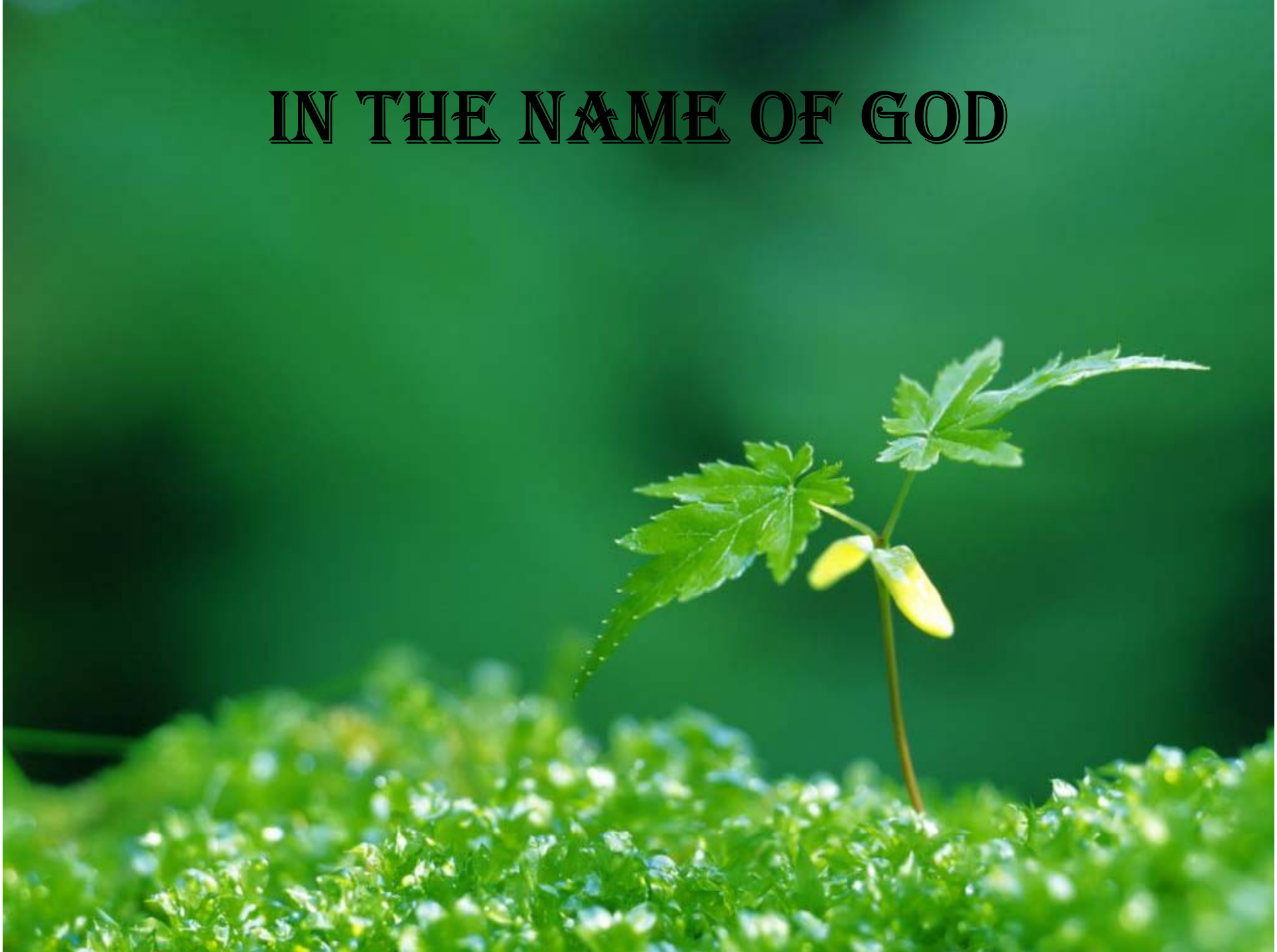

IN THE NAME OF GOD

Good morning ,

Ladies and Gentlemen,

I'm happy to see you again.

Title of research:

Survey of fluoride level in underground water sources and Urban water distribution network in Qaemshahr city(North of IRAN) from 2006 to 2012

By : Hajar Boudaghi Malidareh (MSc)

Parisa Boudaghi Malidareh

Amir Hossein Mahvi(pH.D)

Amin Alinezhad (MSc)

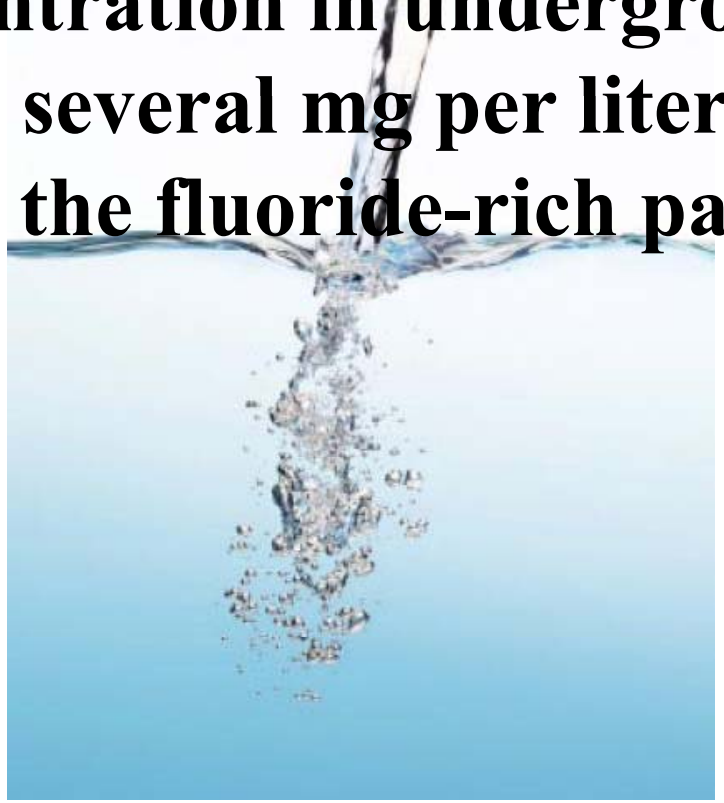
my associates miss parisa boudaghi . Dr. mahvi and alinezhad ; and I did the mentioned research

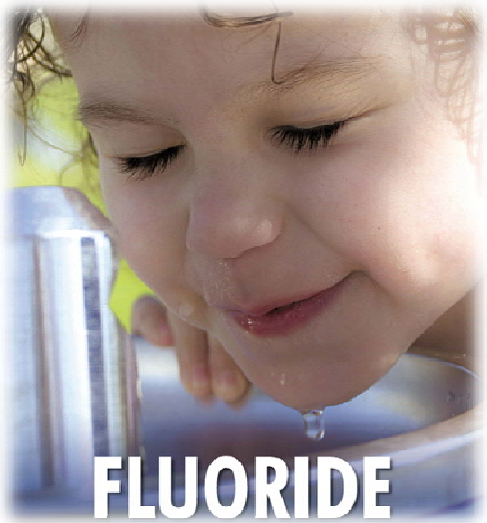
The first WHO publication dealing specifically with drinking – water quality was published in 1958 as international standards for drinking – water.

