Original Article

The Quality Variations of the Drinking Water Sources in the Rural Regions of Sabzevar County in a Five Year Period

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Abstract

Background and purpose: Water is the most important limiting factor of sustainable development. Poor quality of water sources and lack of appropriate management in some regions are the main reasons of water crises in the country. This study was conducted to assess water sources quality and the trend of their change in rural area of Sabzevar County in a five year period.

Materials and Methods: In total 43 sources of water in villages or complexes with more than 700 population were selected randomly and their Physico-Chemical and microbiological variables were studied. For microbiological characteristics 801 samples from those 43 sources were taken and examined in a five year period.

Results: The results showed that the average microbial contamination of all 801 samples from 43 sources during a five year period was 12.3 with a variance of 13.3. Total Dissolved Solids (TDS) index was 349.02 ppm with variance of 193.704 ppm. In three sources, the TDS index had statistically significantly difference with the maximum level of 500 ppm. The maximum limit of EC of water from wells in a three years period has increased from 2526 in year 1 to 3213 in year three of study. Among 43 sources of rural drinking water, just one source, with average 4.7± 3.9 ppm had statistically significantly difference with the upper limit maximum of 1.5 mg per litter.

Conclusion: Having positive result of E-coli in some of water sources and high level of some Physico-Chemical indexes and the increasing trend of declining quality of water sources in a five year period of study, therefore creating a GIS based data bank of water quality for continues monitoring of change in water quality, improvement and filtration of some sources, and replacement with a sources of better quality are essential.

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***Key words*:** Water Sources, Quality Variations, Rural Regions, Sabzevar

1. Introduction

Water is the most important limiting factor of sustainable development. In many regions of the country, water pumping exceeds its aquifer rechargeable, so the crises of water shortage made the problem of water quality more serious (1). Given the frequency of water sources in the farm lands and the limitation of selected wells, sampling repeated with a limited number at a long interval (2) are not adequate. In the majority of cities of Iran drinking water is supplied from underground resources, there should be a concern about the pollution of this resource (3). Underground water is one of the most important sources of drinking water (4). By increase in the depths of wells supplying drinking water, the viscosity of water quality parameters such Nitrate has reduced and the Nitrate rate in deep wells is relatively lower than the wells with less depth (5, 6). Human health is certainly dependent on the clean and safe water. Civil, industrial and agricultural sewages, importantly, transfer different water pollution elements such as phosphate, nitrate, poisonous compounds, heavy metals, solids and mining composites into water sources (7,8). Based on the guideline of World Health Organization, the amount of in drinking water should not exceed the permitted maximum level (9). Sands and the soil layers around the wells are the origin of most Ions in the solution of water (10). Control of water quality is a reality of changing time and improvement in socio-economic situation of the society. There is a need for a continues quality assessment of drinking water supplied from under-ground water or other sources that are under the effects of upper-ground water through a serious quality control plan with continues experiment. Water quality control should be continued with a sampling from different sources of water such as the location of water pooling, the root of transfer, and in the points of use in an organised way (11). Some of the important physical and chemical parameters of water are: 1- Flouride that is related to the temperature of water meaning with the increase in the temperature its rate in the water should be less than 1.5 mg per litter. 2- Chloride, that there is no health based recommendation rate for it and is related to its Cation compound. 3- Ferrous, which in the rate of above 0.3 mg per litter causes stain on washed clothes (5, 6, and 7). 4- Hardness, there is no recommendation from World Health Organisation about the side effect of water hardness, but the water with a hardness level of higher than 200 mg per litter can cause blockage in water pipeline and water with the hardness level of less than 100 ppm recommended (12-14). There are different assessments on the variety of indicators of quality of water in Iran, for instance: an assessment conducted on the underground water of Sabzevar, the study of EC changes graphs declared that the slop of EC change on monthly basis, was positive with a mild slop toward increased saltiness of all targeted wells because of inappropriate uptake and lack of adequate recharge (2). In an investigation which conducted in Neyshahpour city, it has been revealed that change in the Electric Conductivity of water sources of Neyshahpour was because of the effect of reduction in rain fall, decrease in the volume of underground water contractures, the entrance of salty water into underground water layers and instantiated conditions around wells entrance (15). Based on a study performed by Safety Water and Sewage Bureau of Gonabad city in assessing the characteristics of water in terms of Sedimentation and corrusion, the result indicated that the drinking water sources have high level of Sodium, Magnesium, Sulphate and Chloride (16). In a study carried out in 52 villages of Shabestar city, the reasons for contamination and the relation of Microbial contamination with the incidence of water borne diseases affiliated to the Eastern Azerbaijan province, the finding indicated that the average annual Microbial contamination of rural area water in terms of total Coliform was 40.5 percent and for E-coli was 10.3 percent and the average incidence rate of related diseases was 35 per 1000 (17). In an investigation conducted by Dindarlo et al. on the quality of drinking water of Bandar-Abbas city the results have showed that the rates of_Flourine, Soleplate, Cloror, Sodium, total hardness, EC, TDS in the underground water sources were higher than the permitted level and the rate of Nitrite and Calcium were more than optimum level where in the upper-ground water of Minab city all those parameters except TDS were in the optimum level (18). In a study, aimed at measuring the Flour rate of drinking water in rural area in Gorgan city, the result indicated that the average rate of Flour on the wells of farm land and highlands in all seasons was lower than the standard level of 1.5 mg per litter (19). In an investigation on the Nitrite and Nitrate level in the drinking water sources of Semnan, based on a defined specific water contamination scale, all water sources of Semnan except one belong to the TV centre were slightly contaminated in all seasons. The well of TV centre was contaminated in spring and autumn and slightly contaminated in summer and winter. All of these sources of water, in spring had Nitrite rate of higher than the level recommended by WHO. Also the well belong to the TV centre in comparison to other sources of drinking water in Semnen city had higher level of Nitrite and Nitrate contamination (20). In a study, constraints, threats and opportunities, the microbial quality of drinking water in the rural area of the country was investigated in two period 2004 and 2006. The results revealed that the weak points mentioned as the reasons for low level microbial quality of water in 2004 such as problems in water supply facilities, lack or limitation of chlorination device, infrastructure constrain and shortage of capable staff were still the matter in 2006 (21). This study was conducted to assess water sources quality and the trend of their change in rural area of Sabzevar County in a five year period.

