	1. 39	1. 66	0. 54
986	4. 80	9. 50	1. 98	0. 31	9. 13	1. 08	2. 87
886	3. 52	9. 04	2. 57	0. 43	1. 36	1. 61	0. 59
851	10. 39	17. 09	1. 65	0. 40	4. 34	1. 43	1. 75
823	4. 63	10. 68	2. 31	0. 28	16. 13	1. 02	4. 50

A: the C1S1 group waters have a very good quality

B: C1S1, C2S2, C1S3 waters are proper for agricultural usage

C: C2S3, C2S1, C2S2, C3S1, C3S3, C3S2 are used only for soils that have light structure and water can easily be drained from them.

D: group waters of C1S4, C2S4, C3S4, C4S3, C4S2, C4S1 are not proper agriculturally and are only useful for special conditions for special plants. In dry and semi dry regions like Iran we can limitedly use this water for soils that have light patterns (high diffusion ability) and proper drainage conditions. Constant usage of these waters makes the water ingredients to settle, make the water salty and destroys the soil quality, therefore in case we temporarily use this water we must wash the lands previously watered by this water when proper water is accessible. Most of the samples are located in G section waters and these waters are useful for soils that contain light patterns.

Wilkox diagram

This diagram is used for study of water type in agricultural usage. The sodium absorb ratio is in vertical axis and the electrical conductivity is in horizontal axis. And based on current classifications in this axis, we can determine the sample's class of different water regarding agriculture. The Wilkox diagram is presented based on studying underground waters for agricultural usage.

In 1375, most of the samples are located in C4S4 and in 1376 9 samples were located in C4S4 (table 5). Therefore the water of most wells is not proper agriculturally, and is only proper for some plants that are resistant to high salty situation (figure 9 and 10). The samples status in wilkox diagram is presented for understudy period in table 5.

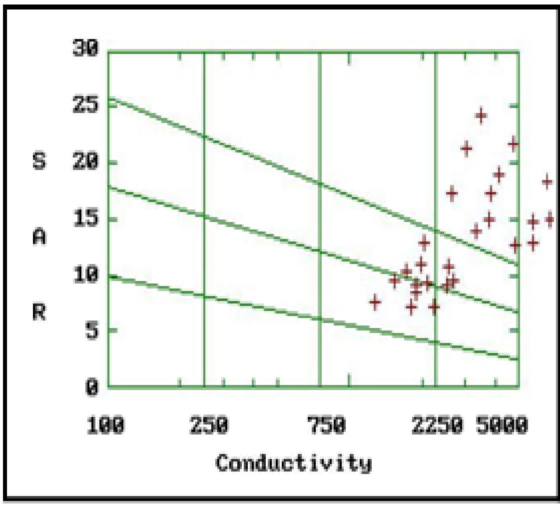

Figure 10: samples classification regarding SAR in 1376 in Minab plain

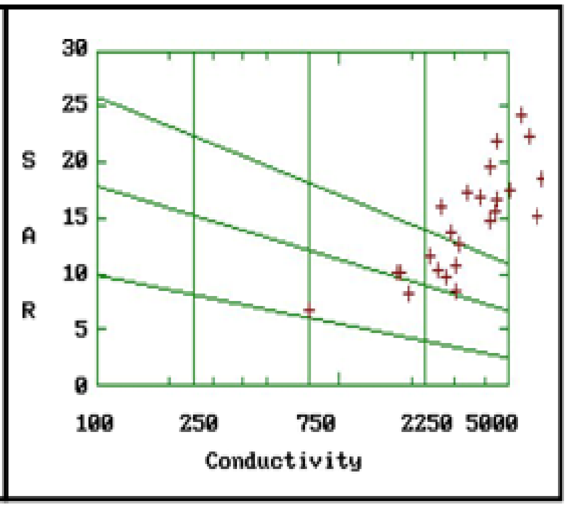

Figure 9: sample classifications regarding SAR content in 1375 in Minab plain

In 1384, 10 samples were located in C4S4 and 6 samples were located outside of the range. 3 samples are also located in C4S3 and 3 samples are in C3S3 location (table 5 and figure 11).