Nineteen fifty-eight

Fluoride

- **… is one of the fundamental and required components in human body.**
- **… concentration in underground water may arrive to several mg per liter because they transmit the fluoride-rich parts.**





- **Fluoride is found in all natural water at some concentration.**

Fluoride in drinking-water will be an invaluable reference source for all those concerned with the management of drinking-water containing fluoride and the health effects arising from its consumption, including water sector managers and practitioners as well as health sector staff at policy and implementation levels .

- **Fluoride has beneficial effects on teeth at low concentrations in drinking – water , but excessive exposure to fluoride in drinking – water , or in combination with exposure to Fluoride from other sources , can give rise to a number of adverse .**
- **At high levels it has been known to cause dental and skeletal fluorosis .**

Materials and methods

- **This is a descriptive and sectional study.**

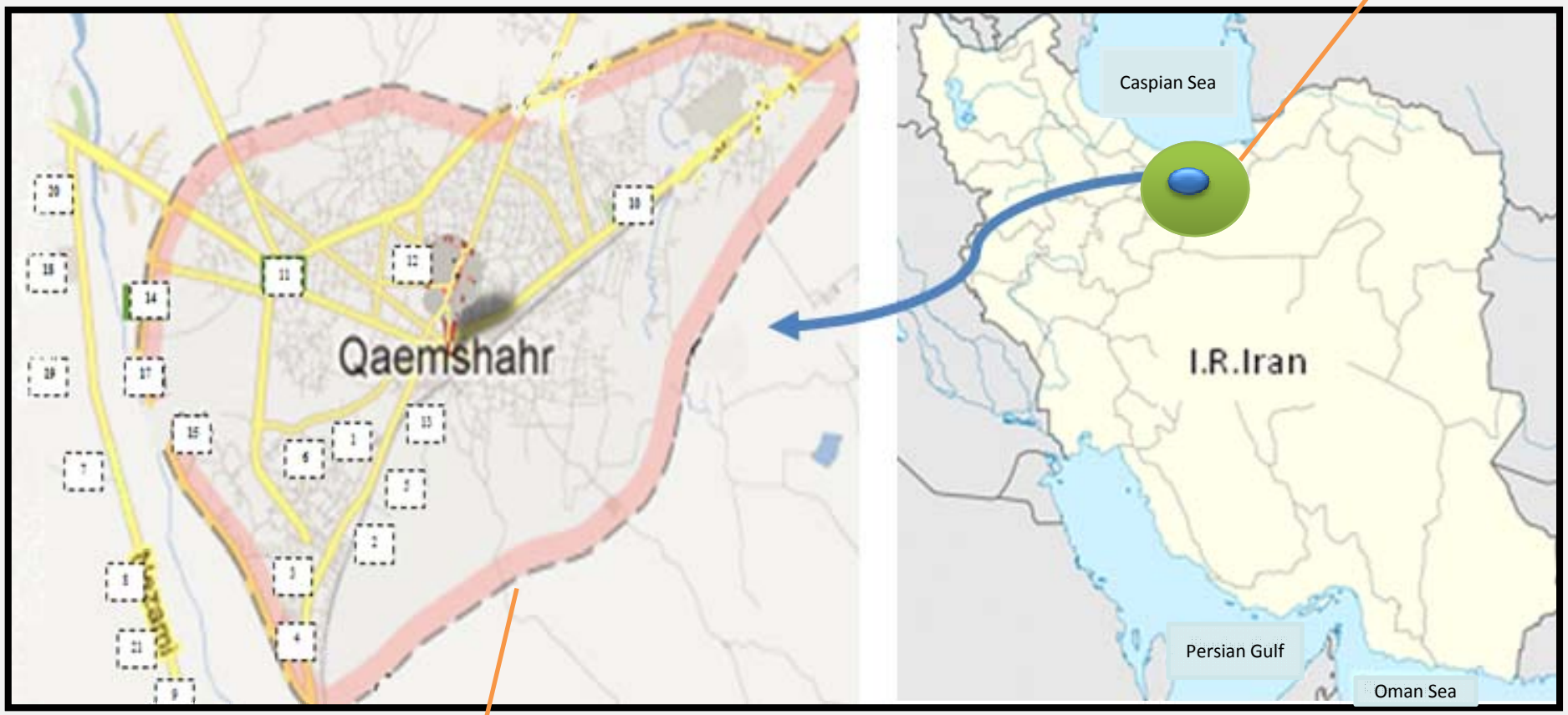
- **In the year 2012 the Covered Population Qaemshahr city was 209920 people(urban).**

Two hundred and nine thousand nine hundred and twenty

Mazandaran province is in the north of IRAN

well-water sampling locations

Map of IRAN



Qaemshahr city is situated 23 kilometres (14 mi) south west of Sari which is the capital of Mazandaran province.

- **Qaemshahr city has twenty-two water wells for water supply wells which some of these wells are inactive off and on .**
- **In every seasons of year water samples were taken from active water wells to the determin the fluoride levels.**

- **Minimum five Sample has been selected according to distribution network statuo randomly.**
- **In other words, Samples have been selected from active water wells and Urban water distribution network from 2006 - 2012 through accidental method**

- **Samples were experimented in Qaemshahr water and wastewater department laboratory.**

SPADNS Fluoride Reagent Solution

DR 2800 Spectrophotometer

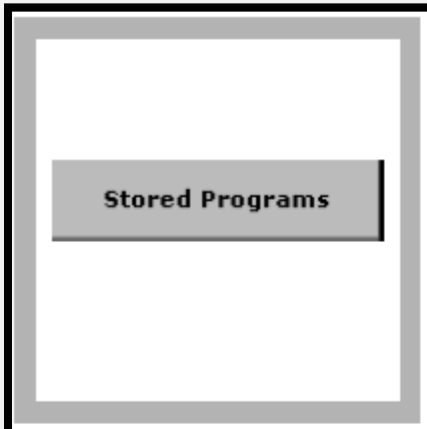
Expected Precision for DR 2800 Methods

PARAMETER	Method Number	Stored Program	Method	Concentration Range	95% Confidence Interval		
					Lower Limit	Target Conc.	Upper Limit
Fluoride	8029	190	SPADNS	0.02–2.00 mg/L F–	0.97	1.00	1.03

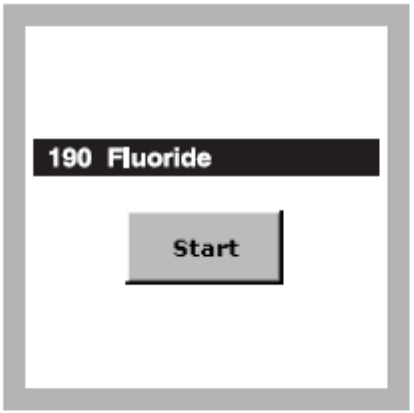
Fluoride concentration in samples has been measured by DR2800 and Method 8029 SPADNS Method Reagent Solution.