2. Materials and Methods

This study is a descriptive & cross-sectional study. The region of study displayed in figure 1. The study area was the sources of water supply in villages of Sabzevar County. This county has 25 dehestan and 497 Hamlets with residents (10). Given some Hamlets with limited number of residents and therefore low level of water consumption and the lack of correct and understandable results the attempt was to choose those water sources that support more than 700 populations. In such cases it might be possible, because of their high level consumption of water, to link some of the results to the water sources of the county. The result of this process was the selection of 43 sources of water in single villages or complexes. For data collection we have used related records from water and Sewage Company and environmental health laboratory in district health authority of Sabzevar city. Collected data were entered in Excel programme and were analysed by SPSS software using T test. The results were compared with national standard of Iran. For the description of data annual average and viscosity variance of assessed parameters were used. The findings of this study will be analysed against standard indexes to find the trends of any hypothetical changes. Samples were taken by experts and professionals under standard condition. For experiments, samples taken by district health authority were transferred to its laboratory within 6 hours while other samples taken by rural water and Sewage Company were taken to the laboratory at provincial level within 24 hours. For microbiological samples, based on the handbook of standard method for water and sewage, all required conditions including temperature, and sample plates, sample sterilisation and residual chlorine neutralization by thiosulfate solution 3%, and the time between sampling and microbiological experiment (24 hours) were considered. Some of the parameters such as EC, PH, temperature, chlorine and blurredness have been measured by mobile laboratory or portable device of water and Sewage Company in the location on monthly bases and being reported for each season. The experiments were performed according to standard method or national standard of Iran or by portable devices.