In 1385, 11 samples are located in C4S4 and 8 samples are located outside of range. 5 samples were also located in C4S3 and 4 samples in C3S2 region (table 5 figures 12).

Table 5: well locations in Wilkox diagram in statistical period of 1375-1385

Outside	C_3S_2	C_3S_3	C_3S_1	C_4S_1	C_4S_3	C_4S_4	year
6	2	2			5	11	1375
4	6	4			3	9	1376
3			7	14			1377
6	6	5			9	8	1378
5			9	15			1379
8	5	4			5	13	1380
6	2	3			9	12	1381
10	4	4			8	14	1382
5	6	3	1		5	17	1383
6	1	3			3	10	1384
8	4	2		1	5	11	1385

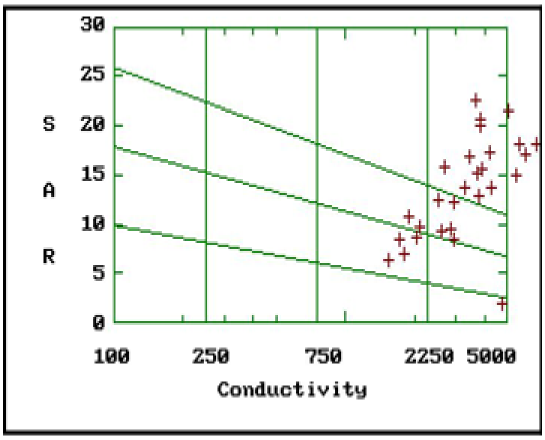

Figure 11: samples classification regarding SAR amount in 1384 in Minab plain

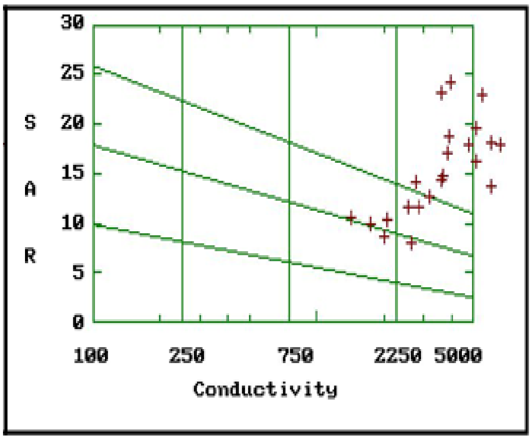

Figure 12: samples classification regarding SAR in 1385 in Minab plain

Showing the structure of chemical quality in determining points

One of the methods to study underground water quality in one region is to provide Stiff diagram. In this diagram, the analysis results are shown in horizontal axis in milli ekyvalan in liters (cations are in left side of zero and anions in right side). We obtain special figures by connecting the points that is useful in fast comparison of many samples. As this cations and onions become closer regarding quantity, the produced shape is more regular.

In figures 13 and 14 of Stiff diagram, a number of well are provided for 1375 and 1385. According to these diagrams (provided for all of the period and for all the wells, it was not provided in order to shorten the article) we can determine the most ion in each sample. In most of the samples of Minab plain, the chloride is the most popular ion and Sulfate is lowest.

