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WATER QUALITY INDEX AROUND SRIKAKULAM DISTRICT

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Abstract -*Due to expansion people, progressed agrarian practices, industrialization, man-affected improvement, to water is as a rule fundamentally contaminated with various contaminants. Water Quality index, indicating the water quality in terms of index number. Water Quality Index was determined on the basis of various physic- chemical parameters like pH, electrical conductivity, TDS, Alkalinity total hardness, chloride, nitrate, sulphate, BOD, etc. It tells about present status of useable water for household and also modern utilize. The results indicate that the different water samples analyzed from lake water and bore water are safe for safe for human consumption after homemade treatments and for other domestic purposes while the samples analyzed from well water are not safe for human consumption.*

Key Words: Physic- Chemical Parameters, Water Quality Index, Biochemical Oxygen Demand (BOD).

1. INTRODUCTION

The importance of water to man cannot be over emphasized. He can survive longer without food than without water. He requires it for his cooking, washing, sanitation, drinking and for growing his crops and running his factories[1]. This reality clearly represents why water is viewed as a standout amongst the most key substances throughout everyday life and like air it is generally plenteous. Human exercises frequently result in water contamination making such water unfit for utilize[2]. Water contamination is an adjustment in the nature of water which renders it flimsy or unsafe as respects nourishments, man and creature wellbeing, industry, horticulture, angling or recreation[3]. Accordingly, it is essential that the nature of drinking water quality to be checked at customary time interim, in light of the fact that because of utilization of debased drinking water, human populace experiences shifting of water borne maladies[4]. Water contamination is a difficult issue in India as very nearly 70 for each penny of its surface water assets and a developing level of its groundwater holds are tainted by natural, dangerous, natural, and inorganic toxins. As a rule, these sources have been rendered risky for human utilization and also for different exercises, for example, water system and modern needs. Over the most recent couple of decades there has been a gigantic increment in the interest for freshwater because of quick development of populace and the quickened pace of industrialization[5]. Out of the aggregate water stores of the world, around 97% is salty water and just 3% is fresh water[6]. Water tainting is a critical issue in India as ideal around 70 for each penny of its surface water resources and a creating level of its groundwater spares are debased by common, perilous, regular, and inorganic poisons[7]. A few research considers have been inspected and announced about physicochemical parameters in various locales of the world[8]. The centrality of water to man can't be over underlined. He can survive longer without sustenance than without water[9]. He requires it for his cooking, washing, sanitation, drinking and for developing his products and running his processing plants. Aside from its mechanical utilize water is a vital social enhancement. The provision of good quality water can help in eradicating water-borne diseases and in improving the general sanitation of near sankili villages [10]. Water quality Index (WQI) gives a solitary number that communicates the general water quality at a specific area and time in light of a few water quality parameters [11]. The target of WQI is to transform complex water quality information into data that is justifiable and usable by people in general [12]. Various Indices have been created to compress water quality information in an effectively expressible and effortlessly comprehended organization. The index result represents the level of water quality in a given water basin [13]. Lacking administration of water assets as specifically or by implication brought about the debasement of hydrological condition. Therefore, a continuous periodical monitoring of water quality is necessary so that appropriate steps may be taken for water resource management practices [14]. The present investigations was carried out to compute the Water Quality Index (WQI) in order to assess the suitability of water from different sources collected from different areas around the industrial region of sankili.

1.1 The main objective of the study is:

- Collection of water samples from lake water, well water, river water bore water and industrial waste water in the industrial region of Sarasanapalli.
- Analysis of a few quality parameters *viz*., pH, total alkalinity, chlorides, sulphate, nitrate, total hardness, calcium, magnesium, electrical conductivity, dissolved oxygen, biochemical oxygen demand, total dissolved solids and total suspended solids as recommended by World Health Organization
- Assessment of the water quality using water quality index (WQI).

2. Materials and methods

2.1 Study area

Sarasanapalli is a village in srikakulam district of Andhra Pradesh, India. Geographically lies between *18º57'68.6"N, 83º 64'35.6"E* longitude[13]. These samples was collected around PAPER industry located in Sarasanapalli srikakulam (dt) , India, at a distance of about 3000m from industry the sampling was carried for November month ,2017

2.2 Sampling collection

Collection of water samples from lake water, well water, bore water and river water in the industrial region of sankili. All plastics and glasses utilized were pre-treated by washing with dilute HCl and later rinsed with distilled water. They were then air-dried in a dust free environment.