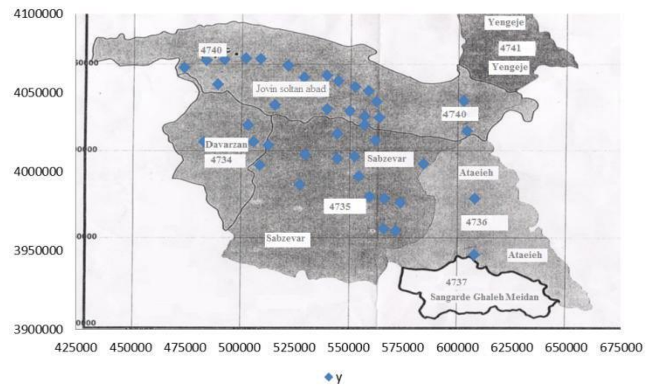

Figure 1. The region of study

3. Results

In terms of microbial quality of drinking water in rural area of Sabzevar, the results of 801 samples taken from 43 sources of drinking water in villages or complexes in a five year period have showed that the average microbial contamination was 12.3±13.3. Considering the confidence interval level of 90% the contamination level has negative lower bundary that means it has not significant difference with zero therefore the contamination is not obvious. In terms of Physico-Chemical quality based on available data the results of samples from underground water of 30 wells among 43 wells were selected and studied. The one-sample statistics of data regarding (basophilic, hardness, flour, ferrous, Chloride) indexes and their comparison with national standard is depicted in tables. Seasonal and yearly average of parameters is displayed in tables. The Physico-Chemical results of wells using One Sample

T test in all wells with analysis, the wells number of 19, 29, and 38 regarding TDS had significant difference with national standard. The T coefficient and P value of them have showed in table 1. As table 1 shows TDS quality in three wells of drinking water was higher than the maximum level of 500 mg per litter. Also the result of One Sample T test in drinking water wells regarding TDS has indicated in table 2. As table 2 indicates the average TDS rate was 349.02 per litter with a variance of 193.704 mg per litter.

Table 1. The characteristics of wells with problems in TDS

Well's No.	Mean(mg/L)	T	Sig. (2-tailed) (P_v)
19	583±12/3	16/5	0
29	619/7±14/9	19/8	0
38	710/8±79/6	6/5	0/001

Table 2. The results of One Sample T test in drinking water wells regarding TDS

	N	Mean	Std. Deviation	Std. Error Mean
TDS	2856	349.02	193.704	3.625

Table 3. The result of One Sample T Test in drinking water wells regarding TDS

	Test Value = 500					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
TDS	-41.656	2855	.000	-150.985	-158.09	-143.88

The statistical analysis of Flour revealed that Well number 38 with average 4.7± 3.9 mg per litter with Confidence Interval Level of 99% had statistically significant difference with the optimum level of 1.5 mg per litter (Pv <0.01). Its T coefficient and P value is presented in Table 4.

Table 4. The characteristics of wells having problem in terms of Flour

Well's No.	Mean (mg/L)	T	Sig. (2-tailed) (P_v)
37	4/7±3/9	1/9	0

The worst situation of quality of rural drinking water sources is related to Colour of water in which among 42 sources of studied rural drinking water sources 9 of them including wells number of 8, 13, 19, 20, 21, 22, 28, 29 and 38 had higher level of 200 mg per litter of Chloride with remaining had good condition.

Table 5. The characteristics of wells with Chloride above the optimum maximum level and substantially with problem

Well's No.	Mean (mg/L)	T	Sig. (2-tailed) (P_v)
8	341±54/4	6/4	0/001
13	390±60/7	7/7	0/001
19	299±14/7	16/5	0
20	318±13/9	20/8	0
21	304/5±25/8	9/9	0
22	110±208/8	0/196	./852
28	105/4±206/5	0/152	./855
29	443±33/6	17/7	0
38	298/7±23/2	10/4	0

Using a One Sample T test for Colour it has been found that wells number of 38, 29, 21, 20, 19, 13, 8 had statistically significantly difference with national standard. Their average, T coefficient and P value is depicted in table 5 and figure 2. However the Chloride level of wells number 22 and 28 was more the maximum level of 200 mg per litter but the T coefficient and P value of them show that they have not statistically significant difference with the maximum optimum level.

