Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

European Journal of Experimental Biology, 2011, 1 (1):

Analysis of Chloride, Sodium and Potassium in Groundwater Samples of Nanded City in Mahabharata, India

[1]Sayyed Juned A. and [2]Bhosle Arjun B.

Department of Environmental Science, School of Earth Sciences, S.R.T.M.University, Nanded, India

---

ABSTRACT

Ground water quality study was carried out in the Nanded city area, Marathwada. The objective of this study is to identify the quality of ground water where ground water is used for domestic and agriculture purposes. Seventy groundwater samples were collected in the pre and post monsoon month of January 2010 from different bore wells samples and were analysed for Cl, Na, and K. This study reveals that the agriculture activities, geological formation and local environmental conditions control the groundwater quality. The groundwater in this area is mostly moderately hard. Groundwater suitability for domestic industrial and irrigation purposes were examined using WHO, Indian standards classification, which indicate that groundwater in a few sampling sites, were unsuitable for domestic purpose and irrigation.

Keywords: Water quality, Groundwater, Chloride, Sodium, Potassium.

INTRODUCTION

Water is an essential component of the environment and it sustains life on the earth. Human beings depend on water for their survival. Water is also a raw material for photosynthesis and therefore, is important for crop production. Obviously, an optimum agricultural production depends on water and soil quality [9].

In Nanded, the ground water is considered the Second water source for irrigation and other human routine uses after the river Godavari, and irrigation canals and drains. Thus, the ground water is considered as a secondary source to irrigate some agricultural areas in the Nanded region and as an essential source for some cultivated lands to which the Godavari water is not reachable.

Approximately 75% of the inhabitants use the public water supply; the rest obtain their water from shallow drilled or dug wells. During the last 15 years the water consumption has reduced by more than a half and is currently 50 million m^3 per year [3].

The usage of groundwater has increased substantially in Nanded city of Marathwada, India. Hence, it is necessary to undergo for quality analysis of groundwater in order to assess its suitability for consumption, irrigation and industrial activities. An appropriate assessment of the suitability of groundwater for domestic water supplies requires the concentrations of some important parameters like K, Na and Cl.

The pollution of groundwater is of major concern, firstly because of increasing utilization for human needs and secondly because of the ill effects of the increased industrial activity. The groundwater is believed to be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and created health problems [1]

Sodium and chloride occur naturally in groundwater. However, sources such as road salt storage and application, industrial wastes, sewage, fertilizers, water softener discharge, and proximity to saltwater are usually the cause of elevated levels in drinking water supplies. This can be a concern for people on low-sodium diets. Elevated levels of sodium and chloride can also interfere with taste, the watering of certain plants, and increase the corrosivity of water, which in turn can affect the household plumbing.

Studies of variations in major ions help to identify the chemical processes and interaction between soil and water that are responsible for the changes in groundwater quality with respect to space and time. He reported on the importance of groundwater recharge on seasonal variation in the major-ion concentration of groundwater [5].

Anthropogenic activities like explosion of population, industrial growth, inputs of fertilizer, pesticides, and irrigation has been a crucial factor for determining the quality of groundwater. Numerous publications have reported that urban development and agricultural activities directly or indirectly affect the groundwater quality [15, 16, 17, 18, 19, 20].

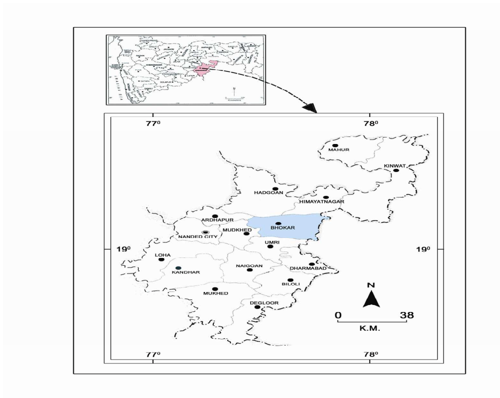
Groundwater chemistry, in turn, depends on a number of factors, such as general geology, degree of chemical weathering of the various rock types, quality of recharge water and inputs from sources other than water rock interaction. Such factors and their interactions result in a complex groundwater quality [6, 7, 8].