Two thousand and eight hundred Eight hundred and twenty-nine One hundred and ninety

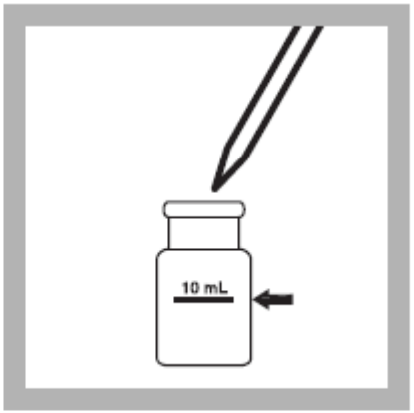
Practical steps to test by DR 2800 -According of Images



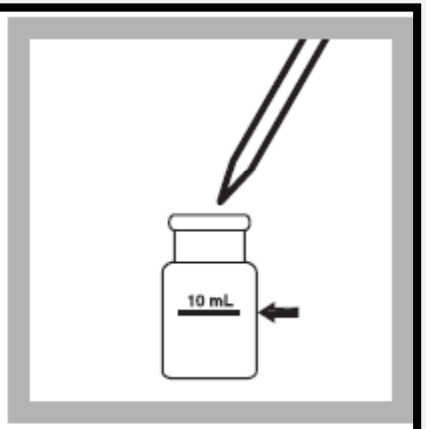
1. Press **STORED PROGRAMS**.



2. Select the test.

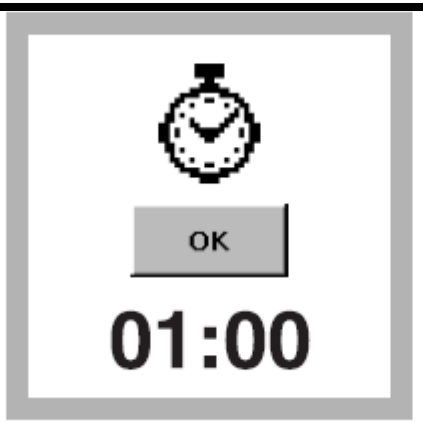


3. Prepared Sample: Pipet 10.0 mL of sample into a dry square sample cell.



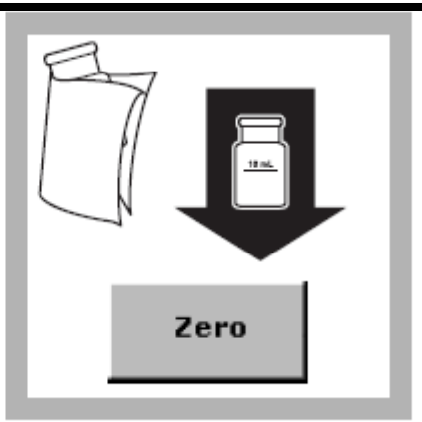
4. Blank Preparation: Pipet 10.0 mL of deionized water into a second dry square sample cell.

5. Carefully pipet 2.0 mL of SPADNS Reagent into each cell. Swirl to mix.



6. Press **TIMER>OK**.

A one-minute reaction period will begin.

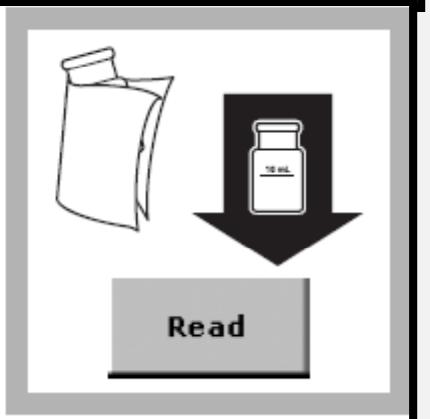


7. When the timer expires, insert the blank into the cell holder with the fill line facing right.

Press **ZERO**.

The display will show:

0.00 mg/L F^-



8. Insert the prepared sample into the cell holder with the fill line facing right.

Press **READ**. Results are in mg/L F^-.


RESULTS

Fluoride concentrations (ppm) in underground water sources in Qaemshahr city in 2006-2012

Season	Spring					
Year / Water-well	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
1	0.54	0.34	0.35	0.45	0.13	0.20
2	0.42	0.40		0.30	0.40	0.21
3	0.35	0.32	0.10	0.46	0.31	0.15
4	0.35	0.37	0.16	0.61	0.01	0.29
5	0.36	0.29	0.39	0.46	0.07	0.30
6	0.47	0.35	0.10	0.41	0.19	0.21
7	0.44	0.37	0.10	0.46	0.45	0.41
8	0.16	0.31	0.20	0.30	0.40	0.20
9	0.27	0.25	0.10	0.25	0.06	0.26
10	0.44	0.26	0.67	0.61	0.19	0.22
11	0.06	0.21	0.29	0.10	0.32	0.31
12	0.52	0.20	0.21	0.45	0.19	0.11
13	0.34	0.18			0.50	
14	0.34	0.33	0.10	0.44	0.35	0.40
15	0.17	0.17	0.19	0.51	0.21	0.43
16	0.44	0.47	0.32	Inactive well-water		
17			0.19	0.45	0.33	0.20
18	0.12	0.35			0.12	0.41
19	0.52	0.52	0.44	0.20	0.30	0.48
20	0.25			0.35		0.15
21		0.22	0.23	0.45		0.23
22				0.50	0.24	0.25

water well (No .16) was removed from the circuit = Inactive during 2009 - 2012

Fluoride concentrations (ppm) in underground water sources in Qaemshahr city 2006-2012

Season	Summer					
Year / Water-well	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
1	0.23	0.33	0.46	0.37	0.33	0.10
2	0.34	0.16	0.50	0.10	0.42	0.23
3	0.00	0.27	0.49	0.42	0.26	0.10
4	0.31	0.22	0.65	0.60	0.21	0.26
5	0.78	0.18	0.62	0.29	0.50	0.20
6	0.20	0.27	0.40	0.08	0.03	0.32
7	0.75	0.30	0.26	0.62	0.51	0.37
8	0.56	0.30	0.36	0.25	0.40	0.34
9		0.20	0.45	0.20	0.09	0.17
10	0.13	0.22	0.53	0.34	0.59	0.34
11	0.39	0.18	0.45	0.02	0.54	0.21
12	0.11	0.15	0.32	0.39	0.43	0.19
13	0.23	0.15	0.39		0.47	0.20
14	0.69	0.30	0.18	0.34	0.52	0.29
15	0.41	0.18	0.36	0.48	0.10	0.23
16	0.31	0.31	0.29			
17	0.51		0.16	0.38	0.40	0.,31
18	0.50	0.28	0.36	0.4	0.50	0.53
19	0.16	0.29	0.32	0.07	0.50	0.32
20	0.23		0.49	0.30	0.50	0.25
21		0.20	0.34	0.20	0.45	0.19
22		0.26	0.43	0.47	0.37	0.16

Fluoride concentrations (ppm) in underground water sources in Qaemshahr city in 2006-2012