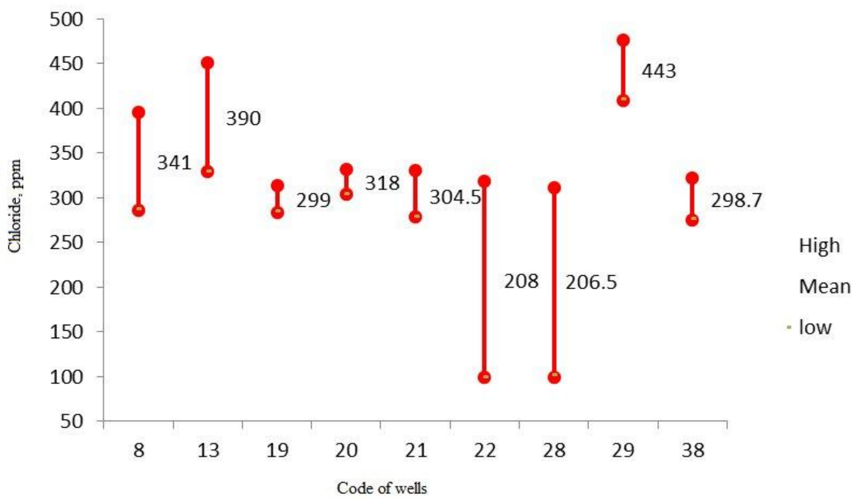

Figure 2. Mean and SD of Chloride in Wells

The results of aforementioned test for Ferrous revealed that well number 14 has significant difference and its mean fluctuation is more than permitted level that cause red stain on washed clothes and a taste for water. The mean, T coefficient and P value of that is showed in table 6.

Table 6. The characteristics of well with problem in terms of Ferrous

Well's No.	Mean (mg/L)	T	Sig. (2-tailed) (P_v)
14	0/3±0/1	5/3	0/003

Using One Sample T test for EC the result has showed that well number 8, 31, 29 and 13 had statistically significant difference with national standard. In table 7 their mean, T coefficient and P value is presented.

Table 7. The characteristics of wells having problem of EC

Well's No.	Mean (mg/L)	T	Sig. (2-tailed) (P_v)
8	2387±272	12/2	0
13	2703±189	23	0
29	2277±172	16/9	0
31	2426±231	15	0

By analyzing the mean of TDS and PH of all wells in all different seasons of related study years there was an increasing trend of both parameters that has showed in Figures 3 and 4.

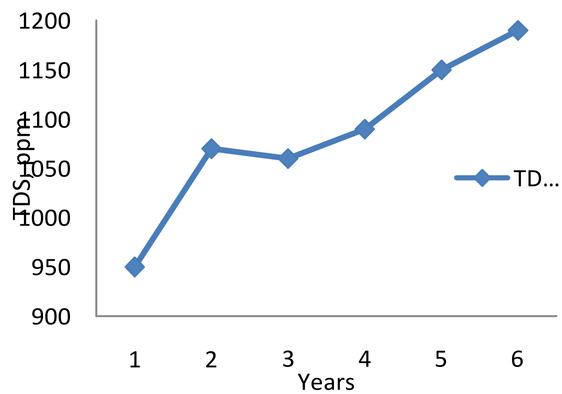

Figure 3. The trend of change in TDS mean related to the years of study

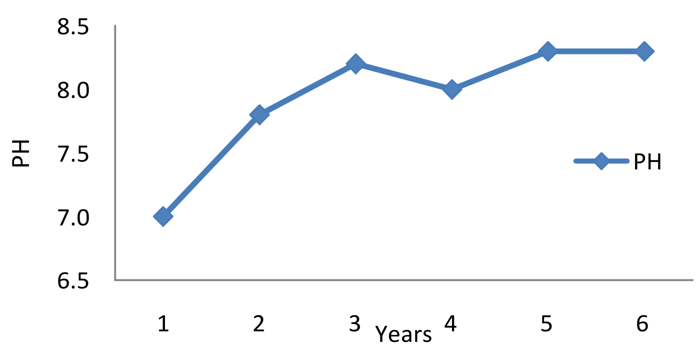

Figure 4. The trend of change in PH mean related to the years of study

The results of descriptive statistics of samples taken from wells in terms of EC has presented in table 8. As the table indicates the maximum EC of wells in a five year period has increased from 2526 in the first year to 3213 in the third year and declined to 2746 in year fifths.

Table 8. The result of descriptive statistics samples in terms of EC of Wells

year		N	Minimum	Maximum	Mean	Std. Deviation
1	EC	34	343.33	2526.50	9.5847E2	518.74457
	Valid N (listwise)	34				
2	EC	154	331.00	2888.50	1.0675E3	594.50956
	Valid N (listwise)	154				
3	EC	77	310.00	3213.33	1.0615E3	611.41578
	Valid N (listwise)	77				
4	EC	155	335.00	2786.67	1.0842E3	595.28211
	Valid N (listwise)	155				
5	EC	114	361.00	2746.00	1.1553E3	612.00455
	Valid N (listwise)	114				

The results of descriptive statistics of samples taken from wells in terms of EC has presented in table 8. As the table indicates the maximum EC of wells in a five year period has increased from 2526 in the first year to 3213 in the third year and declined to 2746 in year fifths. The mean of different Physico-Chemical parameters of rural drinking water sources in Sabsevar is depicted in table 9.