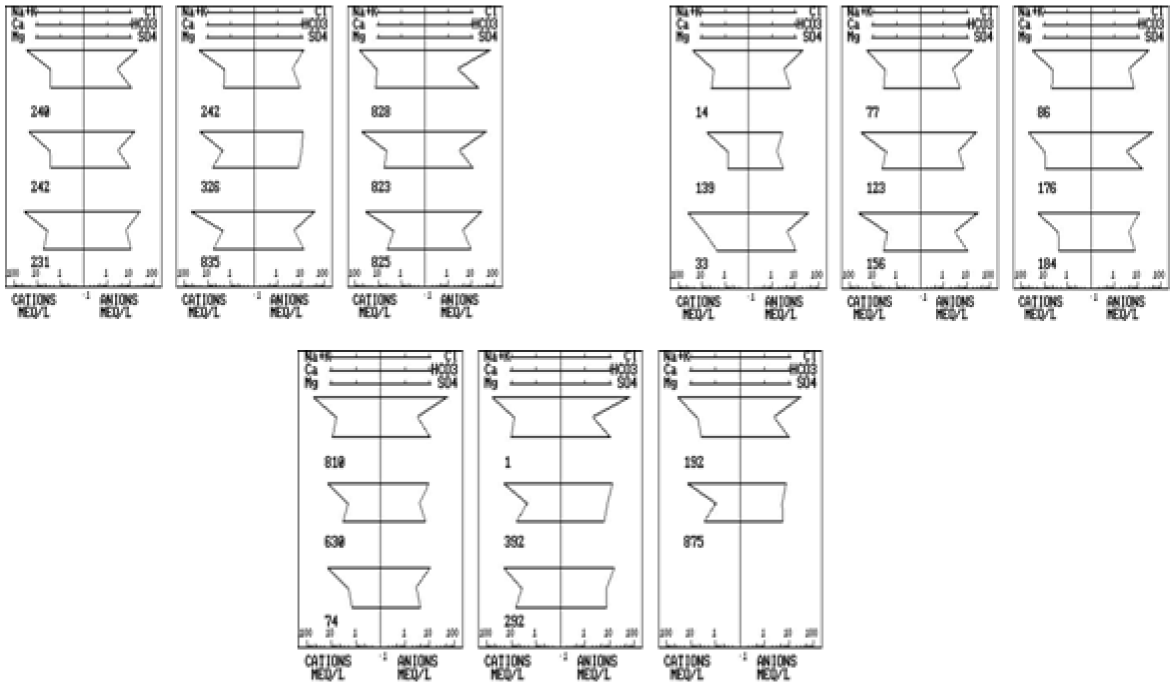

Figure 13 diagram: Stiff diagram in 1375 samples

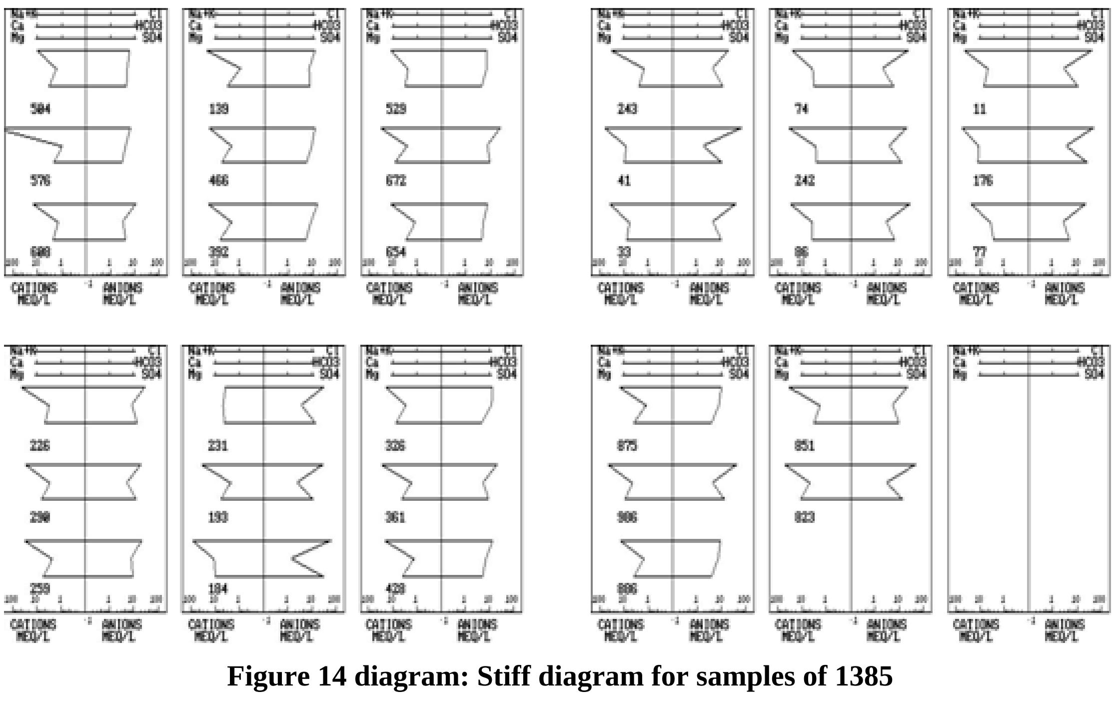

Figure 14 diagram: Stiff diagram for samples of 1385

Piper diagram

In piper diagram we can show many samples in one diagram. This diagram is useful to translate the chemical analysis results. This diagram is made of combining three separate fields. The Anions and cations ratios are performed in triangle fields and the combination location is performed in lozenge field. (fig 15). The piper diagram shows the chemical characteristics of water regarding relative density of elements. In Piper diagram we can quickly recognize the water type. The piper diagram for water samples in different years are provided and are presented for 1375, 1376, 1384 and 1385 (figures 16 to 19). Paying attention to these diagrams show that the highest samples density for different years in located in saline region. Except for 1377 and 1379 years that all samples are located in Permanent hardness region.