Season	Autumn					
Year / Water -well	2006- 2007	2007- 2008	2008- 2009	2009-2010	2010-2011	2011-2012
1	0.06		0.63		0.14	0.16
2	0.53	0.33	0.40	0.23	0.59	0.31
3	0.05		0.50	0.23	0.31	0.19
4	0.46	0.14	0.52	0.30	0.22	0.33
5	0.20	0.12	0.58	0.05	0.36	0.31
6	0.06	0.45	0.20	0.27	0.25	0.33
7		0.01	0.60	0.47	0.48	0.36
8			0.20	0.21	0.19	0.18
9				0.07	0.07	0.19
10	0.25		0.41	0.50	0.31	0.25
11			0.47	0.30	0.51	
12	0.13				0.30	0.20
13	0.01	0.03	0.28		0.37	0.10
14	0.05	0.42	0.20	0.32	0.40	0.23
15			0.35	0.20	0.50	0.38
16	0.30					
17				0.32	0.57	0.31
18	0.12	0.4	0.20	0.18	0.40	0.31
19			0.30	0.21	0.51	0.34
20			0.47		0.39	0.21
21		0.02		0.28	0.43	0.13
22			0.38	0.29		0.19

Fluoride concentrations (ppm) in underground water sources in Qaemshahr city in 2006-2012

Season	Winter					
Year / Water-well	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
1		0.15		0.32	0.20	0.20
2		0.09		0.30	0.39	0.31
3	0.01	0.18	0.53	0.27	0.42	0.48
4	0.02	0.34		0.25	0.28	0.30
5		0.01	0.45	0.08	0.28	0.31
6	0.10	0.29	0.17	0.32	0.31	0.11
7	0.11	0.35	0.60	0.40	0.39	0.31
8	0.30	0.12	0.05	0.24	0.57	0.10
9		0.21		0.50	0.11	0.20
10	0.10	0.15	0.40		0.26	0.67
11	0.04	0.13	0.38	0.49	0.63	
12	0.23	0.12	0.14	0.20	0.10	0.10
13		0.31	0.15		0.38	0.50
14	0.07	0.31	0.45	0.54	0.10	0.50
15	0.13	0.16	0.23	0.52	0.32	0.31
16	0.27	0.15	0.19			
17	0.18		0.10	0.10	0.40	0.15
18	0.21	0.45	0.52	0.30	0.12	0.28
19		0.18	0.43	0.67	0.36	0.30
20	0.21		0.45		0.40	0.42
21		0.20			0.41	0.20
22		0.36	0.51	0.19		0.53

Fluoride concentrations (ppm) in Urban water distribution network in Qaemshahr city (2006-2012)

Season	Spring						Summer						Autumn						Winter					
Year	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Fluoride (ppm)	0.21 0.18 0.39 0.68 0.31	0.24 0.36 0.39	0.37 0.10 0.30	0.33 0.40 0.33 0.39 0.20	0.19 0.37 0.06 0.35 0.26 0.29 0.21	0.25 0.24 0.13 0.21 0.25 0.30 0.23 0.31	0.23 0.27 0.26 0.51 0.58	0.19 0.06 0.29 0.21 0.29 0.28	0.27 0.26 0.33 0.52 0.21	0.37 0.39 0.36 0.47 0.68 0.29 0.32 0.30	0.48 0.26 0.29 0.38 0.33 0.48 0.45	0.40 0.50 0.10 0.34 0.21 0.31 0.10 0.30 0.10	0.023 0.250 0.040 0.056 0.21 0.023	0.18 0.35 0.03 0.34 0.19	0.31 0.47 0.61 0.34 0.41	0.40 0.29 0.34 0.31 0.28 0.27 0.01 0.34	0.09 0.60 0.21 0.50 0.28 0.24	0.21 0.20 0.19 0.27 0.12 0.23	0.06 0.01 0.04	0.21 0.31 0.17 0.27	0.31 0.45	0.46 0.34 0.03 0.35 0.02 0.27 0.26	0.31 0.22 0.11 0.23 0.30 0.20 0.13	0.40 0.34 0.25 0.35 0.30 0.40 0.48
N	5	3	3	5	7	8	5	6	5	8	7	9	6	5	5	8	6	6	3	4	2	7	7	7
Mean	0.28	0.33	0.26	0.33	0.25	0.24	0.37	0.22	0.32	0.40	0.38	0.26	0.10	0.22	0.43	0.28	0.32	0.20	0.04	0.24	0.38	0.25	0.21	0.36
S D	0.14	0.08	0.14	0.08	0.11	0.06	0.16	0.09	0.12	0.13	0.09	0.14	0.10	0.13	0.12	0.12	0.19	0.05	0.03	0.06	0.10	0.17	0.08	0.08
Min	0.01	0.24	0.10	0.20	0.06	0.13	0.23	0.06	0.21	0.29	0.26	0.10	0.02	0.03	0.31	0.01	0.09	0.12	0.01	0.17	0.31	0.02	0.11	0.25
Max	0.68	0.39	0.37	0.40	0.37	0.31	0.58	0.29	0.52	0.68	0.48	0.50	0.25	0.35	0.61	0.40	0.60	0.27	0.06	0.31	0.45	0.46	0.31	0.48

Maximum , Minimum and Mean levels of fluoride concentrations (ppm) in Urban water distribution network & underground water sources in Qaemshahr city (2006-2012)

Season	Spring		Summer		Autumn		Winter		TOTAL	
	sources	network	sources	network	sources	network	sources	network	sources	network
N	113	31	123	40	95	36	108	30	439	137
Mean	0.31	0.28	0.32	0.32	0.29	0.26	0.28	0.25	0.30	0.28
S D	0.14	0.11	0.16	0.14	0.15	0.15	0.16	0.13	0.15	0.14
Min	0.01	0.06	0.00	0.06	0.01	0.01	0.01	0.01	0.00	0.01
Max	0.67	0.68	0.78	0.68	0.63	0.61	0.67	0.48	0.78	0.68

In differnet seasons

- **The suggested fluoride concentration for fluorideated water supply system can be estimated from follow relation :**

$$F\ (mg/l) = \frac{0.34}{0.038 + (0.0062\ T\ ^{\circ}f)}$$

Fluoride concentration according to the formula

Reference:

Fawell JK, Bailey K. Fluoride in drinking-water: World Health Organization 2006

Suggested fluoride concentration for fluorideated water supply system according average maximum daily temperature in seasons (ppm) in Qaemshahr city (2006-2012)

Year / T . F- / Seasons	2006-7		2007- 8		2008- 9		2009-10		2010-11		2011-12	
	T °f	F-	T °f	F-	T °f	F-	T °f	F-	T °f	F-	T °f	F-
Spring	42.12	0.68	40.86	0.69	44.46	0.66	38.88	0.71	42.12	0.68	41.94	0.68
Summer	57.06	0.57	55.26	0.59	57.24	0.58	53.28	0.60	58.32	0.57	55.26	0.59
Autumn	37.80	0.72	36.00	0.74	34.92	0.75	36.72	0.73	41.76	0.69	31.86	0.78
Winter	24.48	0.88	21.60	0.92	25.20	0.87	25.74	0.86	23.22	0.89	21.06	0.93

- **Several studies have been done on fluoride in different countries that the fluoride concentration in some was less than Standard and in some.**

For example :