As the table shows the most problems in terms of Physico-Chemical quality of drinking water were an increase in the rate of Chloride, TDS, and EC above the maximum level recommended. The trend of these parameters is an indicator of different contaminations entrance into underground water sources of rural area emerged from agricultural, industrial and civil swages and surface water.

Table 9. The mean of Physico-Chemical parameters of rural drinking water sources

Parameter The code source or complex	TDS,(mg/L)	Total Hardness ,(mg/L)	Fluorine ,(mg/L)	Cl-,(mg/L)	Iron,(mg/L)	Alkalinity ,(mg/L)
	Maximum optimal	Maximum optimal	Maximum optimal	Maximum optimal	Maximum optimal	Maximum optimal
	500	350	1/5	200	0/1	**
1	317,5 ± 128	138,7 ± 24,8	0,5 ± 0,14	91,6 ± 14,2	0,02 ± 0,01	156 ± 15,8
2	165,3 ± 12,9	120,8 ± 36,6	0,8 ± 0,13	97,5 ± 41,5	*	166,8 ± 18,6
3	235,8 ± 42,1	308,8 ± 49,	0,3 ± 0,08	117,8 ± 31,6	0,02	130,8 ± 80
4	383,6 ± 25,5	115,6 ± 8,8	0,3 ± 0,08	174,3 ± 11,5	0,02	174 ± 8,7
5	*	207 ± 92,5	0,18 ± 0,02	19,5 ± 1,4	0,04 ± 0,04	210,3 ± 38,6
6	*	231,6 ± 8,3	0,2 ± 0,01	38 ± 3,6	0,04 ± 0,01	277 ± 8
7	*	110,8 ± 7,9	0,2 ± 0,01	34,8 ± 3,8	0,04 ± 0,03	115 ± 12,8
8	448,1 ± 96,9	**399 ± 42,4**	0,4 ± 0,25	**341 ± 54,4**	0,05 ± 0,01	236 ± 51,9
9	155,8 ± 15,9	337,5 ± 285,7	0,35 ± 0,2	39,7 ± 32,8	0,02 ± 0,01	172,5 ± 37,8
10	*	201,5 ± 86,5	0,00	96,3 ± 14	0,03 ± 0,01	230 ± 9,9
11	119,8 ± 12	180,8 ± 57,3	0,15 ± 0,09	21,8 ± 5,5	0,04 ± 0,01	132,8 ± 12,6
12	258,5 ± 50,2	157 ± 36,4	0,4 ± 0,10	150,1 ± 50,8	0,05 ± 0,03	108,5 ± 21,6
13	179,6 ± 16,6	308,6 ± 55,3	0,7 ± 0,33	**390,2 ± 60,7**	0,04	186,8 ± 78,2
14	250,1 ± 12,4	194,3 ± 5	0,03 ± 0,01	15,3 ± 1,6	**0,34 ± 0,11**	143,7 ± 18,6
15	245,8 ± 29,8	195,4 ± 56,3	0,1 ± 0,08	66,4 ± 25,5	0,04 ± 0,02	135 ± 15,7
16	238,3 ± 59	181,5 ± 79,8	0,47 ± 0,05	122,6 ± 53,2	0,02 ± 0,01	139,3 ± 16,7
17	442,1 ± 45,8	298,5 ± 23,8	0,6 ± 0,08	38 ± 3,2	0,02 ± 0,01	233,8 ± 39,8
19	**583, ± 12,3**	210,8 ± 9,3	0,3 ± 0,2	**299 ± 14,7**	0,21 ± 0,34	200,5 ± 18,4
20	243 ± 5	216,8 ± 11	0,4 ± 0,07	**317,9 ± 13,9**	0,06 ± 0,07	202,3 ± 8,2
21	**617 ± 136,4**	**640 ± 131,7**	0,4 ± 0,1	**304,5 ± 25,9**	0,02 ± 0,01	144 ± 8,8
22	242,6 ± 34	247,5 ± 37,4	0,45 ± 0,08	**208,8 ± 110**	0,05 ± 0,02	151,8 ± 15,9
23	*	*	0,4 ± 0,07	192 ± 12,5	0,00	*
27	259,1 ± 34	**364,3 ± 284,6**	0,4 ± 0,05	81,5 ± 11,3	0,02	260,3 ± 105,8
28	416,7 ± 71	263,7 ± 73,2	0,29 ± 0,21	**206,5 ± 105,4**	0,05 ± 0,03	150,2 ± 19,5
29	**619,7 ± 14,8**	229,7 ± 9,6	0,57 ± 0,26	**443,3± 33,6**	0,03 ± 0,01	142 ± 7,9
33	227,2 ± 86,4	247,7 ± 31,4	0,22 ± 0,11	81,7 ± 10,4	0,03 ± 0,04	154,3 ± 28,3
35	133,2 ± 6	262,7 ± 6	0,36 ± 0,16	38,8 ± 2,2	0,04 ± 0,01	80,3 ± 9,9
37	442 ± 7,2	**534,8 ± 18**	**4,7 ± 3,9**	133,7 ± 7,7	0,08 ± 0,08	156,7 ± 27
38	**710,8 ± 79,6**	316,8 ± 58	0,54 ± 0,06	**298,7 ± 2**	0,08 ± 0,07	228 ± 54, 1
42	156,8 ± 44	322 ± 80,3	0,30 ± 0,15	75 ± 27	0,13 ± 0,05	117 ± 19,4