Sodium in our diets results mainly from eating table salt found within many food products. Sodium in drinking water normally presents no health risks, as about 99 percent of the daily salt intake is from food and only about one percent from water. However, elevated sodium in well water may be considered a health concern for those on a salt restricted diet. Individuals on a low sodium diet due to a high blood pressure or other medical problems are often restricted to water containing less than 20 milligrams per liter of sodium.

Consult your physician if your drinking water exceeds such a level. All ion exchange treatment systems using sodium chloride water softeners will increase the amount of sodium in water. If this type of treatment system is installed in the home, arrange to test the treated tap

Chloride is often associated with sodium since sodium chloride is a common constituent of some water sources, especially well water. Levels above 140 ppm are considered to be toxic for plants [10]. However, a value of 600 mg/l has been set as the tolerance limit for irrigation water [11].

Study area:
The study area is located between 15°13'53" to 15°14'10" East and longitude and 4°15'7.2" to 4°15'28.8" South latitude (Figure 1).Temperature varies from 18°C to 24°C in rainy season, while it is between 25°C and 42°C in dry season. The mean annual rainfall is 1150 mm.



Map-1 Location of Maharashatra state in India and city Show to Nanded city in Maharashatra state

Map-2 Location of Sampling Show in Nanded

MATERIALS AND METHODS

The groundwater samples were collected from 70 bore wells in selected stations of Nanded region. The samples were collected as per the standard methods recommended by APHA [2]. Before water sampling, all the double-stoppered polythene containers were cleaned and rinsed thoroughly with water samples to be analyzed. The chemical analysis was done using the standard methods.

In case, where the investigation does not take into account the changes in groundwater quality, the key constituents determined in a large number of samples collected over the entire area is utilized to determine the water quality of the study area. Selection of samples for comprehensive analysis can be fixed. If the key constituents are not known at the beginning, the water quality pattern is arrived at, by first making a comprehensive analysis and thus partial analysis at other site

Sample collection and analysis:
Seventy samples study area (Figure1). The samples were analyzed for different parameters as Cl^- and Na, K^+following standards methods of APHA [2] The groundwater samples are collected in the pre and post monsoons sample season in the year of 2010 from the sampling, all the

polyethylene bottles were cleaned and rinsed thoroughly with water to be analyzed. All reagents used were of analytical grade. Samples were unfiltered and the concentration of the different parameters could correspond to the total concentration if the groundwater was used by the consumers for drinking. Sodium (Na) and Potassium (K^+) were determined by flame photometer, Chloride (Cl^-) was determined using standard AgNO3 titration.

RESULTS AND DISCUSSION

Water naturally contains number of different dissolved inorganic constituents. The major cations are sodium, and potassium and the anions are chloride permissible limit in most of the groundwater, higher concentration observed during post monsoon and low in pre monsoon season. Sodium and potassium concentration is below the permissible limit, higher concentration of sodium and potassium was observed in post monsoon compared to pre monsoon and , the increasing sodium in to groundwater is likely due to leaching of soaps influence and study area near to agriculture area to use of fertilizer.

Potassium concentration in to groundwater all groundwater samples coming under permissible limit, The sources of potassium is likely due to silicate minerals, orthoclase, microcline, hornblende, muscovite and biotite in igneous and metamorphic rocks and evaporate deposits gypsum and sulphate release considerable amount of potassium in to groundwater. Main reason increasing potassium into groundwater due to agricultural activities.

Chloride concentration exceeding permissible limit except some groundwater samples, the increasing chloride in to groundwater is likely to salt pan deposits agricultural return flow in to groundwater, this are main reason for increasing of chloride in groundwater. Table-1 shows that some of the parameters are within the limit as per the BIS standards [14].