- **The average annual mean maximum temperatures(AMMT) of Pakistan is 29°C at which the optimal fluoride in drinking water of Pakistan was calculated to be 0.7 ppm(Khan et al., 2004).**

- **The investigation has confirmed that the maximum allowable concentrations (MAC) of fluorides is exceeded in the artesian waters of the Moscow Region (Klochkova et al., 2010).**

- **The population of the studied area(the basaltic areas) is at a high risk due to excessive fluoride intake especially when they are unaware of the amount of fluoride being ingested due to lack of awareness (Asghari and Fijani 2008).**

- **Fluoride concentration was 0.2 to 9.2 mg/l(Keshavarzi et al., 2010).**

- **Results indicated that water supply from 42% of the municipalities had a fluoride concentration over the Mexican standards of 1.5 mg/l(Hurtado and Gardea-Torresdey 2004).**

- **Fluoride levels were low in most parts of the country, being 0.3 ppm or less in 62% of the local government areas(Akpata et al., 2009).**

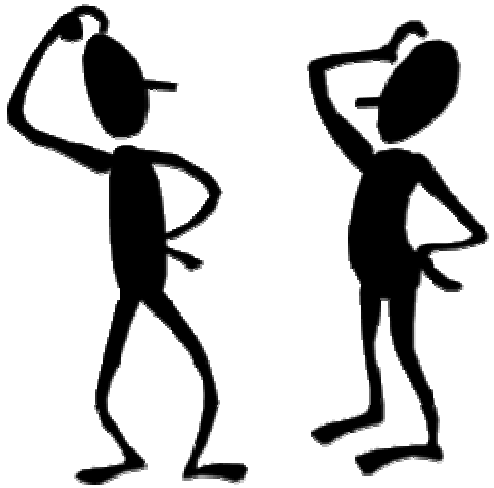
- **Incidence of dental, skeletal and crippling skeletal fluorosis was reported in India with average fluoride concentrations as low as 0.5, 0.7 and 2.8 ppm respectively (Ayoob and Gupta 2006).**

- **The average fluoride concentration for this region was recorded 2.82 mg/l(Suthar et al., 2008).**

- **Fluoride content ranged between 0.01 ppm and 9.35 ppm(Buzalaf et al., 2002).**
- **Fluoride concentrations were blow WHO drinking water standard limits (0.7 – 2.0 mg/l) in the Karaj and Jajrud Rivers respectively (Azimi 2004).**

- **At nationwide level, the portion of extracted groundwater with fluoride concentration lower than the minimum permissible level of 0.5 mg/L, desirable fluoride range of 0.5–1.5 mg/L and elevated fluoride level was 69.2, 29.3 and 1.4%, respectively(Mesdaghinia et al., 2010).**

Discussion & Conclusion



In2012 the Environmental Protection Agency explained that:

The Maximum Contaminant Level Goal (MCLG) and The Maximum Contaminant Level (MCL) for fluoride are 4 mg/l

also Secondary Drinking Water Regulations (SDWR) is 0.2 mg/l.

MCLG	MCL	SDWR
4 mg/l	4 mg/l	0.2 mg/l

(EPA 2012)

in 2008 World Health Organization and in 2009 Institute of Standards & Industrial Research of Iran explained that …

Guideline value (Min and Max) are 0.5 and 1.5 mg/l .The amounts added to drinking-water are such that final concentrations are between 0.5 and 1 mg/l.

WHO 2008 and ISIRI 2009	
Min	**Max**
0.5 mg/l	**1.5 mg/l**

Comparing to standards (MCLG , MCL and SDWR) , National standards of IRAN and according to climatic conditions, proper levels of fluoride were in underground water sources

season	Spring						
(%) Year	2006-7	2007-8	2008-9	2009-10	2010-11	2011-12	Total
Suggested F	0	0	6	0	0	0	0.9
WHO/ISIRI : 0.5 - 1.5	16	5	6	21	5	0	9
SDWR: 0.2	79	89	53	95	58	85	77
MCLG and MCL : 4	0	0	0	0	0	0	0

season	Summer						
(%) Year	2006-7	2007-8	2008-9	2009-10	2010-11	2011-12	Total
Suggested F	16	0	9	10	5	0	6.5
WHO/ISIRI : 0.5 - 1.5	32	0	18	10	38	5	17
SDWR: 0.2	79	70	91	80	86	67	79
MCLG and MCL : 4	0	0	0	0	0	0	0

Fluoride concentration in 12% of the samples in Noshahr city were relevant to SDWR (0.2 ppm) and also 100% (Hundred percent) of the samples were lower than 0.5 ppm.

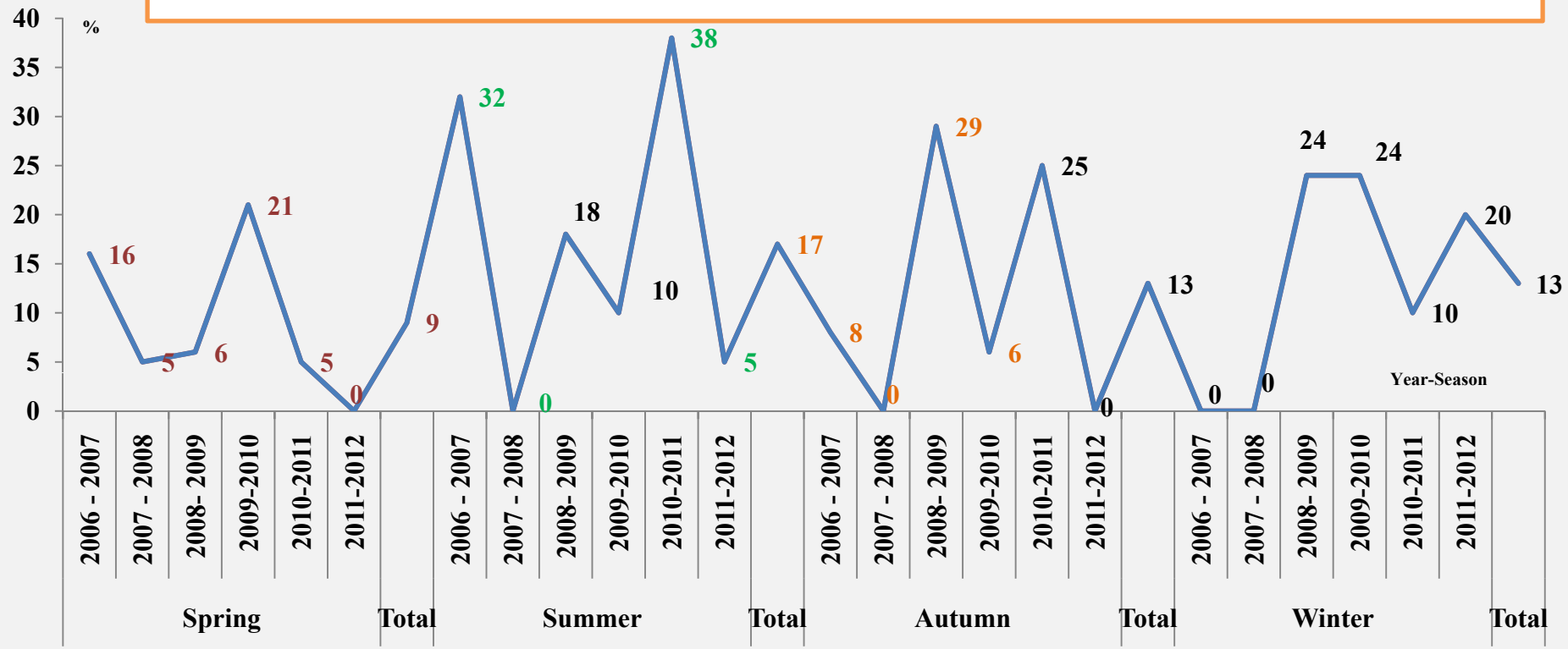
Comparing to standards (MCLG , MCL and SDWR) , National standards of IRAN and according to climatic conditions, proper levels of fluoride were in underground water sources

