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Study on the Post Tsunami Impact on Sea Water in Tuticorin Coastal Area

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This paper deals with the study on the post Tsunami impact on sea water intrusion in Tuticorin coastal area. In the present investigation, more than 12 ground water samples were collected from the various parts of Tuticorin coastal area *i.e.*, 1 and 5 km away from the sea shore. physico- chemical parameters such as pH, alkalinity, turbidity, electrical conductivity, total dissolved solids, total hardness, calcium, magnesium, dissolved oxygen, biological oxygen demand, chemical oxygen demand, fluoride, chlorides, nitrates, ammonia, phosphate, trace metals like iron and manganese were analyzed. Bacteriological examinations for the enumeration of coliform bacteria were carried out. Standard methods were followed for the analysis of physico-chemical and bacteriological examinations. The results were observed in each sample and compared with standards WHO, ICMR and BIS. The water quality in all the areas surveyed was found to be unfit for human consumption. Because of lack of poor water quality due to sea water intrusion, the residents of Tuticorin coastal area were affected by water borne diseases. Hence, suitable water quality management is essential to avoid contamination.

Key Words: Sea water, Tsunami impact, Tuticorin coastal area, Water quality parameters.

INTRODUCTION

The intrusion of salty sea water into wells is a ground water pollution problem in many coastal cities and towns. The quality of ground water is more important as the case of quantity. Since ground water contains a number of undesired constituents such as dissolved solids, suspended impurities, biological matters, *etc.*, it has to be treated to remove their constituents before consumption. About 90 % of the population in the coastal area utilizes a shallow ground water for drinking and other needs. Regular monitoring of the quality of ground water should be undertaken, temporarily and spatially to identify the sources of toxic contaminants and other inhibitory compounds that affect the potability of water[1].

EXPERIMENTAL

12 Ground water samples were collected from twelve bore wells and open wells around Tuticorin coastal area namely Chinamaninagar (S-1), Kamaraj College (S-2), Sathya Nagar (S-3), Harbour (S-4), Muthaiyapuram (S-5), Thendral Nagar (S-6), Kakanji Nagar (S-7), Palayakayal (S-8), Attoor (S-9), Arumuganeri (S10), Kayalpattinam (S11) and Tiruchendur (S-12). The present study forms the part of east coast of India and southern part of Tamil Nadu in the South 1 to 5 km from the sea shore after Tsunami. The turbidity of water samples were measured nephelometrically. pH of the samples were measured with digital pH meter. The electrical conductivity was determined by digital conductivity meter. Total hardness and alkalinity were determined using titration method. The presence of calcium was determined by EDTA-titrimetric method. Dissolved oxygen, chemical oxygen demand and biological oxygen demand were estimated using standard methods. The presence of nitrate is determined by visible spectrometer. Chloride was determined by titration method using standard silver nitrate solution. The method used for the determination of fluoride was zirconyl-alizarin method. The gravimetric method was used to determine the presence of sulphate. The method used for the determination of total phosphates was stannous chloride method. The determination of ammonia was done using nesslerization method. The presence of iron was analyzed by calorimetric method using thiocyanate solution and for bacteriological examinations, the standard plate count method was used[2,3].

RESULTS AND DISCUSSION

The results of both physico-chemical and bacteriological analysis of different ground water samples are given in Tables 2 and 3. The results were compared with values of prescribed standard quality parameters presented in Table-1.

The results reveal that pH values of all the samples vary from 7.3 to 7.9. These values are within the permissible limit[4] of 6.5 to 9.2.

TDS in all the water samples exceed the permissible limit. TDS in the water sample S-1, S-5, S-6, S-7, S-8, S-9 and S-11 are slightly higher than the permissible limit and hence these water samples are suitable for domestic purposes[5].

Total hardness of the samples collected from S-2, S-3, S-4, S-8 and S-10 are above the permissible limits of WHO. Water samples collected from S-1, S-5, S-6 and S-9 showed total hardness values within the permissible limits. The electrical conductivity of all the water samples exceeded the domestic water standards of 300 $\mu \Omega^{-1} s^{-1}$. These high values of electrical conductivity may due to sea water intrusion. So these water samples cannot be used for drinking purposes[6].

TABLE-1
PARAMETERS OF WATER QUALITY
CHARACTERIZATION AND STANDARDS
All units except pH and electrical conductivity are in mg/L

Parameters	WHO	ICMR	USPH	ISI
pH	6.5-9.2	7.0-8.5	6.0-8.5	6.5-8.5
Electrical conductivity mho/cm	300	300	300	–
TDS	500	500	500	500
Alkalinity	120	120	–	200
Total hardness	300	300	500	300
Calcium	75-200	75	100	–
Magnesium	30-150	50	30	30
Chloride	200-600	250	250	250
Sulphate	200-400	200	250	200
Fluoride	1.0-1.5	1.0	1.5	0.6
Nitrate	45	20	45	45
Phosphate	–	–	–	–
Dissolved oxygen	4-6	–	4-6	3.0
BOD	6.0	–	5	–
COD	10	–	4	–
Iron	0.1-1.0	0.3	–	0.3
Ammonia	–	0.1	–	–
Coliform bacteria	10	10	–	10

WHO = World Health Organisation
ICMR = Indian Council of Medical Research
USPH = United States Public Drinking Water Standards
ISI = Indian Standard Institution

In samples S-2, S-3, S-4, S-7 and S-10 as the alkalinity values are much less than the values of total hardness, neutral salts of calcium or magnesium such as sulphates and chlorides may be present because of the intrusion of sea water. But in samples S-1, S-5, S S-8, S-9 and S-11 the alkalinity values are not much less than that of total hardness. So the water samples can be used for domestic purposes[7].

