Complication to Protected Water Sources of Tekkali Mandal of Srikakulam District, Andhra Pradesh, India

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Abstract—**In Srikakulam district, the prevalence of pathogenic organisms in tap water, compounded by inadequate hygiene practices among rural communities, has led to a significant burden of gastrointestinal diseases, posing a serious threat to public health. The lack of household water management and waste water treatment infrastructure has resulted in the majority of the children's population and a portion of the adult population showing a high incidence of diseases caused by microbial pathogens such as *E.coli* and *Salmonella* among others. The present study was aimed to determine the microbiological and physico-chemical quality of protected water supplies of Tekkali mandal of Srikakulam district for a period of two years i.e. from January 2018 to December 2019. It was found that protected water supplies showed high microbial contamination throughout the two years. The incidence of diseases and the rainfall data recorded in the mandal was also taken.**

The study demonstrated that protection of water resources can improve the hygiene quality of rural water supplies, where disinfection is not feasible. Our findings supported the WHO recommendations that *E.coli* should be the principal microbial indicator for portability of untreated water. Strategies for developing safe water systems must include public health education in hygiene and water source protection, practical methods and standards for water quality monitoring, and a resource centre for project information to facilitate programme evaluation and planning.

Index Terms—**E. coli, microbial contamination, gastrointestinal infections, GI infections, precipitation.**

I. INTRODUCTION

Water of good drinking quality is of basic importance to human physiology and man's continued existence depends very much on its availability.[1,15,2] The provision of potable water to the rural and urban population is necessary to prevent health hazards.[3,4] In developing countries more than 60% of population has no access to drinking pure drinking water.[5] Water treatment and distribution system, if not properly operated and maintained can be a source of disease outbreak affecting large population. The sewage water gets accumulated in the form of stagnant water and if there are any drinking water pipes near to that area there is a chance for the intrusion of sewage water in drinking water pipelines.

Fecal pollution of drinking water may introduce various forms of intestinal pathogens which may cause mild diseases like mild gastro enteritis to severe and sometimes fatal dysentery, diarrhoea, cholera, typhoid and hepatitis A.[6,7,8] In order to protect public health and to ensure that the water is safe for public use any water intended for drinking, treated or untreated, piped or unpiped must need certain microbiological standards.

Therefore, the present study was undergone to determine the microbial and physico-chemical quality of protected water supplies of Tekkali mandal of Srikakulam district of Andhra Pradesh. The incidence of diarrhoea and fever cases reported from the nearby primary health centre were recorded. The rainfall data reported in the mandal during the 2-year study was also recorded. The derived results were analyzed statistically through regression analysis.

II. MATERIALS AND METHODS

Area of Sample Collection

The water samples for study were collected from Tekkali mandal for a period of two years from January 2018 to December 2019. The mandal is situated 18-16'-67"-mts-sec latitudes and 83-14'-59" degrees-mts-sec-longitudes. The area of the mandal is 135sq kms.Its total geographical area covers 18,370 acres with forests covering 3120 acres and barren uncultivable land covers 1970 acres. The mandal comes under the revenue division Srikakulam. It includes 35 revenue villages, 28 panchayats and 246

Pt wards. Its total population is 56,094 persons with 27,764 males and 28,330 females. Itincludes 12,887 households. Its urban and rural population is 5,282 and 50,812 respectively. Its mainoccupation is cultivation besides agricultural laborers and house hold industry. Number of literates in the mandal includes 21,567 with 13,267 males and 8,300 females being educated in 43 primary schools, 15 upper primary schools, 9 high schools and 5 junior colleges. Its medical facilities include 1 hospital and 1 primary health centre. Drinking water sources include 361 bore wells, 18 protected water schemes and 29 open wells.

Sample collection

The protected water supply samples were collected from Tekkali mandal for a period of two years from January 2018 to December 2019. The water samples were collected in the form usually consumed by the inhabitants. The taps were allowed to run for 1 minute before water was aseptically collected into sterile wide mouth glass bottles. The time of collection, its source and the name of the mandal was noted on the sample bottle. In order to protect the samples from contamination the water samples were taken in closed sterilized glass containers (300ml capacity) and the collected samples were stored at 4 ^{0} C on ice and transported aseptically for processing within 24 hrs. The study was carried in accordance with the method of the Environmental Protection Agency (EPA) of the United States of America.[9]

Physico-Chemical Analysis of Water

The water samples were analyzed physico-chemically forthe parameters like pH, TDS and Fluoride content. The pH of the water samples was measured by pH meter. TDS was analyzed by Gravimetric method and fluoride content was analyzed by Alizarin Visual method.