season	Autumn						
(%) Year	2006-7	2007- 8	2008- 9	2009-10	2010-11	2011-12	Total
Suggested F	0	0	0	0	0	0	0
WHO/ISIRI : 0.5 - 1.5	8	0	29	6	25	0	13
SDWR: 0.2	42	44	100	82	85	65	74
MCLG and MCL : 4	0	0	0	0	0	0	0

season	Winter						
(%) Year	2006-7	2007- 8	2008- 9	2009-10	2010-11	2011-12	Total
Suggested F	0	0	0	0	0	0	0
WHO/ISIRI : 0.5 - 1.5	0	0	24	24	10	20	13
SDWR: 0.2	36	45	65	82	80	80	66
MCLG and MCL : 4	0	0	0	0	0	0	0

Totally : Summer › Autumn = Winter › Spring

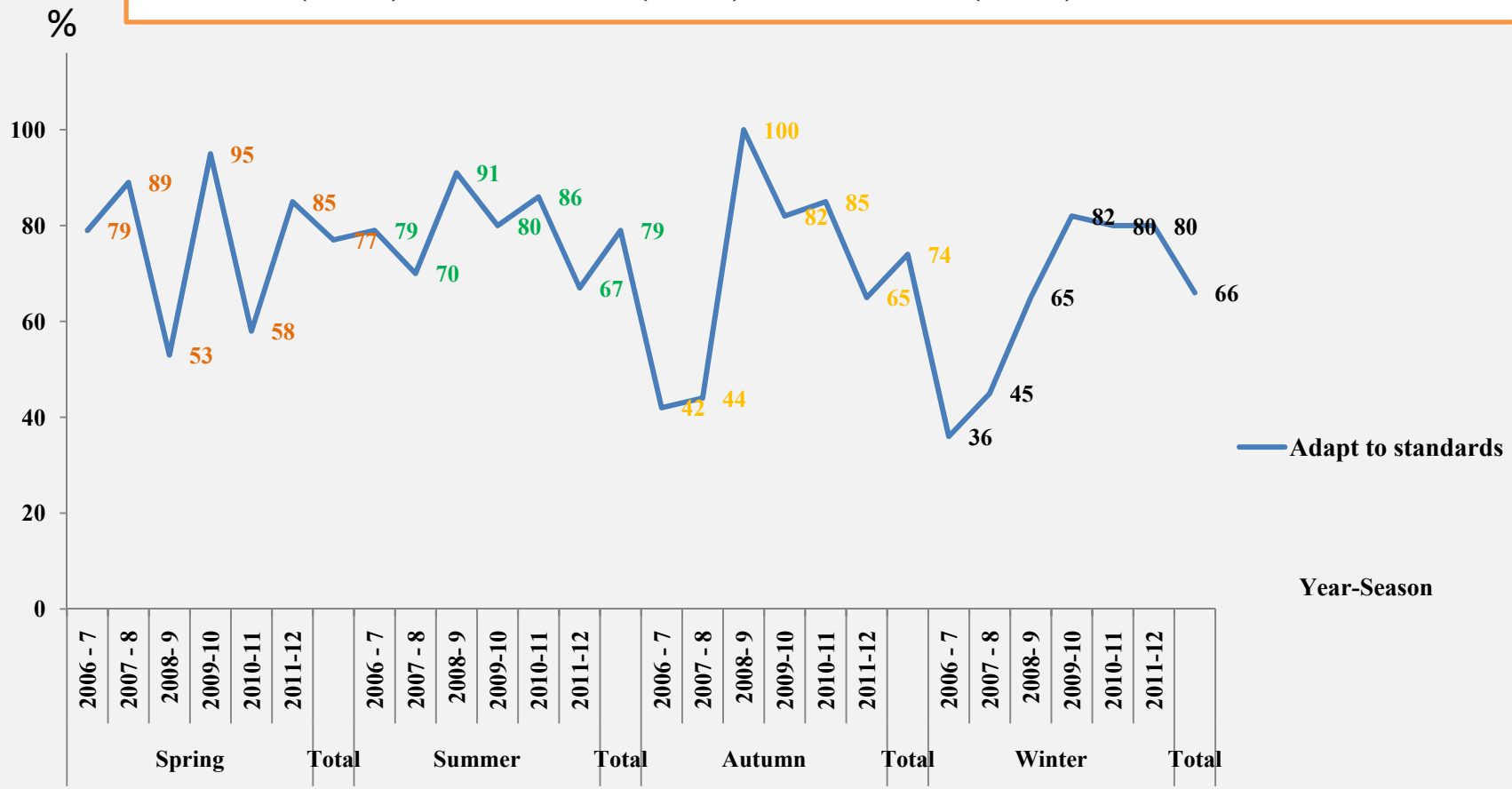
Fluoride concentration were relevant to (WHO / ISIRI = 0.5 - 1.5 ppm) in spring(17%) ,in summer(9%) and in Autumn & Winter(13%) .



Graph of Fluoride concentration inunderground water sources was adapted to standards (WHO / ISIRI = 0.5 - 1.5 ppm)

Totally : Summer › Spring › Autumn › Winter

Fluoride concentration were relevant to (SDWR=0.2 ppm) in spring(77%) ,in summer(79%) ,in Autumn (74%) and Winter(66%) .



Graph of Fluoride concentration inunderground water sources was adapted to standards (SDWR=0.2 ppm)

Comparing to standards (MCLG , MCL and SDWR) , National standards of IRAN and according to climatic conditions, proper levels of fluoride were in Urban water distribution network

season	Spring						
(%) Year	2006-7	2007-8	2008-9	2009-10	2010-11	2011-12	Total
Suggested F	20	0	0	0	0	0	3.2
WHO/ISIRI : 0.5 - 1.5	20	0	0	0	0	0	3.2
SDWR: 0.2	80	100	67	100	71	88	84
MCLG and MCL : 4	0	0	0	0	0	0	0

Which are (0.00 , 0.00 and 77 %) , (9 %) and (0.9 %) respectively in spring.

