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Assessment of the Quality of drinking water sources with reference to Physico-Chemical and Microbiological parameters in the villages of Venkayya-Vayyeru Canal area, W.G.Dt., A.P. India.

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Abstract: Drinking water is a basic requirement for life and a determinant of standard of living. However, besides government efforts, supply and demand side factors of both surface and ground water determine the level of drinking water available to people. A Physico-chemical and of micro biological study in twenty four villages of Venkayya-Vayyeru Canal area has been carried out to assess the quality of drinking water sources. Water samples were collected from Canal, Summer-storage tanks, Treated drinking water and NTR sujala, NGO and R.O waters available in those villages. The samples were analyzed for Turbidity, pH, TDS, EC, Hardness, Alkalinity, DO, BOD, COD, Ammonia, Nitrites, Nitrates, Sodium, Potassium, Chlorides, MPN, TFC, E.Coli etc., are measured as standard APHA methods. The resulted parameters were compared with the drinking water standards of WHO and BIS: 10500. Poor water quality problem has been observed in more number of villages. Inadequate resource management and institutional systems seems to be major causes for present problems.

Introduction:

The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer[9].One should take proper managerial action to use and conserve water from mountains, wells, rivers and also rain water for use in drinking, agriculture and industries (Rig-Veda). The resources of water on earth are limited and are reducing every year. The United Nation has predicted that by the next two decades there will be 17% more demand of water compared to resources available. According to global study by International Food Policy Research Institute (IFPRI), the world is on a path towards rapidly deteriorating water quality in many countries. The first of its kind study indicates that up to 1 in 3 people will be exposed to a high risk of water pollution in 2050 (from increased amounts of N&P) and up to 1 in 5people will be exposed to a high risk of water pollution reflected by increased levels of BOD[6].

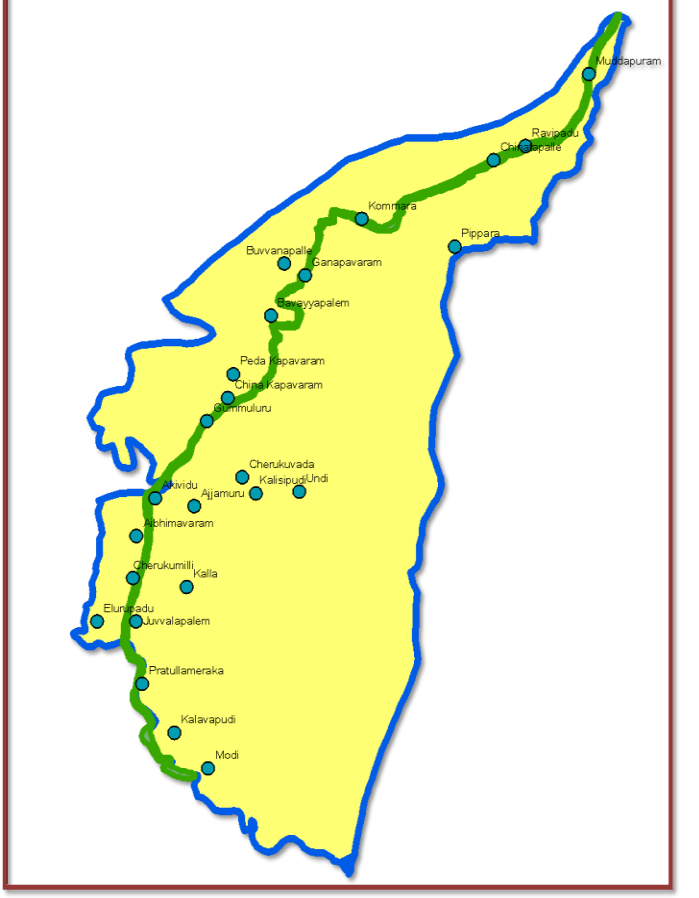
Clean drinking water is a basic human need. Each person on earth at least requires 20-50 liters of clean fresh water a day. Polluted water is not just dirty-it is deadly. Some 1.8 million people die every year of diarrheal diseases like Cholera. Tens of millions of others are seriously sickened by a host of water related ailments- many of which are easily preventable[8]. Efforts to prevent death from diarrhea to reduce the burden of such diseases as Ascaris, Dracunculiasis, Hookworm, Shistosomiasis and Trachoma are doomed to failure unless people have access to safe drinking water. Besides all that has been said above, the most important and dangerous problem faced by some sections of population is pollution of water through industrial pollutants, leakage of sewerage pipes, mixing of groundwater and drainage water in the areas where shallow groundwater conditions exist particularly during rainy season. This mixing of drinking water in shallow bore wells and drainage (sewerage) water is common during rainy season in the areas located along major rivers like Godavari and Krishna, in Canal command areas and Deltaic areas. Most of the villages located in such areas do not have underground drainage and toilets are constructed with local pits. Lack of connectivity of pits and locations of final disposal in far off places causes mixing of drinking water with sewerage flow. In such localities, particularly during rainy season, several diseases like diarrhea, jaundice will affect the population. Priority should be given to schemes dealing with sanitation and water[2].

