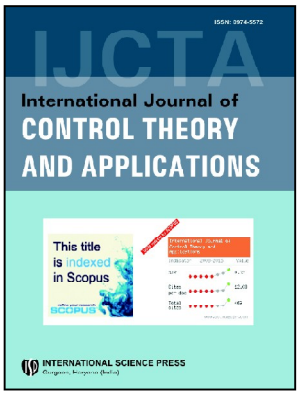

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A Study of Ground Water Quality in the Coastal Slum Area Peda Jalaripeta of Visakhapatnam by Nemerow's Pollution Index Method During Pre-Monsoon

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Abstract: In the present study, the ground water quality in the slum area Peda Jalaripeta of Visakhapatnam has been surveyed. The samples have been collected from the dug wells and bore wells for physico-chemical analysis, which was carried out, in the Environmental Engineering Laboratory Andhra University. The physico-chemical parameters evaluated through standard test procedures include pH, conductivity, calcium, magnesium, total hardness with dissolved solids, chlorides and sulphates. Quality of water is interpreted through Nemerow's Pollution Index (NPI) method using the experimental values. The study aims in evaluating ground water quality status in the study area and its portability during Pre-Monsoon.

Keywords: Peda Jalaripeta, water samples, physico - chemical analysis, pre monsoon.

1. INTRODUCTION

Water is an important source for life on the earth. Several people need only on groundwater for consumption and other uses. In the present days, increase in population, rapid industrialization, unplanned urbanization, improper use of fertilizers and pesticides can contaminate the ground water. Deprived quality of water not only effects the plant growth but also shows impact on the human health.

In the present scenario, increase in population, rapid industrialization, unplanned urbanization, improper use of fertilizers and pesticides can contaminate the ground water. The groundwater value is equally significant as that of its quantity. Bad feature of water not only effects the plant growth but also shows impact on the human health.

There is a pressing global problem of increasing freshwater scarcity. The other side to the problem is diminishing water quality. Scarcity and quality problems will be made much worse with the twin challenges of a growing world population and climate change; both these factors are expected to increase the frequency and severity of droughts in mid-latitudes.

(A) Necessity of the study

Slum urbanization could affect many water processes. For example, the range of materials dumped in-stream, including household rubbish and appliances, sewage, chemical, grease and oils, could affect channel-bed composition. Housing which does not comply with more important requirements as to sanitation or which is in urgent need of repairs is known as "substandard" housing. An area in which substandard housing predominates, frequently accompanied by over crowding is known as "slum".

Any dwelling having four or more such deficiencies like

a) Polluted water contribute

b) Water supply outer living unit or structure

c) Common Toilet or outside the structure

d) Common Bath or outside the structure

e) Over 1.5 persons for each habitable room

f) Over crowding of sleeping rooms

g) Fewer than 40 sq ft of sleeping region for each person

h) Rooms lacking a window and

i) Serious deterioration.

The slum area Peda Jalaripeta of Visakhapatnam city is taken as the area of study. Groundwater samples are held through the bore wells and hand pumps. Suitable conclusions are drawn from the results related to difference in water quality in Pre-Monsoon season and the pollutants present.

Usha Madhuri., *et al.,* [11] assessed a ground water quality survey in commercial areas of Visakhapatnam, (e.g. RTC Complex, Police barex, Jagadamba etc) has been carried out. Samples have been assembled from dug wells or bore wells and were analysed for physio- chemical parameters like pH, Cl- , TDS, TH, Ca, Nitrates, Sulphates and Iron. The impurities in ground water samples collected are assessed using Nemerow's Pollution Index to identify the status of aquifers. Important pollutants noticed are nitrate concentration at police barex, gurudwara junction. Iron is a pollutant at RTC Complex, Police barex and Jagadamba. Hardness is important pollutant found in all the areas analysed.

Chaudhari *et al.,* [1] assessed the ground water quality index near industrial area at Jalgaon (Maharashtra). The physio-chemical characteristics for the collected samples were determined before and after the rainy seasons for 11 parameters taking seven sampling sites into consideration. These water quality index studies suggested that the water is not suitable for direct consumption. In view of the above, it was observed that the samples of all the sites were not suitable for drinking and can be used only for irrigation purposes.