* Data was not available
** There is no defined standard

Among rural drinking water sources in overall the situation of Fluorine and Iron of rural drinking water were in appropriate position. Regarding Fluorine just a source with code 37 that its Fluorine viscosity was 4.7± 3.9 mg per litter above the maximum optimum level of 1.5 mg per litter. This source needs special assessing and emergency action for water refinement or replacement with accepted Fluorine rate. Regarding Iron the source of 14 with average viscosity of 0.34±0.11 mg per litter was higher than maximum optimal 0.1 mg per litter requiring action to be taken for its refinement or replacement. About the Alkalinity of water there has been no problem. As the results of table 9 indicates the lowest TDS of rural drinking water was related to source 11 with 119,8 ± 12 mg per litter and maximum TDS rural drinking water sources was related to source 38 with a rate of 710,8±79,6 mg per litter that is higher than maximum optimum level 500 mg per litter. Except for 3 sources, the remaining sources were in the range of below the optimum level and other sources had closed to maximum level that with this trend in the near future will reach beyond the maximum level. Regarding to total hardness of rural drinking water the trend is almost like TDS. Lowest total hardness of rural drinking water is related to source with code 7 having a rate of 110,8±7,9 mg per litter that is a an appropriate hardness . The higher total hardness of rural drinking water is related to source with code 21 having a rate of 640±131,7 mg per litter that is above the maximum optimum level of 350 mg per litter. Except in four sources, the remaining sources are approximately in the rage of below the maximum level and five sources with total hardness above 300mg per litter were closed to the maximum optimum the with the current trend will pass the maximum level.

Table 10. Average yearly and seasonal EC (Micromhos per Centimeter) villages or complexes

Year	season	minimum	maximum	mean
1	winter	343,3	2526,5	958,5 ± 518,7
	spring	371	2888,5	1109,3 ± 626,7
2	summer	355	2783	1029 ± 555,9
	autumn	331	2823	1000 ± 613
	winter	342	2575	1082 ± 601,4
	annually	331	2888,5	1067 ± 594,5
	spring	348,3	3213	1108 ± 674,7
3	winter	310	2440	1014 ± 543,8
	annually	310	3213,3	1061 ± 611,4
	spring	343,7	2545	1061 ± 588,4
4	summer	338	2670	1046 ± 595,3
	autumn	397,5	2760	1107 ± 602,5
	winter	335	2786,7	1123 ± 615,2
	annually	335	2786	1084 ± 595,3
	spring	361	2746	1134 ± 613,4
5	summer	424	2650	1171 ± 613,7
	autumn	380	2667	1171 ± 631
	winter	780,7	780,7	780,8
	annually	361	2746	1155 ± 612