Study Area:

West Godavari is one of the 13 districts of Andhra Pradesh, India. West Godavari district occupies an area approximately 7700 square kilometers. It has 46 mandals; out of which 20 are in Upland and the rest in Deltaic region. The delta region is abundant with water sources and so agriculture and aquaculture and industries based on these two are thriving well in this region. The water samples are collected from 24 villages namely- Muddapuram, Ravipadu, Pippara, Chintapalli, Jallikommara, Bhuvanapalli, Ganapavaram, Bavayyapalem, Peddakapavaram, Chinakapavaram, Gummuluru, Undi,

Akiveedu, Kalisipudi, Cherukuvada, Ajjamuru, Ayi-Bhimavaram, Cherukumilli, Juvvalapalem, Elurupadu,Pathellameraka, Kalavapudi,Modi and Kalla.

Figure 1 .Villages Of Venkayya Vayyeru Canal Area, West Godavari, A.P.



Results and Discussion:

Turbidity: Turbidity is the cloudiness of water caused by a variety of particles and is another key parameter in drinking water analysis. It is also related to the content of diseases causing organisms in water, which may come from soil runoff. The values vary from 0.6 to 14.4 with an average of 6.8 in canal water.

pH: This is a measure of the intensity of the alkaline or acid condition of water. It is the way of expressing "Hydrogen ion concentration". pH varies from 8.0 to 8.8 with an average of 8.3 where as the standard value is in between 6.5 to 8.5. In four places Ganapavaram, Bavayyapalem, Peddakapavaram and Chinakapavaram the pH values are slightly more than 8.5. In other 20 villages the values are within the range.

Total Dissolved Solids (TDS):

TDS is composed mainly of Carbonates, Bicarbonates, Chlorides, Phosphates and Nitrates of calcium, magnesium, sodium, potassium, manganese. In addition to that organic matter and other salts may also contribute to TDS. The TDS values vary from 130ppm to 840ppm with an average of 298.2ppm.The desirable range of TDS is between 150 to 500ppm. Although majority of the villages have the values within the range, in Kalavapudi, Prathellameraka and Elurupadu the TDS values are more than 500ppm.However the values are higher (even though within the range) in Gummuluru, Akiveedu, Juvvalapalem, Cherukumilli, Chinnakapavaram, Ayi-Bhimavaram etc., may be due to the back waters from the Bay of Bengal through Upputeru which is nearer to these villages.

Electrical Conductivity (EC):

The conductivity of water is an expression of its ability to conduct an electric current. As this property is related to the ionic content of the sample which is in turn a function of the dissolved (ionisable) solids concentration, the relevance of easily performed conductivity measurements is apparent. For many surface waters the following approximation will apply: Conductivity (µS/cm) x 2/3 = Total Dissolved Solids (mg/l). The TDS and EC values well obeyed this equation.

Total Hardness (TH):

Total hardness of water is characterized by content of Calcium and Magnesium salts[5]. It is the total of Calcium hardness and Magnesium hardness.

Calcium Hardness:

High levels may be beneficial and waters which are rich in Calcium are very palatable. This element is the most important and abundant in the human body and an adequate intake is essential for normal growth and health. The maximum daily requirement is of the order of 1 - 2 grams and comes especially from dairy products.