Sandhya [8] assessed portability of the groundwater in various localities in Bollaram area. An entire 24 samples from various bore wells were gathered and analyzed for 18 different parameters to verify the water value in the study region. In most of the cases it was observed that except pH, all the other parameters like hardness, alkalinity, electrical conductivity, calcium, magnesium, chloride, sulphate, nitrate, sodium, potassium and fluoride were not meeting the drinking water standards. In heavy metal analysis it was observed that arsenic, copper, cadmium and lead were below detectable level, whereas chromium, manganese in few samples were exceeding the desirable limits whereas zinc and iron were meeting the norms.

Rama Krishna, Mallikarjuna Rao, Subbarao and Srinivas [7] assesed portability of ground water in Slums of Visakhapatnam city Sampled data were analysed based on water quality index for various parameters like pH, Chlorides, TDS, Total hardness, Calcium, Nitrates, Sulphates, iron and DO.

The study appraised by Swarna Latha and Nageshwara Rao [9] on estimation and groundwater value in Greater Visakhapatnam was clearly exhibited the GIS technology effectiveness merged with lab investigation in assessment and groundwater value mapping in town area.

Devendra Dohare, Shriram Deshpande and Atul Kotiya (2014) analysed ground water quality in various wards of indore city.

2. EXPERIMENTAL METHODOLOGY

(A) Study area

The slum area Peda Jalaripeta is taken into consideration for the present study. For this, Groundwater samples are gathered from the bore wells at different locations in study area. Various physico-chemical considerations are pH, Electrical Conductivity, Total Dissolved Solids, Total Alkalinity, Total Hardness, Chloride, Calcium, Magnesium and sulphates are determined following standard procedures prescribed by B. Kotaiah and N. Kumara Swamy (Water and Waste Water Quality laboratory manual).

The water pollution has been considered as the descriptive capricious to evaluate water pollution effects on the decided households. When there is raise in water pollution over be a possibility to cause chronic disease.

Groundwater samples are accumulated by the bore wells at different locations in the study area.

The values of these parameters are used to determine Nemerow's Pollution Index.

Table 1
Analytical methods adopted for physico-chemical analysis

Analysis	*Method/instrument*
pH	Digital pH meter
Electrical conductivity (EC)	Digital conductivity meter
Total dissolved solids (TDS)	Indirectmethod (Raghunath, 2003[9])0.64*ECμs/cm
Total hardness (TH)	EDTA-Titrimetry
Chlorides (Cl)	Mohr's-Titrimetry
Calcium hardness (CaH)	EDTA-Titrimetry
Magnesium hardness (MgH)	Indirect methodTotal hardness- Calcium hardness
Sulphates (SO_4)	Gravimetric method

(B) pH

Most commonly, pH solution is considered as negative logarithm of Hz ions. The pH scale commonly ranges from 0 to 14. The range of pH from 0 to 7 is acidic, from 7 to 14 is alkaline, and 7 is neutral. Most importantly the pH of drinking water is between 6.5 to 8.5. It is known that pH of water ranging from 6.5 to 8.5, has not affecting health directly. However lower value under 5.0 produces sore taste and higher value over 8.5 provides alkaline taste.

The procedure for pH is calibrating the electrode(s) with two basic buffer solutions like pH 4.0 and 9.2 (A buffer is a solution provides resistance to modify in pH and whose pH value is well-known). The sample temperature is established at the same time. Immerse the electrode in the sample solution, twirl it and stay up to 1 minute for stable reading. The reading has to be captured only when the value is constant for a minute.

figure missing

Figure 1: Ripple carry adder(4 bit) with input carry =0

(C) Electrical Conductivity

figure missing

Figure 2: Carry Selective Adder (4 Bit)

It is a significant factor to determine the water value for drinking and agricultural uses. In other words the Electrical conductivity can also term as the water capability to allow electric current throughout it and is articulated in micro mhos per centimetre (μ mhos/cm). E.C of water indicates whether the water is polluted with electrolytes (dissolved mineral contents) or not.

Generally E.C is determined at 250C by conductivity meter. A speedy evaluation of entire dissolved solids contented in water is acquired by EC.

(D) Total Dissolved Solids

A 100ml of fine blended sample (measured cylinder is washed to make sure shifting of all suspended substance) is kept in the dish and vanished at 1000C on water bath, pursued by drying in oven at 1030C for about1 hour. Drying to a constant weight at 1030C, cool in desiccators and weigh.

Total solids (mg/l) = (A-B) * 1000 / V

A = Final weight of the dish in mg.

B = Initial weight of the dish in mg.

V= Volume of sample taken in ml.

