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OPEN DEFECATION- A THREAT TO PROTECTED WATER SOURCES OF GAJAPATINAGARAM MANDAL OF VIZIANAGARAM DISTRICT, ANDHRA PRADESH, INDIA

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ABSTRACT
Human health has been severely impacted by gastro intestinal diseases caused by the presence of pathogenic organisms in tap water and the lack of appropriate hygiene habits among the rural populations of Vizianagaram district. 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 Gajapati Nagaram mandal of Vizianagaram district for a period of two years i.e. from January 2007 to December 2008. 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.
KEY WORDS: *Escherichia coli*, sanitation, water quality, pathogenicity, diarrhoea and rainfall.

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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 Gajapathi Nagaram mandal of Vizianagaram district of Andhra Pradesh. The incidence of diarrhoea and fever cases reported from the near by 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.

MATERIALS AND METHODS

Area of Sample Collection

The water samples for study were collected from Gajapati Nagaram mandal for a period of two years from January 2007 to December 2008. The mandal is situated 18-16'-33"-mts-sec latitudes and 83-20'-56" degrees-mts-sec-longitudes. The area of the mandal is 121sq kms. Its total geographical area covers 15,319 acres with forests covering 3120 acres and barren uncultivable land covers 1970 acres. The mandal comes under the revenue division Vizianagaram. 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. It includes 12,887 households. Its urban and rural population is 5,282 and 50,812 respectively. Its main occupation 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 GajapatiNagaram mandal for a period of two years from January 2007 to December 2008. 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 for the 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.

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 been associated 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 samples during the year 2007 and 2008 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 2007 was in an average of 0.35 mg/l and during 2008 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 2007 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 2008, 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 2007, the MPN index ranged between 64 to 240/100ml indicating high microbial contamination throughout the year (Table:I). During 2008, also there was a high proportion of indicator organisms ranging between 210 -460/100ml (Table: II). This high counts was due to high rainfall recorded in that year, 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, inadequate chlorination, poor planning and maintenance of water supply system. In 2008 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 also evident 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 2007 for protected water supply, every unit change of plate count reflected a change of 1.143 units of MPN index. During the year 2008, every unit change in the plate count reflected a change of 1.75 units of MPN index.

Diarrhoea and Fever Cases

The clinical outcome of diarrhoea 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 diarrhoea 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 in Mexico city that lined the rate of diarrhoea 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 Pakistan within one year due to uptake of microbial contaminated water.[2]

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 an intensive 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.

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Table:I Gajapathi Nagaram Mandal 2007 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	1202	0.4	262	240	+	+
February	1201	0.4	282	240	+	+
March	1201	0.3	198	120	+	+
April	1201	0.3	195	150	+	+
May	1202	0.4	272	210	+	+
June	1201	0.3	163	150	+	+
July	1202	0.3	124	120	+	+
August	1202	0.4	96	93	+	+
September	1201	0.4	82	75	+	+
October	1202	0.3	78	64	+	+
November	1201	0.4	234	210	+	+
December	1202	0.3	>300	240	+	+

+ indicates presence of the organism in the water sample

- indicates absence of the organism in the water sample

Table:II Gajapathi Nagaram Mandal 2008 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	1200	0.3	126	240	+	+
February	1200	0.3	>300	460	+	+
March	1201	0.3	98	210	+	+
April	1200	0.4	153	240	+	+
May	1200	0.3	148	240	+	+
June	1201	0.4	>300	460	+	+
July	1200	0.3	>300	460	+	+
August	1201	0.4	161	240	+	+
September	1200	0.3	>300	460	+	+
October	1201	0.4	148	240	+	+
November	1201	0.3	152	240	+	+
December	1200	0.4	166	240	+	+

+ 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

Gajapathi Nagaram Mandal during 2007-08

Year	2007			2008			
Month	Rain fall (mm)	Diarrhoea	Fever	Rain fall (mm)	Diarrhoea	Fever	Typhoid
January	0.0	1	249	22.0	31	128	0
February	0.0	4	202	75.2	49	121	0
March	0.0	0	280	49.6	18	220	0
April	29.4	0	210	17.8	28	105	0
May	72.6	0	213	27.8	28	128	0
June	394.7	0	154	99.2	49	154	0
July	70.8	0	321	110.8	48	241	0
August	68.4	0	241	182.4	26	256	1
September	167.8	0	213	143.4	41	189	0
October	100.8	0	96	51.0	42	238	0
November	0.0	0	213	7.0	45	260	0
December	0.0	2	190	0.0	43	211	0

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