Table 1: Physico-chemical and Biological analysis of Venkayya-Vayyeru Canal water

S. N	Village	PH	TDS	EC	TH	TA
1.	Muddapuram	8.1	120	180	75	92
2.	Ravipadu	8.2	130	200	80	92
3.	Pippara	8.5	140	200	130	124
4.	Chintapalli	8.3	140	200	75	76
5.	Jallikommara	8.2	200	300	95	96
6.	Bhuvanapalli	8.3	210	310	125	100
7.	Ganapavaram	8.8	230	320	105	156
8.	Bavayyapalem	8.8	290	430	125	116
9.	Peddakapavaram	8.6	240	350	60	120
10.	Chinnakapavaram	8.6	320	470	140	128
11.	Gummuluru	8.4	490	720	220	152
12.	Undi	8.4	140	210	50	60
13.	Akiveedu	8.0	340	470	40	132
14.	Kalisipudi	8.1	140	210	65	75
15.	Cherukuwada	8.3	130	200	65	75
16.	Ajjaram	8.0	130	200	75	85
17.	Ayi-Bhimavaram	8.0	320	490	70	140
18.	Cherukumilli	8.2	350	480	45	152
19.	Juvvalapalem	8.1	380	550	100	164
20.	Elurupadu	8.2	600	850	115	220
21.	Prathalameraka	8.2	840	1200	145	224
22.	Kalavapudi	8.5	720	1460	135	220
23.	Kalla	8.1	260	390	170	110
Averages		**8.3**	**298.2**	**422.1**	**100.2**	**116.9**

TURB	NH_3	NO_2	NO_3	DO	BOD	COD
0.6	0.0	0.0	26.4	7.4	3.6	9.6
2.8	0.7	0.0	22.1	6.4	3.6	19.2
3.4	0.01	0.02	2.76	5.8	2.5	6.8
4.3	0.5	0.0	23.4	6.6	3.6	48.0
5.7	0.5	0.0	21.3	6.6	3.6	22.4
4.8	0.5	0.1	18.6	6.2	2.4	41.6
7.7	0.5	0.3	15.4	5.0	6.0	9.6
9.0	0.6	0.0	7.8	5.6	6.0	19.2
10.2	0.7	0.1	18.6	6.8	3.6	16.2
11.2	0.3	0.0	9.4	7.8	1.4	3.2
3.1	0.8	0.7	8.8	7.4	2.4	5.6
11.2	0.5	0.1	4.5	5.8	4.2	9.0
3.0	0.23	0.02	2.48	4.4	3.6	19.2
12.1	0.6	0.0	4.2	5.2	4.6	11.5
8.5	0.5	0.1	3.9	5.4	2.4	8.2
9.5	0.3	0.2	4.5	4.6	3.5	9.6
1.3	0.43	0.06	2.99	4.8	3.6	20.2
8.0	0.35	0.01	2.41	3.8	2.4	10.5
2.1	0.36	0.02	3.17	4.2	2.4	12.6
1.0	0.63	0.08	3.96	4.8	3.6	9.6
14.4	0.83	0.05	4.52	5.8	3.6	15.6
10.8	0.87	0.27	4.65	5.6	4.8	12.6
11.8	0.04	0.04	1.42	5.5	2.7	8.5
6.8	**0.46**	**0.09**	**9.4**	**5.7**	**3.4**	**15.15**

Magnesium Hardness: Magnesium is also an essential element of the body particularly for cardiovascular functions. Hardness values vary from 40ppm to 145ppm with an average of 100ppm. The maximum permissible value of hardness for drinking water is 300ppm and all the water samples are below that level.

Chlorides:

Chloride exists in all natural waters, the concentrations varying very widely and reaching a maximum in sea water (up to 35,000 mg/l Cl). In fresh waters the sources include soil and rock formations, sea spray and waste discharges. Sewage contains large amounts of chloride, as do some industrial effluents. At levels above 250 mg/l Cl water will begin to taste salty and will become increasingly objectionable as the concentration rises further.

In the present study the chloride values varies from 17.7 ppm to 383ppm with an average of 120.6ppm. In three villages Gummuluru, Prathellameraka and Kalavapudi the Chloride values are more than 250 ppm due to sea water contamination.