The DO permissible limit for all the domestic purposes is 4-6 ppm (WHO). The observed values for the water samples from S-2, S-3, S-4, S-10 and S-12 lie above the permissible limit[8].

The WHO permissible limit for BOD values range from 4.1 to 8.0 mg/L. Water samples from S-2, S-3, S-4, S-10 and S-12 exceed the permissible limit of 6 mg/L and in S-3 and S-4 the values are very high[9].

The WHO permissible limit for COD is 10 mg/L for domestic water. COD values in the water samples S-2, S-3, S-4, S-10, S -11 and S-12 slightly exceed the permissible limit and especially in S-10 the value is high[10].

TABLE-2
PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER IN THE STUDY AREA

Parameters	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12
pH		7.7	7.3	7.4	7.3	7.9	7.6	7.3	7.3	7.9	7.5	7.4
Electrical conductivity mho/cm	1350	10190	6590	4520	765	1435	2200	1940	970	7030	2230	4500
TDS	945	7133	4613	3164	536	1005	1596	1358	679	4921	1561	3150
Alkalinity	254	373	564	572	284	318	212	522	204	644	437	522
Total hardness	275	626	909	1010	246	202	434	576	271	808	444	465
Calcium	71	178	234	275	69	58	117	145	71	226	109	113
Magnesium	23	44	78	78	17	14	34	51	22	58	41	44
Chloride	223	3127	1675	1049	53	180	514	212	184	1696	413	1230
Sulphate	84	140	66	330	55	99	116	136	55	178	128	116
Fluoride	0.4	0.8	0.8	0.6	0.4	0.6	0.4	0.6	0.6	o.2	0.2	0.8
Nitrate	14	13	2	3	2	12	1	4	1	2	6	5
Phosphate	0.20	0.24	0.08	0.24	0.08	0.16	0.16	0.20	0.12	0.20	0.16	0.24
Dissolved oxygen	5.6	7.6	8.8	8.5	5.0	4.3	5.7	4.9	5.4	7.9	4.8	8.3
BOD	5	6.3	7.5	7.8	5.7	4.1	5.2	4.4	5.9	6.4	6.5	6.2
COD	9.8	10.1	10.5	10.3	9.8	8.4	9.1	8.0	8.2	12.5	9.0	10.7
Ammonia	0.20	0.24	0.08	0.24	0.08	0.16	0.16	0.20	0.12	0.20	0.16	0.24

TABLE-3
PATHOGENS IDENTIFIED IN DIFFERENT SAMPLES

Samples	*Vibrio cholerae*	*Vibrio parahaemolyticus*	*E. coli*	*Salmonella Sp.*	*Enterobacter Aerogen*
S-1	✓	✓	✓	-	✓
S-5	-	-	-	-	-
S-6	✓	✓	-	✓	✓
S-7	✓	-	✓	✓	✓
S-8	-	-	-	-	-
S-9	✓	-	-	✓	1
S-11	✓	-	-	-	✓

Most of the water samples have high calcium concentration and magnesium concentration and most of the samples lie within the permissible limit 200 mg/L for calcium and 150 mg/L for magnesium[11].

The chloride concentration of most of the water samples except S-1, S-5, S-6, S-8 and S-9 exceed the ISI limit of 250 mg/L. Hence the water samples S-1, S-5, S-6, S-8 and S-9 and can be used for domestic purposes and S-2, S-3, S-4, S-7, S-10, S-11 and S-12 can not be used for the same purpose.

Sulphate concentration in the study area is found to vary from 55 to 330 mg/L. All the water samples except S-4 lie within WHO permissible limit[12] of 400 mg/L.

The permissible limit for fluoride concentration is 1 to 1.5 mg/L. All the samples have fluoride content less than 1 mg/L. Nitrate content of all the water samples lie within the prescribed limit given by WHO[2].

The ammonia content present in water samples should not exceed 0.05 mg/L. The phosphorous content ranges from 0.08 to 0.24 mg/L. All the water samples except S-6 and S-10 do not contain the iron concentration. Sites S-6 and S-10 contain iron concentration 0.2 and 0.1 mg/L which lie within the WHO permissible limit of 0.3 mg/L. Samples do not contain the concentration of manganese[12].

In all water samples, except S-10 the pathogens *Vibrio cholerae* and *Enterobacter aerogen* is present and in all the water samples except S-1 and S-2 *Salmonella* are present[10].

Conclusion

In the present study, the analysis shows that according to the physico-chemical and bacteriological examinations, all the water samples are unfit for drinking purposes. The reason may be due to sea water intrusion and the presence of pathogens like *Vibrio cholera*, *Salmonella* and *E. coli*. The water samples that are collected 1 km away from the sea are more

contaminated than that are collected 5 km away from the sea water. Because of the ground water contamination more by microorganism, disposal of sewage and intrusion of sea water, many water borne diseases and skin diseases are caused. Hence after making necessary water quality management, the water could be used.

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