Sample No	Sample Name	Chloride		Sodium		Potassium	
		PRM	POM	PRM	POM	PRM	POM
1.	GWS_1	153.1	170.4	9.2	11.9	0.4	0.4
2.	GWS_2	315.4	327.6	24	28.7	0.4	0.4
3.	GWS_3	200.5	227.2	9.2	13.2	0.3	0.3
4.	GWS_4	111.5	142	8.5	11.5	0.2	0.2
5.	GWS_5	136.6	156.2	15.5	15.5	0.4	0.4
6.	GWS_6	150.9	170.4	11.6	14.6	0.2	0.2
7.	GWS_7	187	213	15.7	19	0.1	0.1
8.	GWS_8	212.9	241.4	10.8	13.1	0.3	0.3
9.	GWS_9	117.2	127.8	3.5	4.1	0.2	0.2
10.	GWS_{10}	268.5	298.8	12.4	14.8	0.1	0.1
11.	GWS_{11}	262.9	312.4	20.2	23.7	0.4	0.4
12.	GWS_{12}	310.8	340.2	17.7	22.3	0.6	0.6
13.	GWS_{13}	215.9	255.6	15.8	19.2	0.3	0.3
14.	GWS_{14}	151.2	184.6	8	13.6	1.3	1.3
15	GWS_{15}	117.5	127.8	8.7	11.4	1.1	1.5
16.	GWS_{16}	379	426	10.7	13.2	0.5	0.5
17.	GWS_{17}	156.2	175.7	4.1	9.4	0.2	0.2
18.	GWS_{18}	54	71	11.7	17.3	0.2	0.2

19.	GWS_{19}	241.3	269.8	10.5	15.7	0.2	0.2
20.	GWS_{20}	211.9	239.4	13.5	17.3	0.5	0.5
21.	GWS_{21}	65	69	5.9	7.4	1.2	1.2
22.	GWS_{22}	249.5	269.2	7.2	11.2	0.1	0.1
23.	GWS_{23}	327	355	14.4	18.5	0.2	0.2
24.	GWS_{24}	312.4	349.7	10.5	14.7	0.5	0.5
25.	GWS_{25}	110.9	170.4	7.1	10.4	0.4	0.4
26.	GWS_{26}	244	265	9.8	14	0.2	0.2
27.	GWS_{27}	227.2	257.7	9.1	12.9	0.0	0.0
28.	GWS_{28}	269.8	291.1	4.2	7.6	0.1	0.1
29.	GWS_{29}	132	145	13.7	19.1	0.5	0.5
30.	GWS_{30}	259	284	6.8	9.7	0.7	0.7
31.	GWS_{31}	170.4	210.9	9.8	14.3	0.2	0.2
32.	GWS_{32}	156	198	4.5	8.9	0.5	0.5
33.	GWS_{33}	321.7	339.2	8.7	8.7	0.5	0.5
34.	GWS_{34}	227.2	261.4	6.7	11.2	0.3	0.3
35.	GWS_{35}	245.9	298.2	6.4	12.7	0.4	0.4
36.	GWS_{36}	227.3	269.8	7.7	10.2	0.5	0.5
37.	GWS_{37}	239	284	9.4	14	0.5	0.5
38.	GWS_{38}	119.	127.2	11.7	17.2	0.3	0.3
39.	GWS_{39}	237	284	11.3	15.9	0.4	0.4
40.	GWS_{40}	309.2	326.6	5.3	9.7	0.2	0.2
41	GWS_{41}	211.9	241.4	7.9	11.3	0.1	0.1
42.	GWS_{42}	276	321	9.4	14.6	0.2	0.2
43.	GWS_{43}	209.8	234.1	7.1	12	0.4	0.4
44.	GWS_{44}	219.1	257.3	13.2	17.5	0.2	0.2
45.	GWS_{45}	217.4	244.7	17.4	21.1	0.1	0.1
46.	GWS_{46}	221.9	255.2	19.5	24.8	0.3	0.3
47.	GWS_{47}	241.9	249.2	15.4	26.7	0.2	0.2
48.	GWS_{48}	305.7	335.4	17.2	22.9	0.4	0.4
49.	GWS_{49}	317.1	342.5	11.5	21.7	0.1	0.1
50.	GWS_{50}	190	210.3	14.2	24.5	0.2	0.2
51.	GWS_{51}	221	245	17.9	27.2	0.0	0.0
52.	GWS_{52}	241.5	267.2	22	25.6	0.5	0.5
53	GWS_{53}	256.1	299.8	21.9	26.5	1.1	1.1
54.	GWS_{54}	317.9	397.6	12.1	20.3	1	1
55.	GWS_{55}	267.6	294.3	19.6	23.7	0.4	0.4
56.	GWS_{56}	180.4	280.7	16	21.1	0.4	0.4
57.	GWS_{57}	208.4	257.7	13.5	17.7	0.2	0.2
58.	GWS_{58}	341.2	359.8	15.9	19.4	0.4	0.4
59.	GWS_{59}	226.7	257.2	21.1	25.5	0.5	0.5
60.	GWS_{60}	309.5	328.2	14.7	18.4	0.1	0.1
61.	GWS_{61}	247.4	289.8	19.1	22	0.3	0.3
62.	GWS_{62}	294.8	314.2	15.4	18.8	0.3	0.3
63.	GWS_{63}	355	362	16.1	19.5	0.4	0.4
64.	GWS_{64}	264.7	314.2	13.8	17.3	0.1	0.1
65.	GWS_{65}	214	242	15.3	17.9	0.5	0.5
66.	GWS_{66}	241.9	284.1	16.8	21.4	0.6	0.6
67.	GWS_{67}	309.5	329.7	19.2	23.7	0.1	0.1
68.	GWS_{68}	329.7	341.1	15.7	18.7	0.1	0.1
69.	GWS_{69}	233.7	274.3	21	25.1	0.4	0.4
70.	GWS_{70}	309.2	334.5	26.1	27.4	0.5	0.5