Table 2: Summer storage tanks in the villages of along Venkayya- Vayyeru canal

S.No	Village	pH	TDS	EC	TH	TA	TURB	NH_3
1.	Muddapuram	8.3	150	230	140	208	21.6	0.3
2.	Ravipadu	7.9	160	230	80	100	3.8	0.5
3.	Pippara	8.6	160	250	115	155	9.2	0.01
4.	Chintapalli	8.2	190	280	100	116	2.0	0.5
5.	Jallikommara	8.4	210	310	100	112	8.5	0.5
6.	Bhuvanapalli	8.1	320	470	75	140	8.9	0.5
7.	Ganapavaraman	8.9	310	450	135	136	12.1	0.5
8.	Bavayyapalem	8.8	410	610	165	168	2.3	0.4
9.	Pedakapavaram	8.5	490	730	205	92	10.6	0.5
10.	Chinnakapavaram	8.6	410	610	190	148	5.8	0.6
11.	Gummuluru	8.5	460	700	175	192	2.0	0.0
12.	Undi	8.1	170	250	40	125	18.8	0.37
13.	Akiveedu	8.4	450	650	90	216	1.0	0.81
14.	Kalisipudi	8.3	190	280	50	140	1.8	0.14
15.	Cherukuvada	7.9	230	330	55	145	1.7	0.18
16.	Ajjaram	8.2	400	580	80	170	0.3	0.13
17.	Ayi-Bhimavaram	8.3	460	660	90	192	6.0	0.26
18.	Cherukumilli	8.5	410	590	75	188	1.9	0.38
19.	Juvvalapalem	8.3	560	810	95	196	0.7	0.64
20.	Elurupadu	8.2	600	850	75	176	0.7	0.47
21.	Prathellameraka	8.5	510	750	95	224	6.8	0.80
22.	Kalavapudi	8.3	740	1080	100	188	6.0	0.83
23.	Modi	8.3	770	1220	135	188	1.0	0.38
24.	Kalla	9.7	340	490	170	140	12.9	0.04
	Averages	**8.4**	**379**	**503**	**102**	**106.6**	**6.1**	**0.4**

Nitrates:

Relatively little of the nitrate found in natural waters is of mineral origin; most of the nitrates are coming from organic and inorganic sources, the former including waste discharges and the latter comprising chiefly artificial fertilizers. However, bacterial oxidation and fixing of nitrogen by plants can both produce nitrates. Interest is centered on nitrate concentrations for various reasons. Rivers with high levels of nitrate are more likely to indicate significant run-off from agricultural land than anything else. Nitrate levels in the study area are ranged from 2.67 to 26.4 ppm well within the range of standard value 45ppm.

In summer storage tanks where water is stored for treatment purpose, the pH values vary from7.9 to 9.7 with an average of 8.4. Whereas TDS values varies from 150 to 770ppm with an average of 379ppm and same trend observed in EC values. Hardness values vary from 40 to 170 ppm with an average of 102 ppm. Alkalinity values in storage tanks varied from 92 to 224ppm with an average of 160.6 ppm. Sodium values vary from 26ppm to 116ppm, whereas chloride values vary from minimum 35.4 to maximum 266.8ppm with an average of 134.13ppm. DO values vary from 2.4 to 7.5 ppm with an average of 6.2ppm? BOD values vary from 1.2 to 19.2ppm with an average of 4.5ppm, whereas COD values vary from 3.2 to 64 ppm with an average of 17.5ppm. Nitrates ranges from 1.42 to 24.2 ppm with an average of 7.95 ppm.

pH values of treated water varied from 8.1 to 8.9 with an average of 8.7 which is higher than canal water and summer storage water. The pH values have crossed the limit of 8.5 in Pippara, Ganapavaram, Bavayyapalem, Peddakapavaram, Chinnakapavaram and Juvvalapalem. TDS values vary from 60 to 1000ppm with an average of 340ppm.The TDS value has crossed 500ppm mark in Peddakapavaram, Prathellameraka and Modi.TDS average value of treated water is higher than canal water by 42ppm, but lower than summer storage tank by 39ppm.The same is reflected in EC values. Total hardness and alkalinity values are more or less remains same with summer storage tanks.

When the average values of various sources of water are taken the following facts were noticed. The pH value of Canal, S.S.Tank, P.T.W and NGO (Without R.O) ranged from 255-379ppm which is within the range of required standard (150-500ppm) whereas in case of NGO. with R.O. processed water is very low (45ppm), EC values are also based on TDS values, Hardness values ranges from 81 to109ppm without R.O. and it is just 12.5 ppm with R.O. processed waters. Total alkalinity also ranges from 95.4 to 153ppm without R.O. and it is only 35.4 ppm in the case of R.O. waters. Sodium ranges 53.9 to 67.8 ppm without R.O. and it is 19.8 ppm with R.O.process. Chlorides range from 91.7 to 134.3 ppm without R.O. and it is 21ppm with R.O. waters. In total R.O. processed waters have very low values of minerals when compared to other types of processed or unprocessed water. According to F.Kojisek, water with less mineral content is not good for drinking[7].