Microbiological Analysis

The water samples were analyzed microbiologically using standard plate count technique and most probable number technique for determination of viable count and total coliforms. The examination of coliforms organisms and microbiological studies were followed as per the methods given by APHA.[16] The organisms *E.coli* and *Salmonella* were identified and characterized according to Bergey's manual of Bacteriology.

Statistical Analysis

The derived results were subjected to statistical analysis through Regression according to SPSS 8.0 package.

III. RESULTS AND DISCUSSION

pH: The values of pH of the water samples throughout the two years were between 7.1and 7.2 which is well within permissible limits. pH provides the information about alkalinity or acidity of water samples.[17] It also provides means of classifying and for collecting other characteristics or behavior such as corrosive activity.[14]As eye irritation and exacerbation of skin disorder have beenassociated with pH value greater than 11. So, regarding the pH, the water samples were within the safe limit.

Total dissolved solids

The amount of total dissolved solids of the water samplesduring the year 2018 and 2019 were in an average of 1201.5 mg/l and 1200 mg/l respectively. (Table: I & II) which were below the permissible limits. High TDS is commonly objectional or offensive to taste. A higher concentration of TDS usually serves no health threat to human until the values exceed 10,000 mg/l.[13] This parameter is used for the domestic usage of water.

Fluoride content

The fluoride content of water samples collected during the year 2018 was in an average of 0.35 mg/l and during 2019 was in the average of 0.34mg/l (below the permissible limits 1.5mg/l) (Table- I & II). Analysis of fluoride content in water is given importance because fluoride is known to cause a variety of health problems viz dental fluorosis, skeletal and non-skeletal fluorosis when the level is beyond 1.5 ppm. As far as the fluoride content is concerned, they are within the permissible limits.

Plate count

The standard plate count was used to estimate the total amount of bacteria in water and indicates the over all microbial status of the water. The results of total viable count for the year 2018 is given in Table I, the plate count was found to be in the range of 78 to >300 CFU's/ml. High plate counts were found throughout the year. During 2019, the plate count was found to be in the range of 98 to >300 CFU's/ml (Table:II). The factors responsible for high microbial counts in the water samples may be due to technically ill planned sewerage net work, damaged sewer lines, rusty water pipe lines and poorly maintained disinfection system. The reasons for high microbial counts are in

agreement with the results of Blue ford, Prasai and Obire.[10,11,12] They observed that the sanitary conditions and standard of living of inhabitants in the various locations were improper. They suggested that efficient and proper sanitation check in drinking water supplies has to be executed regularly as well as personal and house hold hygiene has to be emphasized.

Most Probable Number

The water samples were tested for presumptive and coliform counts using the most probable number technique.[18] During 2018, the MPN index ranged between 64 to 250/100ml indicating high microbial contamination throughout the year (Table:I). During 2019, also there was a high proportion of indicator organisms ranging between 220 -450/100ml (Table: II). This high counts was due to high rainfall recorded in thatyear, improper maintenance of sewage and its disposal practices. It was also found that the pipelines were present near to the sewage canals. It was also found that the bacterial contamination of water samples was due to open air defecation around the tanks and taps, inadequatechlorination, poor planning and maintenance of water supply system. In 2019 Omezurike also reported that the contamination of water samples of Abeokuta and Ojota (both in Nigeria) were due to dumping of domestic wastes and deposits of fecal matter near to the water resources.[19] Similarly Srila et al., in 2009 reported that the drinking water of Vellore district in Tamil Nadu was found to be microbiologically unfit for human consumption due to open defecation around the tanks and taps and inadequate chlorination.[20]

Contamination of drinking water with coliforms was alsoevident from the high levels of open air defecation and the practice of tethering animals close to human dwellings contributed to conversion of large areas of land into fecal fields. It is acknowledged that environmental sites are prone to recontamination by human and non human fecal wastes which may contain pathogenic organisms.[21,22] Thus the direct consumption of water from these sources could contribute to the spread of many infectious diseases.