(E) Total Hardness

Water with Hardness above 200 mg / lit affects the scale statement in the allocation system and effect in additional soap utilization and consequent scum construction. Soft water with less hardness of 100 mg/ lit may lowers buffer capability and cause corrosion in water pipes.

Take 25ml sample in conical flask. 1-2 ml buffer solutions added followed by adding 2 drops of Eri-Chrome Black T and titrate with standard EDTA (0.01M) till wine-red colour changes to blue. Take down the EDTA required volume (V).Total hardness as CaCO3 (mg/l) = V * 1000 / volume of sample taken.

Where V = Volume of EDTA required for sample.

(F) Chlorides

Industries are the significant causes for chlorides in water. The procedure for calculation of chloride content in water is as follows.

Take 25 ml of the sample in conical flask. Add 1 ml of potassium chromate to obtain light yellow colour. Titrate with standard silver nitrate solution till colour changes from yellow to brick red. Take down the silver nitrate added volume (V).

Chloride in (mg/l) = V * normality of AgNO3 * 35.46 *1000 / volume of sample taken.

Where normality of AgNO3 = 0.028

V = Volume of silver nitrate required for sample.

(G) Calcium

Take 50 ml of sample in a conical flask and add about 2 ml of NaOH to give a pH of 12 to 13. While stirring, add about 0.2 grams of the Murexide indicator. Continue the stirring and titrate against EDTA slowly until the colour of the solution changes from pink to purple at the end point. Ensure that further addition of 1 or 2 drops EDTA does not change the colour further.

Calcium hardness (mg/l) as CaCO3 = V * 1000 / ml of sample.

Where V = Volume of EDTA employed by sample.

(H) Magnesium

Though magnesium is an essential and beneficial metal, it is toxic at higher concentrations.

Magnesium hardness = Total hardness – Calcium hardness

(I) Sulphates

Natural water has sulphate ions in which most ions are soluble in water. Numerous sulphate ions are produced by ores oxidation, which are present in the industrial wastes. The sulphate quantity is measured through UV Spectrophotometer.

Take 50 ml of the sample, add 1ml of hydroxylamine chloride and then add 1 ml benzidine hydrochloride. Stir the mixture vigorously and allow the precipitate to settle. Filter the solution and wash the beaker and the filter paper with cold distilled water. Pierce the filter paper in funnel and wash the precipitate formed on the filter paper to the original beaker with 100 ml distilled water. Heat the beaker to dissolve the contents for 20-30 minutes. Add 2 drops of phenolphthalein indicator and titrate with 0.05N NaOH until pink colour is developed.

Concentration of sulphates = vol of 0.05N NaOH*38.4/vol of sample taken.

(J) Nemerow's Pollution Index (NPI)

Nemerow's pollution index is a water quality index to find out the pollutants in that particular area of sampling.

A very simplified pollution index was introduced by Nemerow generally termed as Nemerow's Pollution Index (NPI).

It is mathematically expressed as:

NPI=Ci/ Li

Where Ci= observed concentration of ith parameter

Li = permissible limit of ith parameter (Indian standard values).

In the above expression units of Ci & Li should be identical. The entire NPI value shows the relative pollution supplied by particular factor. NPI values exceeding 1.0 represent impurity in water and hence some treatment prior to use is required.

Table 2
Status of Water Quality Based on NPI

Nemerow's Pollution Index (NPI): (observed value/ standard value)	*Status*
<1	It is not a pollutant
>1	It is a pollutant

3. RESULTS AND DISCUSSIONS

The samples are analysed in the Environmental Engineering laboratory, Civil Engineering Department, Andhra University, as per the standard analytical experimental methods.

Table 3
NPI Results for Pre Monsoon

Table 3.1
NPI Results (sample 1)

Parameter	*Permissible limits (L_i)*	*Concentration (C_i)*	*Nemerow's pollution index (NPI)*
p^H	8.5	7.02	0.825
Chloride	250 mg/l	409	1.636*
Total dissolved solids	500 mg/l	787	1.574*
Total hardness as $CaCO_3$	300 mg/l	450	1.50*
Calcium	75 mg/l	108	1.44*
Magnesium	30 mg/l	43	1.43*
Sulphates	150 mg/l	145	0.96

Pollutants identified are: Chloride, Total Dissolved Solids, Total Hardness, Calcium, Magnesium.