Microbiological Quality of Drinking Water:

The presence of Total Coli form bacteria in water is measured in the form of MPN index. i.e. Most Probable Number in 100 ml water sample. Coli form bacteria naturally present in the gastro intestinal tract of human and animals. The presence of Coli form bacteria in water indicate that, water has been contaminated with fecal matter of human and other animals. Presence of E.Coli in water indicates recent fecal contamination and may indicate the possible presence of disease causing pathogens such as bacteria, virus and other parasites. MPN index and E-Coli in drinking water are used as indicators to measure the degree of pollution and sanitary quality of drinking water.

If microbiological values of Panchayat treated water are observed only one sample out of 24 villages is observed to be good and safe for drinking; and another 6 samples may be suitable with proper disinfection; whereas 17 samples are not at all suitable for drinking purpose, that reflects the negligence in the treatment process. In case of NGO supplied (NTR sujala /NGO/R.O) waters 2 out of 20 are found to be safe and suitable for drinking, and another 3 samples may be fit for drinking with a better disinfection process, whereas 15 out of 20 are not at all suitable for drinking. So, the quality of Panchayat treated water and NGO treated water are more or less same and in majority of villages people are not getting proper potable water.

CFU values

0/100ml—No risk

1-10ml/100 ml---low risk disinfection needed

11-100 ml/100ml--- high risk suitable

101-1000 ml/100 ml----- Very high risk

MPN Values

5% No risk

20% proper

75% not

Category	MPN/100ml	Water quality
A	0	Good- safe for drinking
B	<50	Not good- applicable to disinfection treatment
C	>50	Polluted- requires stringent methods of treatment

Table 3: Panchayat Treated drinking water: Physico-Chemical parameters

S.No	Village	pH	TDS	EC	TH	TA
1.	Muddapuram	8.5	150	220	115	100
2.	Ravipadu	8.3	170	250	65	112
3.	Pippara	8.7	170	260	135	155
4.	Chintapalli	8.4	230	310	115	128
5.	Jallikommara	8.3	240	340	110	108
6.	Bhuvanapalli	8.4	340	490	120	140
7.	Ganapavaram	8.9	300	450	205	144
8.	Bavayyapalem	8.7	420	620	175	232
9.	Peddakapavaram	8.6	530	780	225	144
10.	Chinnakapavaram	8.6	410	600	190	188
11.	Gummuluru	8.5	460	680	170	176
12.	Undi	8.4	190	270	50	110
13.	Akiveedu	8.4	390	550	85	190
14.	Kalisipudi	8.2	170	250	45	170
15.	Cherukuvada	8.1	280	400	70	180
16.	Ajjaram	8.4	400	580	75	170
17.	Ayi-Bhimavaram	8.2	60	80	20	45
18.	Cherukumilli	8. 2	400	580	75	188
19.	Juvvalapalem	8.7	480	700	90	188
20.	Elurupadu	8.2	400	580	85	188
21.	Prathellameraka	8.3	560	790	110	212
22.	Kalavapudi	8.2	80	110	10	28
23.	Modi	8.4	1000	1460	135	196
24.	Kalla	8.3	350	510	155	190
	Average	**8.7**	**340**	**494**	**109**	**153**

TURB	NH_3	NO_2	NO_3	DO	BOD	COD	Na	k	cl
2.8	0.02	0.0	32.8	6.4	4.4	16	28	1	85
1.4	0.0	0.0	24.2	5.6	1.4	3.2	37	2	170.1
9.2	0.01	0.0	3.04	5.0	4.0	12	39	5	35.45
6.4	0.5	0.0	11.3	6.4	1.2	3.6	46	3	112.7
6.3	0.5	0.1	13.2	6.8	1.2	5.6	53	4	115.9
0.3	0.5	0.1	21.7	6.6	2.4	22.4	77	4	184.3
4.7	0.1	0.0	12.7	7.6	1.2	3.2	59	8	127.6
0.9	0.1	0.0	18.6	6.4	1.2	9.6	84	5	184.3
0.6	0.0	0.0	10.6	7.4	1.2	6.4	93	5	212.7
0.6	0.0	0.0	5.5	6.6	1.2	6.4	80	3	155.9
0.2	0.0	0.1	7.7	7.6	1.2	9.6	82	3	155.9
0.1	0.0	0.0	4.32	7.0	1.2	6.4	35	9	38.99
0.3	0.06	0.01	2.71	6.0	2.4	9.6	73	3	35.0
3.6	0.21	0.02	1.98	4.8	6	20	32	3	31.9
0.2	0.13	0.01	1.52	7.8	4.8	16.4	54	5	56.72
0.1	0.17	0.0	3.67	6.4	3.6	12	75	4	120.53
0.2	0.04	0.00	0.10	5.8	1.2	8	32	0	43
0.7	0.30	0.03	2.38	4.6	1.2	9	79	8	117
1.0	0.28	0.01	2.55	4.6	2.4	12	91	3	156