PRM –Pre Monsoon, POM-Post Monsoon, All values in mg/l

Chloride in ground water originates from both natural and anthropogenic sources. Chloride content of ground water samples was much higher than the permissible limits. High chloride content indicates heavy pollution. It can be due to the uses of inorganic fertilizer, land fills leachates, septic tank effluent and industrial and irrigation drainage

The high concentration of chloride gives an undesirable taste to water and beverages. Taste thresholds for the chloride anion depends on the associated cation and are in the range of 200–300 mg/l for sodium, potassium, and calcium chlorides [21]. No health-based guideline value is proposed for chloride in drinking water. However, chloride concentrations in excess of about 250 mg/l can give rise to detectable taste in water [21].

The values of chloride for the groundwater pre and post monsoon under consideration are ranged between 54 mg/l to 362 mg/l. The lowest values of chloride pre and post monsoon concentrations are 54 mg/l and 71 mg/l observed in GWS18 at Nanded city, respectively, while the highest values of pre and post monsoon chloride concentrations are 355 mg/l and 362 mg/l at GWS63. Chloride impart a salty taste and some time high concentration causes laxative effect in human beings [27]

Sodium and potassium if compression to chloride is high because of the present of salt in groundwater. The chloride and fluoride are correlated with each other. The sodium concentrations found in Nanded ground water samples are low. The Values of sodium in groundwater pre and post monsoon under the consideration are ranged between 3.2mg/l to 27.4 mg/l.

The lowest concentration of sodium in pre and post monsoon is 3.2mg/l and 4.1 mg/l observed in GWS9 and the highest concentration of sodium is 26.1 mg/l and 27.4 mg/l found in GWS30. Slimier study in Greece showed sodium were lower than the upper limits by 2% of the total number of samples analyzed [22].Result from a study in Lagos city showed almost high levels of sodium in analyzed samples [23].