Statistical Analysis

The regression analysis of the data revealed that during 2018 for protected water supply, every unit change of plate count reflected a change of 1.143 units of MPN index. During the year 2019, every unit change in the plate count reflected a change of 1.75

units of MPNindex.

Diarrhea and Fever Cases

The clinical outcome of diarrhea cases as well as fever and particularly typhoid cases were investigated in the present study and recorded monthly reports were collected from the near by primary health centre (Table:III) to see the relation with that of microbial quality of the water resources. The results showed a spatial distribution between the number of diarrhea and fever cases with that of microbial quality of water samples. High rainfalls recorded from the mandal for both the years also coincided with high microbial counts and high number of PHC cases.

The out come of the study is in agreement with a study inMexico city that lined the rate of diarrhea in children to the water used for domestic purposes which was also of poor microbial quality.[24] Tahir in 1997 also reported that 100 million cases were registered in hospitals of Pakistanwithin one year due to uptake of microbial contaminated water.[2]

IV. CONCLUSION

It is possible that adequate chlorination of the tank or boiling water before domestic use and drinking would have been sufficient to avert the health crisis. This situation highlights the need to monitor the quality of water. Remedial measures must be supplemented with anintensive health care education programme aimed at improving resource management practices. The people should also be advised to maintain water free of contamination in the household. These might ultimately result in the improvements in the health standard of our population.

V. ACKNOWLEDGEMENTS

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Table:I Tekkali Mandal 2018 Scheme Results						
Month	Total Dissolved Solids mg/l	Fluoride (as F) mg/l	Plate Count CFU'S/ml	MPN Index/100ml	E.coli	Salmonella
Jan	1318	0.3	258	230	+	+
February	1318	0.4	264	230	+	+
March	1318	0.3	188	110	+	+
April	1319	0.4	194	140	+	+
May	1318	0.4	272	220	+	+
June	1319	0.3	165	140	+	+
July	1319	0.3	121	110	+	+
August	1318	0.3	98	91	+	+
September	1319	0.3	86	73	+	+
October	1318	0.4	78	66	+	+
November	1319	0.4	236	220	+	+
December	1319	0.3	>300	250	+	+
+ indicates presence of the organism in the water sample						
- indicates absence of the organism in the water sample						

Table:II Tekkali Mandal 2019 Scheme Results

Month	Total Dissolved Solids mg/l	Fluoride (as F) mg/l	Plate Count CFU'S/ml	MPN Index/100ml	E.coli	Salmonella
Jan	1317	0.4	124	230	+	+
February	1318	0.3	>300	450	+	+
March	1317	0.3	98	220	+	+
April	1317	0.4	144	230	+	+
May	1318	0.4	136	230	+	+
June	1318	0.3	>300	450	+	+
July	1317	0.3	>300	450	+	+
August	1318	0.4	152	230	+	+
September	1317	0.4	>300	450	+	+
October	1318	0.4	136	230	+	+
November	1318	0.3	141	230	+	+
December	1317	0.3	158	230	+	+

+ indicates presence of the organism in the water sample

- indicates absence of the organism in the water sample

Table.III Monthly Rainfall, Total Diarrhoea and Fever cases reported from Tekkali Mandal during 2018-19

Year	2018			2019			
Month	Rain fall (mm)	Diarrhea	Fever	Rain fall (mm)	Diarrhea	Fever	Typhoid
January	0.0	1	246	21.0	32	127	0
February	0.0	2	201	75.1	48	120	0
March	0.0	0	278	49.2	17	218	0
April	28.2	0	208	17.6	26	104	0

May	68.8	0	211	27.6	26	126	0
June	393.9	0	152	99.4	47	152	0
July	70.5	0	320	110.6	46	242	0
August	67.8	0	242	182.2	25	254	1
September	164.6	0	211	143.2	40	187	0
October	99.8	0	98	50.0	41	236	0
November	0.0	0	212	7.1	44	262	0
December	0.0	2	191	0.0	42	212	0