4. Discussion

This study shows that in terms of microbial in some of the tests performed on studied sources, stool Coli form was positive that the necessity of detailed planning for water disinfection of extracted drinking water. Plus regarding Physico-Chemical characteristics some of sources had problem. In this regard some of sources in terms of Chlorine rate, TDS, EC, total hardness, Fluorine viscosity need refinement or replacement. In a five year period the trend of average decline in the quality is obvious that is because of the experiments are fulfilling based on routine and task force basis collected in archive with no investigation on the change of its trend. Meanwhile the existing data are based on samples taken from the network and for this reason some of these changes could not be linked to the water sources. For more appropriate and deliberated conclusion to be evidenced more data with specific interval based on standard are needed. Also in this regard considering the involvement of two organizations (Ministry of Health and ministry of Energy) it is possible with an intra-sectorial cooperation both to reduce the high cost of repeated experiment and to increase the control on the trend of quality of water more carefully. There is a requirement for design and implementation of a continues planning supported by a GIS based data bank of water quality to make the continues supervision on the trend of change in the quality of water possible.

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References

1. Safari G, Vaezi F. Assessing the quality of water sources in Mianeh district, Journal of Water & Sewage; 2003; 47: 53-59
2. Tayebi R, Janbani A. The trend of change in the quality of underground water sources in a long term drinking water supply in Sabzevar, A brief report of applied research committee of regional water corporation of Khorasan Razavi Province, 2004.
3. Alizadeh A. The principles of applied Hydrology, Astan Ghodse Razavi Publisher, 1998.
4. Gholami V, Yousefi Z, and Zabardast Rostami H. Modeling of Ground Water Salinity on the Caspian Southern Coasts, Water Resour Manage, 2010; 24:1415–1424
5. Yousefi Z, Naeej O. Study on Nitrate Value in Rural Area in Amol City, J Mazand Univ Med Sci, 2008; 17(61):161-165.
6. Z.Yousefi, M. Sanaat. Evaluation of drinking water quality in Babol rural area without piping network, in Behsazan Mohit, Journal of Environmental Health Research Center, 2004; 3:32-36.
7. Novotny, V. Water Quality. John Wiley and Sons, 2002; 519-570.
8. Sadeghi, G. H., Peda, M., Islami, A. Mohammadi, H. The evaluation of the chemical and microbial quality of drinking water supplies in the villages of Zanjan. Proc. 8th Ed National Meeting on Environmental Health. (8-10 November). Tehran. Iran; 2005. 23.
9. W. H. O. Guideline for Drinking water Quality. First Addendaunt to 3rd Ed. Recommendations., WHO, 2006; 221-427.

10. Malakootian, Sh. Dowlatshahi. Variations of chemical quality for drinking water sources Zarand, Iran. J. Environ. Health. Sci. Eng., 2007; 4(4):257-262
11. Kahrom M. Water transfer system, Mashhad Ferdousi University publication, 2004.
12. Nabizadeh N R., Faezi RD. Recommendations on the quality of drinking water, World Health Organisation. First edition, Nas publication, Tehran, 1976.
13. Mahvi A. Health and beautifulness of water quality. First Edition. Bal-Gostar publication, 1976.
14. Motallebi, R. Chemical quality of Bandar-Abbas drinking water. MSc Thesis, 2010.
15. Yousefi Z, Vafadar M. Assessing the healthy regulation and Nitrate monitoring and Electicity, conductivity drinking water sources of Neishahpour during 1996-2006, 2009.
16. http://idochp2irandoc.ac.ir/scripts/wxiis.cgi ?a=1:46:40
17. Dyndarlv, K. Quality of drinking water in Bandar Abbas. Hormozgan Medical Journal, 10(1), spring 2006:57-62.
18. Rahim Zadeh, H., Kargar M., Dadban Y., and , Bayrami S., Determination of fluoride in drinking water in villages of Gorgan 2006, Journal of laboratory Medicine, 2007; 1(2):45–48.
19. Falah S.H., Mehdinia S.M., Heydaried M., Abasi A. Survey the level of Nitrite and Nitrate in Semnan Drinking Water Resources, Guilan University of Medical Sciences 2006; 15(60):1-6.
20. Ghannadi M. and Mohebi M.R. A Survey of Drinking Water Microbial Quality in Rural Areas in IRAN (Limitations, Challenges, and Opportunities),2008;19(65):23-29.
21. APHA/AWWA/WPCF. Standard methods for the examination of water and wastewater. 20th Ed. APHA, 1998; 2-35-4-181.