Figure 15: Lozenge field classification of Piper diagram

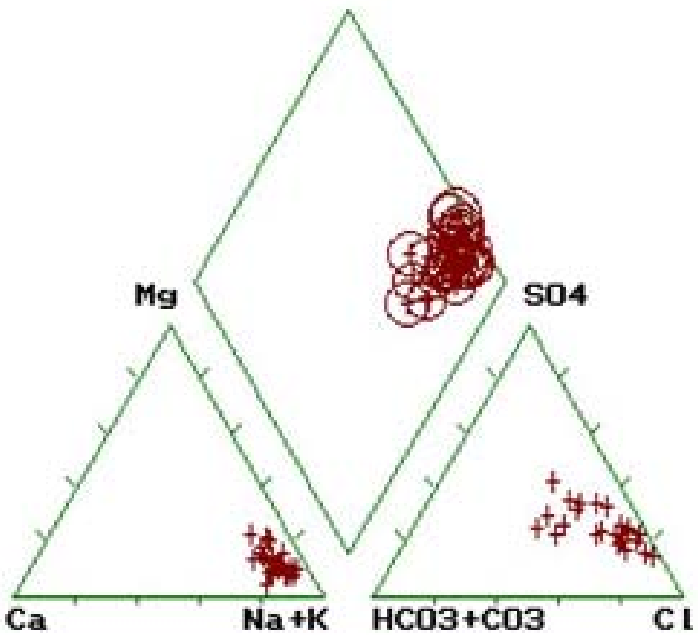

Figure 16: Piper diagram for 1375

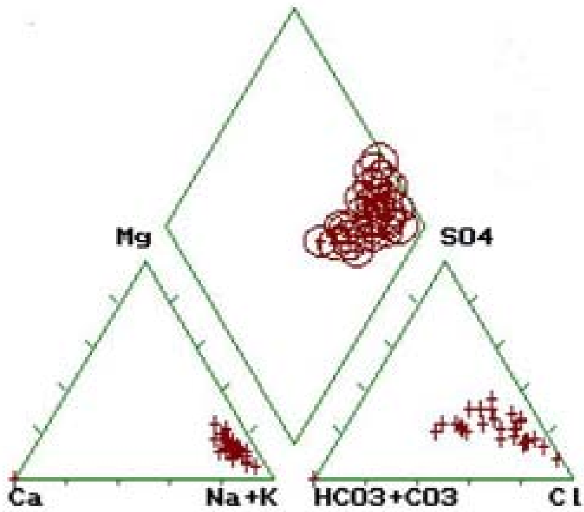

Figure 17: piper diagram for 1376

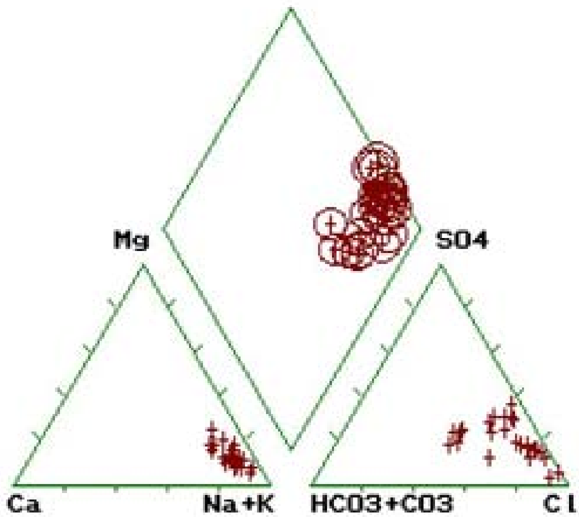

Figure 18: Piper diagram in 1384

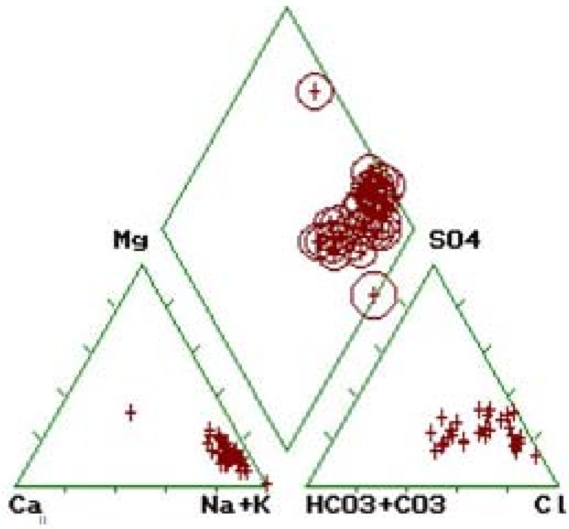

Figure 19: piper diagram in 1385

The collected samples of agricultural wells in 1375, 1376, 1387(with some change in quantity of some ions) 1380, 1381, 1382, 1383, 1384 and 1385 (except for one sample) all samples are located in Saline region. In samples of 1377, there are some changes and the samples are located in Permanent Hardness region.

Geo statistical analysis

Geostatic is a branch of statistics that is focused on spatial patterns analysis and variables quantity assumption in points where sampling has not occurred. In this method, the variable and its spatial position are simultaneously used for spatial models. The main purpose of geostatic is to use notation change and other techniques like critching in order to determine quantity and spatial correlation modeling. The geostatic analysis is used to design quality plans.

Location variation study of electrical conductivity in study period (1375-1385)

1 – 1375: as it can be shown in electrical conductivity plans of 1375 (fig 20), in most of the plain locations, the electrical conductivity is lower that north west and south and south west, but in Chan-esmail well and Gorband, the electrical conductivity is higher due to high pumping and probable return of water. In south part of plain, because of infusion of sea water, the electrical conductivity is much higher.

2 – 1376[1]: about the south part of the plain, and also in a small part in north of plain, the electrical conductivity is low in a region, in the south part it seems that by higher pumping, the salty water infusion into the plain increases.