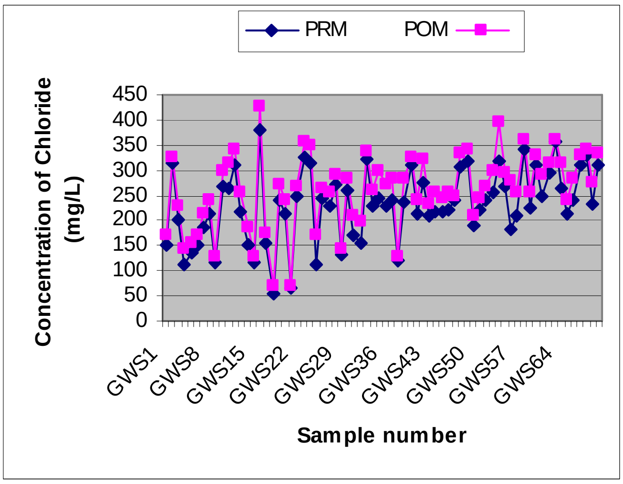


Fig.1 To Showing the concentration of Chloride

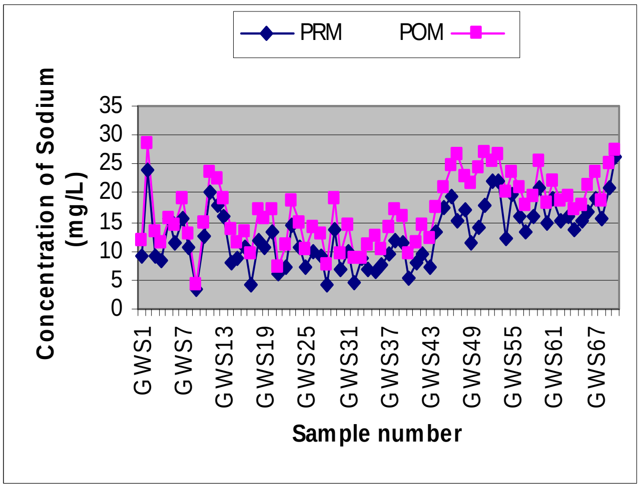


Fig.2 To Showing the concentration of Sodium

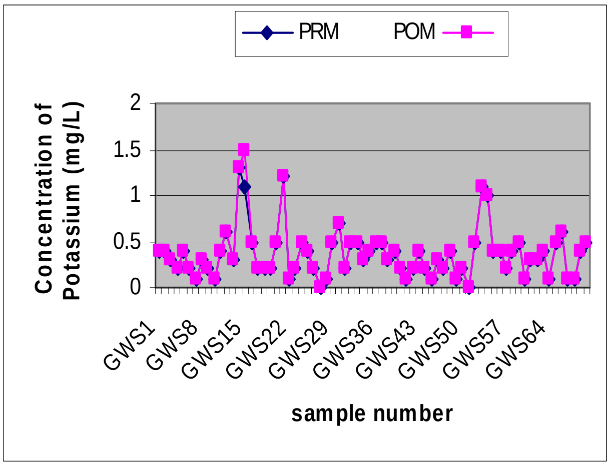


Fig.3 To Showing the concentration of Potassium

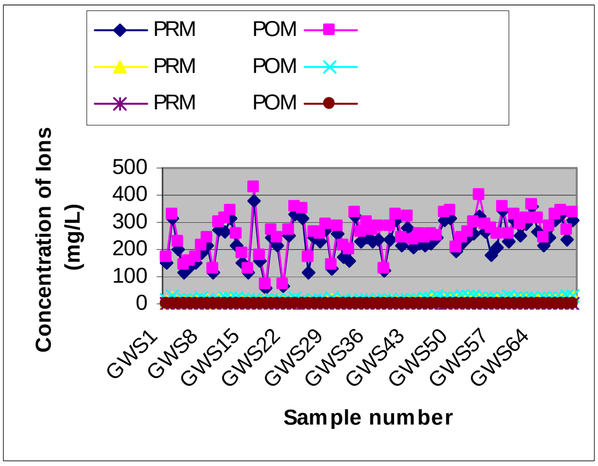


Fig.4 To Showing the concentration of Ions

The above figure1, 2, 3 showing the concentration of Chloride, Sodium and Potassium and figure 4 also showing the combination concentration of Chloride, Sodium and Potassium which can clearly showing the pre and post monsoon concentration of parameters.

Potassium found in groundwater ranged between 0.1 mg/l to 1.5 mg/l in pre and post monsoon from Nanded city. In the maximum samples minimum concentrations of potassium is 0.1 mg/l and maximum concentration is 1.5 mg/l in GWS15. He studied the Sodium and potassium are the exceed the permissible limit in Punnam village which was found of water samples collected lies in the range of 170 to 550 mg/L and 20 to 135 mg/L respectively [24]. Thus, the excess amount of potassium present in the water sample may lead nervous and digestive disorder [25].

Water softeners that regenerate using potassium chloride can significantly raise the level of potassium in water. It is recommended that people with kidney disease or other conditions such as heart disease, coronary artery disease, hypertension, diabetes and those who take medication that interferes with how the body handles potassium do not drink water from a water softener that uses potassium chloride.

CONCLUSION

In conclusion, the concentrations of the investigated major ions like chloride, sodium and potassium in the ground water samples from the Nanded city were within the permissible limits except the chloride is above the permissible limits for drinking water recommended by BIS (1991) and WHO (1984).
Above cited results shows that the overall water quality of Nanded city is suitable for drinking purpose as well as domestic purpose in absence of other sources.

Acknowledgements
One of the authors (Sayyed Juned Allabaksh) is thankful to the MANF, New Delhi, for the award of Junior Research Fellowship (JRF).