Comparing to standards (MCLG , MCL and SDWR) , National standards of IRAN and according to climatic conditions, proper levels of fluoride were in Urban water distribution network

season	Summer						
(%) Year	2006-7	2007- 8	2008- 9	2009-10	2010-11	2011-12	Total
Suggested F	20	0	0	13	0	0	5
WHO/ISIRI : 0.5 - 1.5	40	0	20	13	0	11	12.5
SDWR: 0.2	100	67	100	100	100	67	88
MCLG and MCL : 4	0	0	0	0	0	0	0

Respectively (0.00 , 0.00 and 79 %) , (17 %) and (6.5 %) in summer.

Comparing to standards (MCLG , MCL and SDWR) , National standards of IRAN and according to climatic conditions, proper levels of fluoride were in Urban water distribution network

season	Autumn						
(%) Year	2006-7	2007- 8	2008- 9	2009-10	2010-11	2011-12	Total
Suggested F	0	0	0	0	0	0	0
WHO/ISIRI : 0.5 - 1.5	0	0	20	0	33.3	0	8.3
SDWR: 0.2	33.3	40	100	87.5	83.3	66.6	69.4
MCLG and MCL : 4	0	0	0	0	0	0	0

Respectively(0.00 , 0.00 and 74 %) , (13 %) and (0.00 %) in autumn

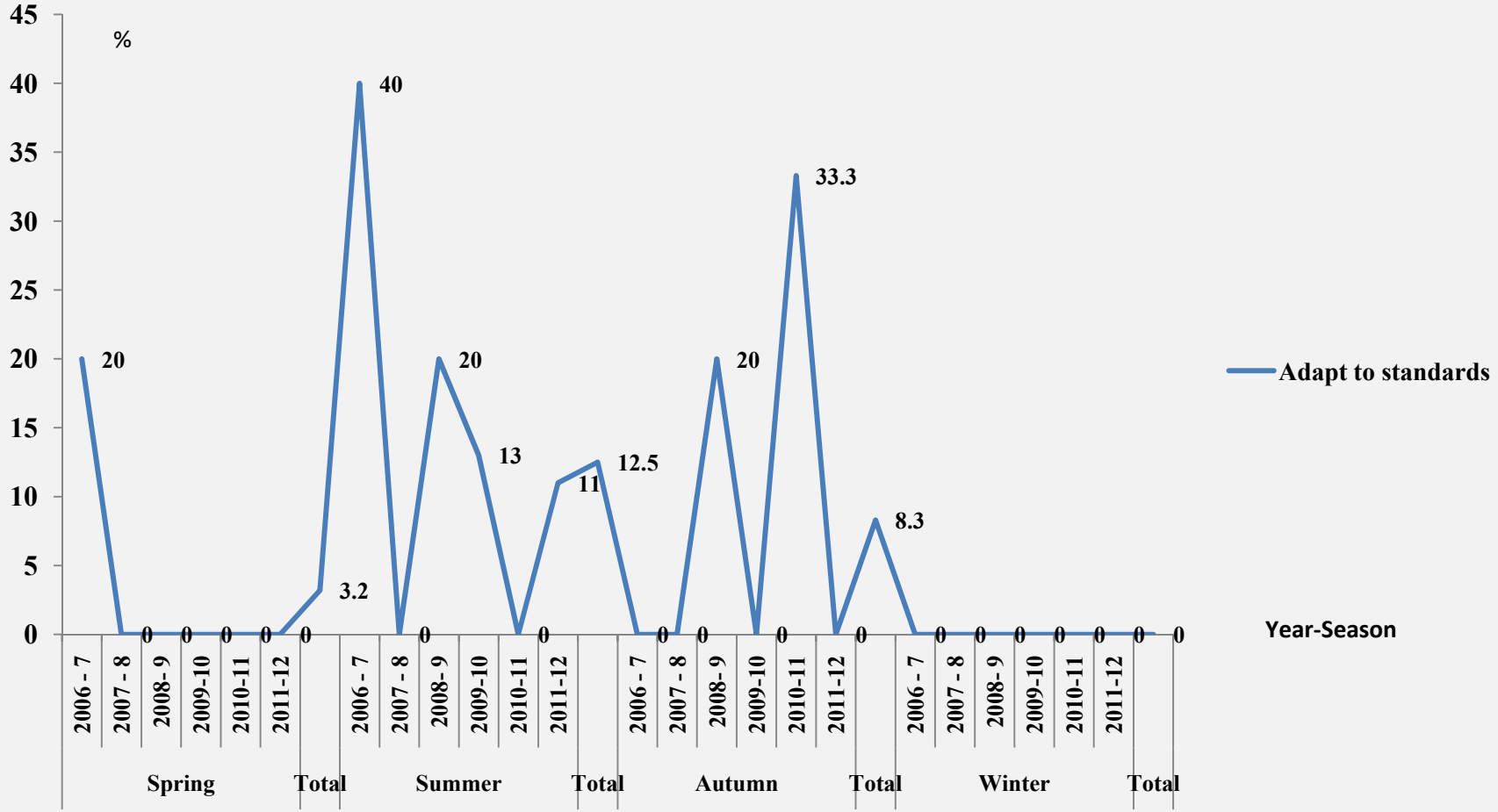
Comparing to standards (MCLG , MCL and SDWR) , National standards of IRAN and according to climatic conditions, proper levels of fluoride were in Urban water distribution network

season	Winter						
(%) Year	2006-7	2007-8	2008-9	2009-10	2010-11	2011-12	Total
Suggested F	0	0	0	0	0	0	0
WHO/ISIRI : 0.5 - 1.5	0	0	0	0	0	0	0
SDWR: 0.2	0	75	100	71.4	71.4	100	73.3
MCLG and MCL : 4	0	0	0	0	0	0	0

Respectively and (0.00 , 0.00 and 66 %) , (13 %) and (0.00 %) in winter.