3 – 1377: in 1377 also like previous year, the electrical conductivity is low around Minab river and in south part of the plain around Grazane villages, the electrical conductivity is high. In the plain also electrical conductivity increase is observed, that is maybe because of high usage of region well and also return water of agriculture.

4 – 1378: in 1378 also the plain condition regarding increase and reduction in electrical conductivity is like 1377 and it is also observed that along Minab river, the electrical conductivity is low and in south part of plain, because of being next to sea, the electrical conductivity has been observed to be high.

5 – 1379: in 1379 in comparison to 1378, in most parts of plain, the electrical conductivity has been observed to be low and also here, the Minab river influence has been seen to be the cause.

6 – 1380: in 1380, except for Minab river path, the increase of EC has been observed in other parts of plain that higher amount of usage and return of water from agriculture causes this increase.

7 – 1381: almost like 1380, except for a limited region, in most parts of the plain, higher electrical conductivity has been observed. In this year, the electrical conductivity is higher in north east of the plain.

8 – 1382: in 1382 in the path of Minab River, the electrical conductivity is low, and in south part of plain the electrical conductivity is high.

9 – 1383: in 1383 compare to 1382 the electrical conductivity in plain is lower

[1] because of limitation in the page numbers of this article in the magazine, we avoid providing all the plans and only the onset and finish plans are shown and for the other years only the descriptions are provided. We are obliged to apply this about diagrams and tables.

than what it seems, in south part in a limited region, the electrical conductivity is very high, in plain level, the wells have high electrical conductivity in one or two events that seems the high usage and return water is the cause.