Table 3.2
NPI Results (sample 2)

Parameter	*Permissible limits (L_i)*	*Concentration (C_i)*	*Nemerow's pollution index (NPI)*
p^H	8.5	7.27	0.855
Chloride	250 mg/l	102	0.408
Total dissolved solids	500 mg/l	534	1.068*
Total hardness as $CaCO_3$	300 mg/l	286	0.95
Calcium	75 mg/l	32	0.426
Magnesium	30 mg/l	48	1.6*
Sulphates	150 mg/l	94	0.62

Pollutants identified are: Total Dissolved Solids, Magnesium.

Table 3.3
NPI Results (sample 3)

Parameter	*Permissible limits (L_i)*	*Concentration (C_i)*	*Nemerow's pollution index (NPI)*
p^H	8.5 mg/l	7.34	0.86
Chloride	250 mg/l	500	2.0*
Total dissolved solids	500 mg/l	954	1.90*
Total hardness as $CaCO_3$	300 mg/l	800	2.67*
Calcium	75 mg/l	201	2.68*
Magnesium	30 mg/l	72	2.4*
Sulphates	150 mg/l	78	0.5

Pollutants identified are: Chloride, Total Dissolved Solids, Total Hardness, Calcium Magnesium.

Table 3.4
NPI Results (sample 4)

Parameter	*Permissible limits (L_i)*	*Concentration (C_i)*	*Nemerow's pollution index (NPI)*
pH	8.5	8.05	0.94
Chloride	250 mg/l	360	1.44*
Total dissolved solids	500 mg/l	783	1.56*
Total hardness as $CaCO_3$	300 mg/l	382	1.27*
Calcium	75 mg/l	96	1.28*
Magnesium	30 mg/l	34	1.13*
Sulphates	150 mg/l	67	0.44

Pollutants identified are: Chloride, Total Dissolved Solids, Total Hardness, Calcium, Magnesium.

Table 3.5
NPI Results (sample 5)

Parameter	*Permissible limits (L_i)*	*Concentration (C_i)*	*Nemerow's pollution index (NPI)*
p^H	8.5	7.21	0.84
Chloride	250 mg/l	408	1.632*
Total dissolved solids	500 mg/l	1178	2.356*
Total hardness as $CaCO_3$	300 mg/l	366	1.22*
Calcium	75 mg/l	77	1.02*
Magnesium	30 mg/l	42	1.4*
Sulphates	150 mg/l	143	0.95

Pollutants identified are: Chloride, Total Dissolved Solids, Total Hardness, Calcium, Magnesium.

Table 3.6
NPI Results (sample 6)

Parameter	*Permissible limits (L_i)*	*Concentration (C_i)*	*Nemerow's pollution index (NPI)*
pH	8.5	7.43	0.87
Chloride	250 mg/l	370	1.48*
Total dissolved solids	500 mg/l	1069	2.13*
Total hardness as $CaCO_3$	300 mg/l	896	2.98*
Calcium	75 mg/l	156	2.08*
Magnesium	30 mg/l	120	4*
Sulphates	150 mg/l	44	0.29

Pollutants identified are: Chloride, Total Dissolved Solids, Total Hardness, Calcium, Magnesium.

Table 4
The pollutants identified in the study areas through Nemerow's Pollution index (NPI) during pre-monsoon

Sample Number	*Area*	*Pollutants Identified*
1	Jalaripeta, Ammoru Temple	Chloride, Total Hardness, Total Dissolved Solids, Calcium, Magnesium.
2	Jalaripeta, Priyadarsini Colony	Total Dissolved Solids, Magnesium.
3	Jalaripeta, Priyadarsini Colony	Chloride, Total Hardness, Total Dissolved Solids, Calcium, Magnesium.
4	Jalaripeta, Babuji Nagar	Chloride, Total Hardness, Total Dissolved Solids, Calcium, Magnesium,
5	Jalaripeta, Babuji Nagar	Chloride, Total Hardness, Total Dissolved Solids, Calcium, Magnesium.
6	Jalaripeta, Sulabha Complex	Chloride, Total Hardness, Total Dissolved Solids, Calcium, Magnesium.

4. CONCLUSION

In this study, conclusions can be drawn that the groundwater in study region consists of pollutants viz., chlorides, and total hardness with dissolved solids, calcium and magnesium. However, in the present area where the pollutants are identified atleast treatment like boiling should be done for portability. This ensures removal of hardness, & TDS and also renders the water safe for drinking. Artificial recharge is also suggested with rain water for dilution.

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