REFERENCES

[1] R. E. Raja, Lydia Sharmila, J.Princy Merlin, Chritopher G, *Indian J Environ Prot*. **2002**, 22(2), 137. 2.
[2] APHA, Standard methods for the examination of water and waste water; Washington DC, USA. **1995**.
[3] M.Narusk and L.Jurimagi. Eesti veemajanduse ulevaade aruande VEEKASUTUS alusel 2007. aasta andmeil [Review of Estonian water management based on the report on water management in 2007]. Toimetis 08-1. Keskkonnaministeeriumi Info- ja Tehnokeskus, Tallinn. **2008**, 4 pp. [in Estonian].
[4] WHO. Guidelines for drinking water quality. **2004**, Vol. I. 3rd Edn. World Health Organization, Geneva.
[5] F.E Poulichet, G. Favreau, C .Leduc C, J.L Seidel. *Applied Geochemistry*. **2002**, 17: 1343–1349.
[6] P. A. Domenico and F. W. Schwartz, "Physical and chemical hydrogeology," John Wiley and Sons, New York. **1990** pp. 824.
[7] C. Guler and G. D. Thyne, *Journal of Hydrology*, Vol. 285, pp. 177–198.
[8] E. Vazquez Sunne, X. Sanchez Vila, and J. Carrera, *Hydrogeology Journal*. **2005**, Vol. 13, pp. 522–533.
[9] K. L.Sachidanandamurthy and H.N. Yajurvedi: *India. J. Environ. Biol*. **2006**, 27, 615-618.
[10] D .Flood: Irrigation Water Quality for BC Greenhouses, Floriculture Fact sheet, Ministry of Agriculture, Fisheries and Food, British Columbia. **1996**.
[11] KSPCBOA.: Handbook of Environmental Laws and Guidelines, Karnataka State Pollution Control Board Officer's Association® (1st Ed), Bangalore. **2000**.
[12] BIS: Drinking Water Specifications, Bureau of Indian Standards, IS: 10500 **(1991)**.
[13] WHO: Guidelines of Drinking Water Quality in Health Criteria and Other Supporting Information. **1984**, Vol. 2, p. 336.
[14] BIS, Bureau of Indian Standards, Drinking Water Standards IS: 10500. **1993**.
[15] M. Jalali. Nitrates leaching from agricultural land in Hamadan, western Iran. Agriculture, Ecosystems & Environment. **2005a**, 110: 210-218.
[16] C. N.,Rivers, K.M . Hiscock, N.A. Feast, M. H. Barrett and P.F. Dennis,. Use of nitrogen isotopes to identify nitrogen contamination of the Sherwood sandstone aquifer beneath the city of Nottingham, UK. Hydrol. J. **1996**, 4(1): 90-102.
[17] K. N Kim, H. J. Rajmohan, G.S. Kim, Hwang and M.J. Cho. *Environ. Geol*. **2004**, 46: 763-774.
[18] K.,Srinivasamoorthy, C. Nanthakumar, M. Vasanthavigar, K. Vijayarag havan, R. Rajivgan dhi, S . Chidambaram, P. Anandhan, R. Manivannan and S. Vasudevan, *Arab J. Geosci*. **2009**, DOI=10.1007/s12517-0-09- 0076-7.
[19] K. Goulding. *Soil Use Manage*, 16: 145-151. *Res. J. Environ. Earth Sci*. **2000**, 1(2): 22-33, 2009
[20] J. Pacheco and S. *Hydrol. J*. **1997**, 5(2): 47-53.
[21] World Health Organization, Geneva, Guideline for Drinking Water Quality. **1993**, 1, p. 56, 124.
[22] K Stirios., S.aikaterini, M. Nikolaos, D.Michael and J Scoullos,. *Desalination*. **2008**, 224 (1-3): 317-329.

[23] K. A. Yusuf. *J.Applied Sci*. **2007**, 7(3): 1780-1784.
[24] G. Raja and P.Venkatesan. *E-Journal of Chemistry*. **2010**, 7(2), 473-478.
[25] T .R Tiwari, *Indian J Environ Health*. **2001**, 43(1), 176.
[26] Practical information for Alberta's Agriculture Industry. Interpretation of Domestic Farm Water Supplies Revised August **2007**, Agdex 716 (D04)
[27] K.Veer Bhadram, M .Ravindra, and M. Pradhanthi. Evaluation of water index at Visakhaptanam city Andhra Pradesh, Nature environmental and Pollution technology. **2004**, 3(1): 65-68.