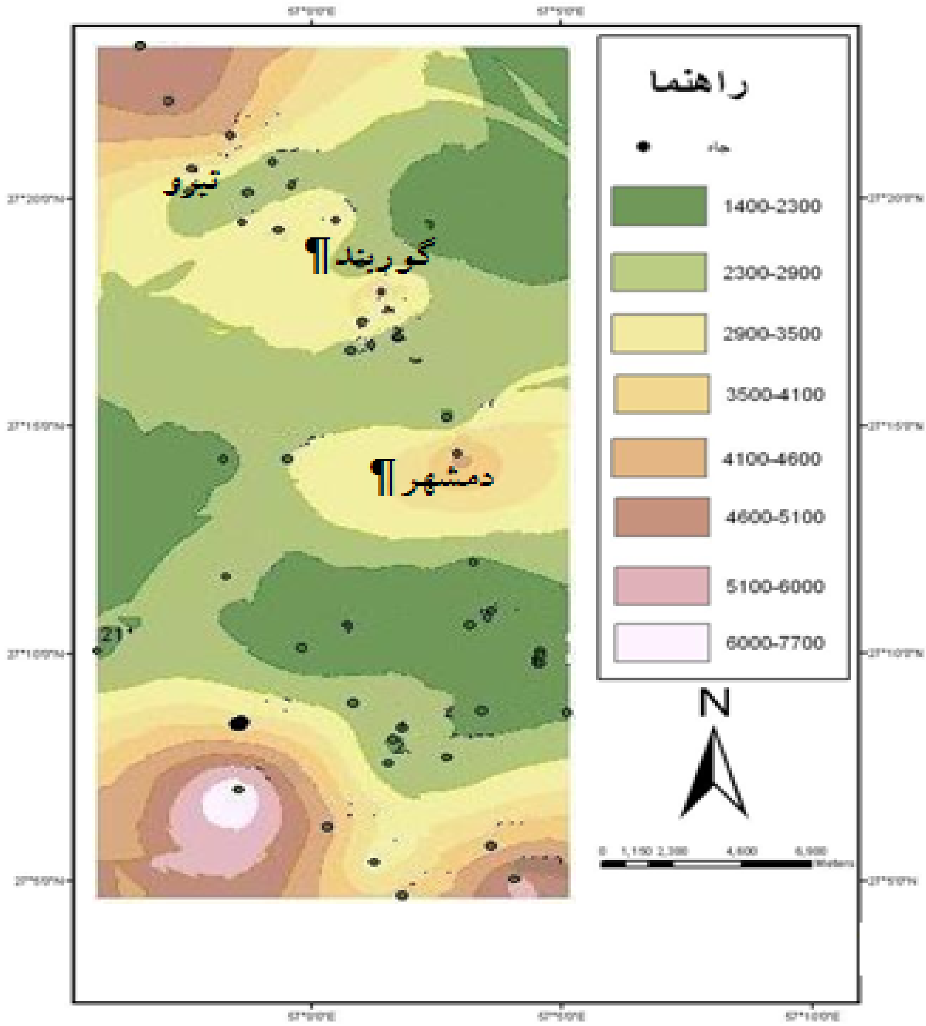

Figure 20: electrical conductivity distribution in 1375

10 – in 1384: because of proper rainfall in region in most of the plain, the electrical conductivity is low and in north west part and south part also the electrical conductivity is high.

11 – 1385: in the first sample of 1385, according to samplings in the north parts of the plain, increase in electrical conductivity is observed, but in the path of Minab River, the electrical conductivity shows decrease like previous years (fig 21). According to schematic of different years and also the map that is obtained from average wells in 75-85, we conclude that in the middle part, the water quality of well water has a better situation regarding electrical conductivity, TDS and. . . in comparison to north and south part of plain that is due to Minab river location in the region that makes it possible that this region of plain have better situation relative to other locations of the plain.