Totally: Summer › Autumn › Spring ›Winter

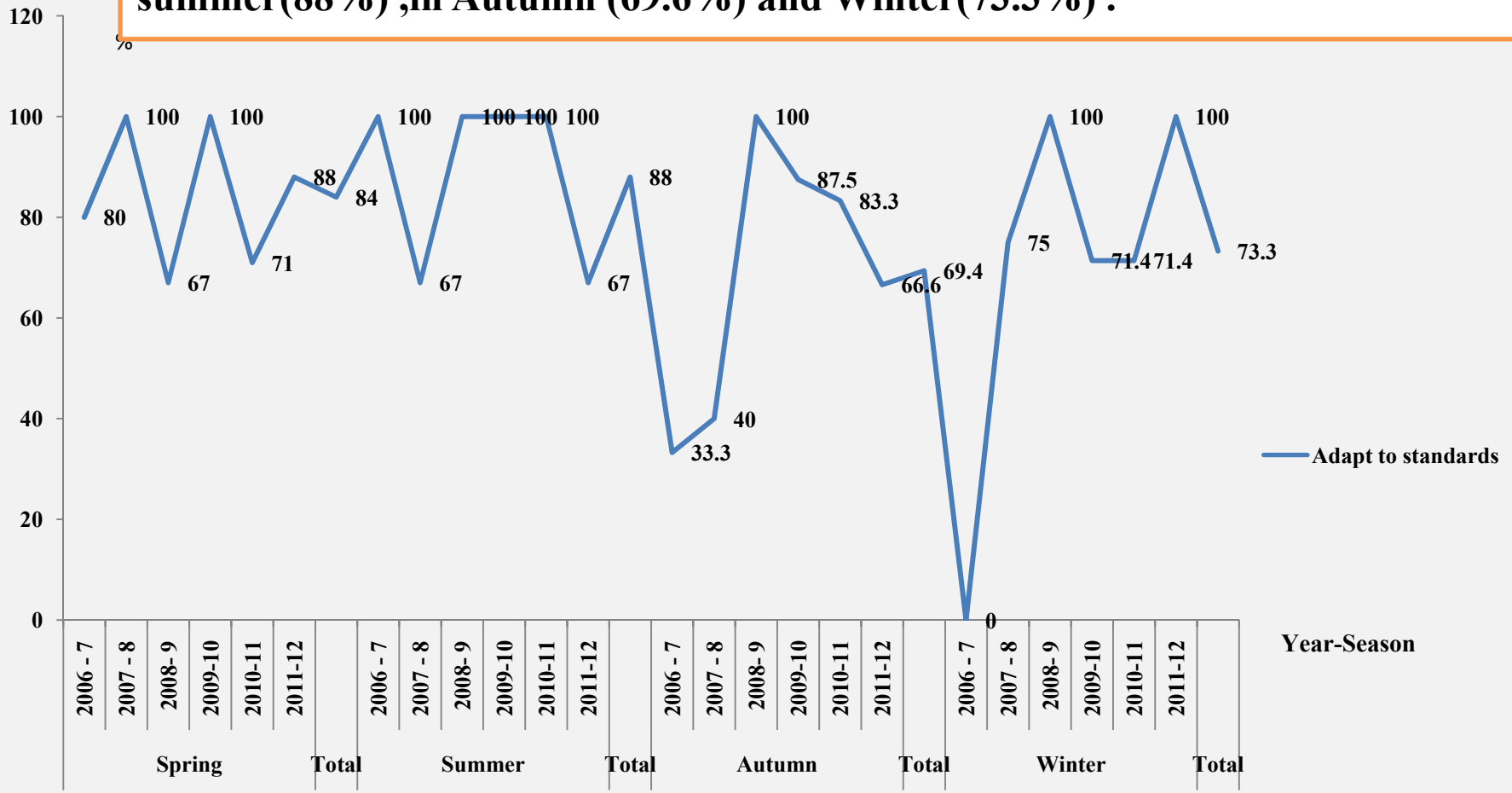
Fluoride concentration were relevant to (SDWR=0.2 ppm) in spring(3.2%) ,in summer(12.5%) ,in Autumn (8.3%) and Winter(0.00%) .



Graph of Fluoride concentration Urban water distribution network was adapted to standards (WHO / ISIRI = 0.5 - 1.5 ppm)

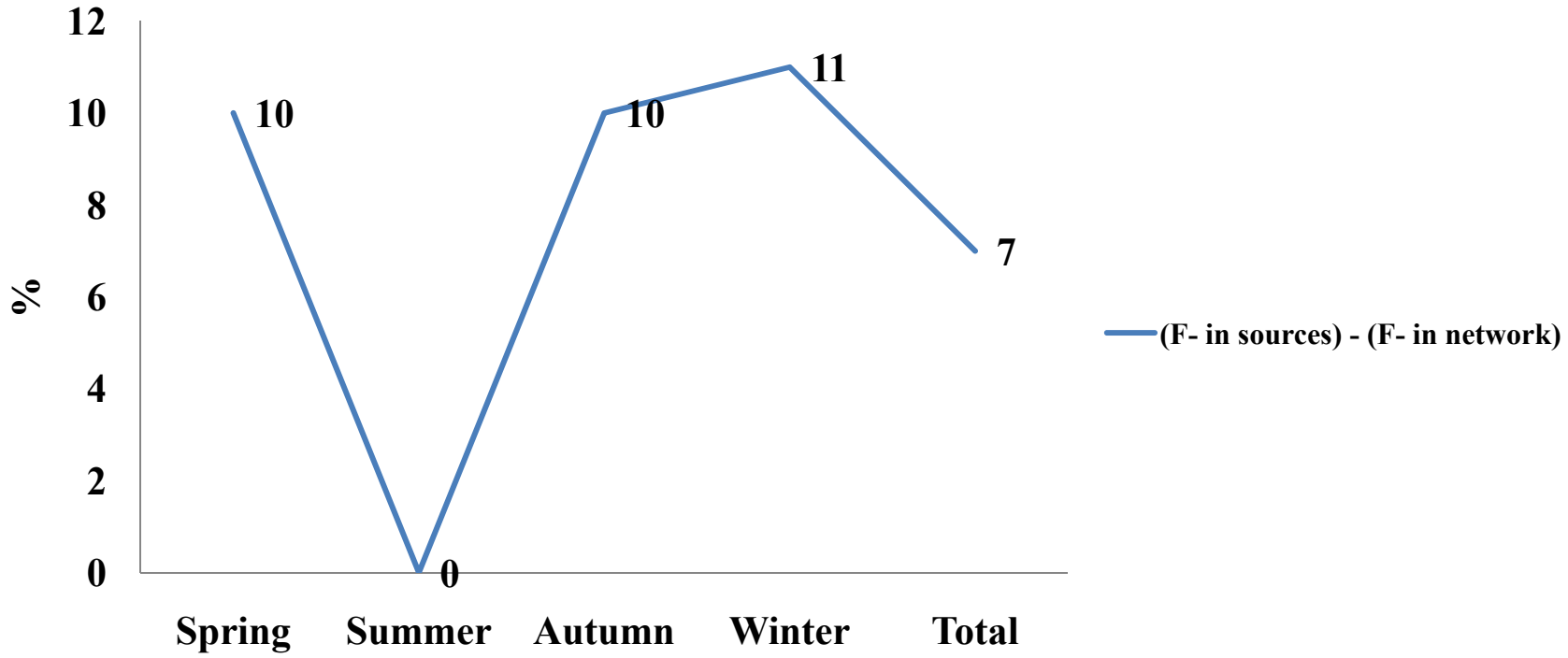
Totally : Summer › Spring › Winter › Autumn

Fluoride concentration were relevant to (SDWR=0.2 ppm) in spring(84%) ,in summer(88%) ,in Autumn (69.6%) and Winter(73.3%) .



Graph of Fluoride concentration Urban water distribution network was adapted to standards (SDWR=0.2 ppm)

The mean difference between the fluoride concentration in underground water sources and Urban water distribution network (%) in Qaemshahr city (2006-2012)



Fluoride concentrations in Urban water distribution network were lower than underground water sources .

The results showed that fluoride concentration in different seasons during these six years and suggested fluoride concentration should be according to average maximum daily temperature in Qaemshahr city for fluoridated water supply system were as follows:

(Summer > Spring > Autumn > Winter)

- **But no significant relation was observed between fluoride concentrations obtained in different seasons and in different years.**

- **According to the results in most cases the Fluoride levels in studied city were lower than universal standards, national and climatic conditions.**
- **It is recommended that adding fluoride to food chain of the studied citizens should be noticed by the relevant authorities.**


Thanks for your attention
Images for photo: Mount Damavand in Northern Iran