NO_2	NO_3	DO	BOD	COD	Na	k	Cl
0.0	18.8	6.8	6.0	18.4	26	1	70.9
0.0	23.7	6.8	4.4	48.0	33	2	70.9
0.02	2.75	5.8	4.8	12.8	40	6	35.4
0.2	24.2	6.4	1.2	3.2	42	3	141.8
0.0	11.4	7.2	6.0	13.2	49	4	155.9
0.1	24.1	6.6	3.6	19.2	76	4	127.6
0.2	12.6	6.8	3.6	12.8	57	8	141.6
0.0	8.5	7.0	3.6	25.6	83	5	141.8
0.0	6.3	6.8	2.4	19.2	87	3	198.5
0.1	12.2	6.6	1.2	9.6	80	4	184.3
0.2	7.8	6.8	1.2	6.4	82	2	266.8
0.07	4.33	6.8	7.2	22.0	30	7	35.45
0.0	3.13	6.6	4.8	12.6	74	5	128
0.01	2.12	6.2	6.0	20.4	34	3	35.45
0.03	2.42	2.4	6.0	24.6	39	3	49.63
0.01	3.51	6.4	7.2	28.4	79	5	120.5
0.0	2.51	5.2	3.6	18.2	75	2	131
0.0	3.21	6.8	4.0	16.6	72	6	121
0.0	3.13	6.4	19.2	64.0	97	4	177
0.0	2.43	6.6	2.0	8.0	76	4	124
0.02	4.13	5.4	2.5	18.6	90	8	156
0.05	3.93	4.4	1.2	9.8	116	8	262
0.03	2.39	5.8	4.0	18.6	115	9	255
0.0	1.42	7.5	4.2	22.4	75	5	88.62
0.04	**7.95**	**6.2**	**4.5**	**17.5**	**67.8**	**4.6**	**134.13**

1.5	0.11	0.01	2.18	6.4	1.2	6	64	5	121
1.1	0.08	0.01	3.72	5.8	1.5	8	91	5	177
0.2	0.00	0.08	1.73	7.4	1.2	6.4	30	0	46
0.4	0.2	0.0	3.9	6.6	1.6	8.8	13	9	37
	6	1	0				4		6
1.1	0.05	0.0	1.55	6.0	1.2	4.6	75	12	85.08

References:

1. Drinking water in Gram Panchayats: Ministry of Panchayati Raj, Government of India. 2014.
2. Water Treatment Process: Drinking Water: United States Environment Protection Agency (EPA).2002.
3. Treating the public water supply: What is in your water, and How Is It made safe to Drink? Inorganic Reactions Experiment: Rachel Casiday,Greg Noelken and Regina Fray.2008.pp 1-18.
4. APHA, Clescerl, Leonore S (Editor), Greenberg, Arnold E (Editor), Eaton, Andrew D. (Editor), "Standard Methods for the Examination of water and Waste water" (20th ed.)American Public Health Association). Washington. DC 2008.
5. The Health Risks from Drinking Demineralized Water, WHO (1980): F.Kojisek.
6. The challenges of sustainable access to safe drinking water in rural areas of developing countries: Case of Zawtan El-charkieh, Southern Lebonon: Massoud, Al-Abady,Jurdi M, Nuwayhid I., J.Environ Health, 72(10)2010:24-30.
7. Water Quality: An Ignored global Crisis: Cecilia Jortajada and Asit K. Biswas; Newyork Times, 2013.
8. Rural water supply and sanitation problems; Incudible India, Joydeep 2014. pp 1-9.
9. Meeting the MDG Drinking Water and Sanitation Target. The Urban and Rural challenges are the Dicade WHO, Unicef 2006.

BIOGRAPHIES

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