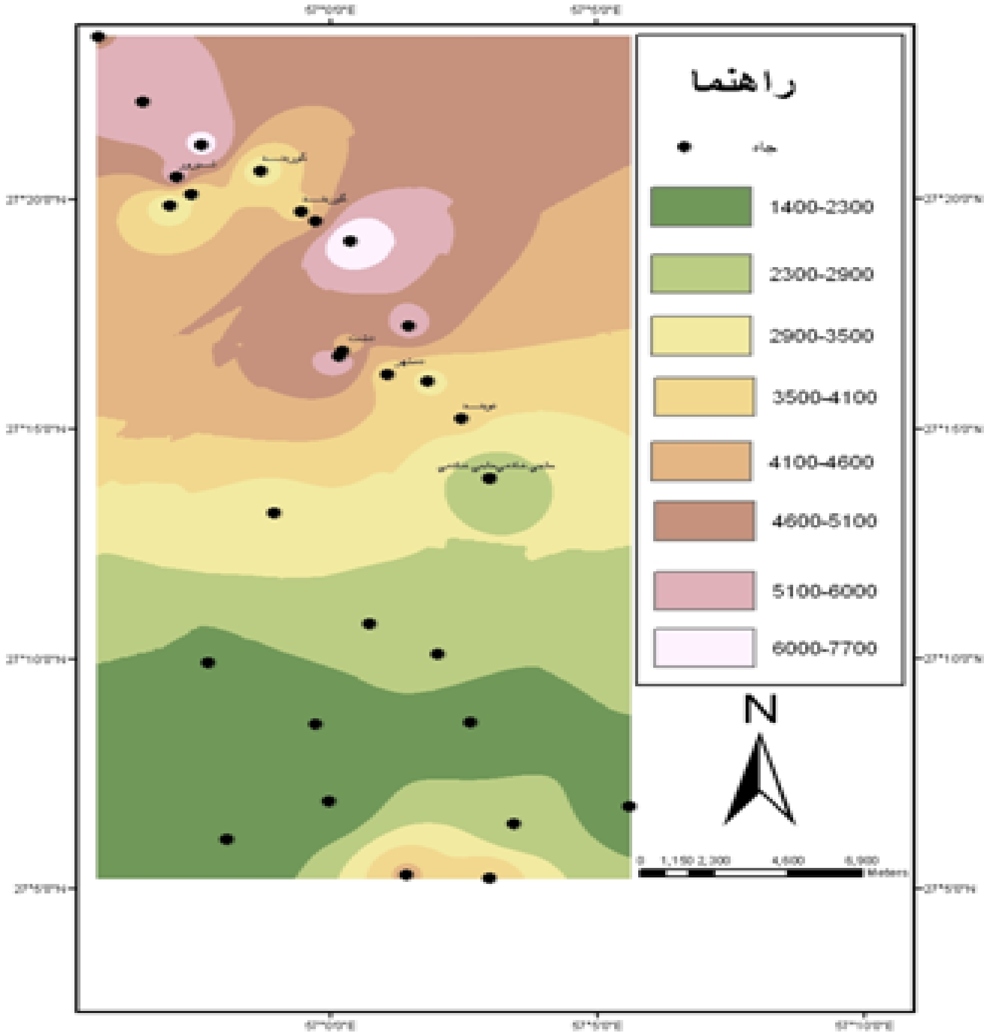

Figure 21: electrical conductivity distribution in 1385

Conclusion

Always it is possible that in relation to the quality and quantity of underground waters, some problems occur, also one of the main conditions in order to use underground waters for different usages is the chemical quality of these waters. Today one of the most important barriers of agricultural, economic and social development in common sections of our country and especially in Hormozgan State, is the quality limitation of underground waters. In Isfahan city because of low rain fall, the seasonal nature of ground waters and salty domes, this limitation is more evident. In Minab plain because of closeness to sea and existence of polluting elements for underground waters in most of the plain it is not proper for agricultural usage regarding increase in electrical conductivity and according to international standards and this issue has made that the agriculture have problem in this plain. But regarding all the limitations, the people perform agriculture because they do not have any other financial income, and thus their products do not have proper quality and quantity.

Studying electrical conductivity diagrams show that generally the electrical conductivity in north (Chah-shirin village) and south east of plain (Gorzang village) parts increases. The electrical conductivity is parameters of salt and other solvents existence in underground waters.

According to schematics, the chloride changes are like electrical conductivity. This issue shows that the chloride solvents that are caused from ingredients settlement influence of this region are the most important items for electrical conductivity increase of underground waters in the study location.

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