Table 1: Water Sampling Locations in study area

Code	Name of the sample	Name of the location	Geographical location
Ws1	Well water	Konda valase	18°56'77.0"N, 83° 64'86.9"E
Ws2	Bore water	Sarasanapalli	18°59'07.7"N, 83° 64'34.6"E
Ws3	Lake water	Jagannadha valasa	18°57'32.0"N, 83° 63'34.7"E
Ws4	River water	Jodubandala	18°58'66.0"N, 83° 65'24.3"E
Ws5	Industrial wastewater	Sarasanapalli	18°57'68.6"N, 83° 64'35.6"E

2.3 Physic-chemical analysis

The analysis of various physico-chemical parameters analyzed namely pH, total alkalinity, chlorides, sulphate, nitrate, total hardness, calcium, magnesium, electrical conductivity, dissolved oxygen, biochemical oxygen demand, total dissolved solids and total suspended solids were carried out as per methods described in [14]

Table 2: Physic-chemical parameters and respective methods

S.No	Parameter	Method of test, refer to part of IS 3025
1	pH	Part 11 - Electrometric
2	Electrical conductivity	Part 14 - Electrometric
3	Total dissolved solids	Part 16 - Gravimetric
4	Chlorides	Part 32 - Argentrometric
5	Alkanity	Part 23 – Potentiometric
6	Total hardness	Part 21 – EDTA
7	Ca hardness	Part 21 – EDTA
8	Mg hardness	Part 21 – EDTA
9	Phosphates	Part 31 - Vandomolybdo phosphoric acid
10	Sulphates	Part 24 - Turbidimetric Method
11	Nitrates	Part 34 - Chromotropic acid
12	Sodium	Part 45 - Flame Photometric Method
13	Potassium	Part 45 - Flame Photometric Method
14	Total suspended solids	Part 16 Gravimetreic
15	BOD	Part 44 - Idometric
16	COD	Part 58 - Tritrometric

2.4 Calculation of Water Quality Index

In this study, water samples were collected at 5 locations, for physico-chemical studies. Calculation water quality index, thirteen important parameters were chosen [1]. The WQI has been ascertained by utilizing measures of drinking water quality prescribed by the American public health association (APHA) [16]. Water samples results come about were contrasted and IS: 10500 specification and CPCB water quality criteria [18]. The weighted Arithmetic index method has been used for the calculation of WQI in this study. Further, quality rating or sub index was calculated using the following expression [11].

$q_n = 100[V_n - V_{io}] / [S_n - V_{io}]$

(Let there be n water quality parameters and quality rating (q_n) corresponding to nth parameter is a number reflecting relative value of this parameter in the polluted water with respect to its standard permissible value)

q_n = Quality rating for the nth Water quality parameter

V_n = Estimated value of the nth parameter at a given water sampling station

S_n = Standard permissible value of the nth parameter

V_{io} = Ideal value of nth parameter in pure water (i.e., 0 for all other parameters except the parameters pH and Dissolve oxygen [7.0 and 14.6 mg/l respectively])

The unit weight was calculated by a value inversely proportional to the recommended standard value S_n of the corresponding parameter.

$W_n = k/S_n$

Where W_n= unit weight for nth parameter

S_n= standard permissible value for nth parameter k = proportionality constant. The overall WQI is calculated by the following equation.

$WQI = \Sigma q_n W_n / \Sigma W_n$

Table 3: Water quality index and status of water quality

Water quality level	Water quality status
þ-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very poor water quality
>100	Unsuitable for drinking

3 Results

Table 4: water quality standards

S. No	Parameters	Standards	Unit weight(w_n)
1	pH	6.5-8.5	0.11764
2	Electrical conductivity	0	0
3	Total dissolved solids	500	0.02
4	Chlorides	250	0.004
5	Alkanity	200	0.005
6	Total hardness	300	0.0033
7	Ca hardness	75	0.013
8	Mg hardness	30	0.033
9	Phosphates	5	0.2
10	Sulphates	200	0.005
11	Nitrates	45	0.022
12	Sodium	100	0.01
13	Potassium	10	0.1
14	Total suspended solids	500	0.3317

Table 5: Physicochemical parameters of 5 water samples

S. No	Parameters	Units	Bore water	River water	Lake water	Well water	Industrial waste water
1	pH	-	8.12	7.89	6.59	6.19	6.90
2	Electrical conductivity	µ mhos/cm	421	513	280	1270	1530
3	Total dissolved solids	mg/l	274	333	182	825	995
4	Chlorides	mg/l	43.01	51.8	63.3	373.1	152.2
5	Alkanity	mg/l	251	357	451	1470	1250
6	Total hardness	mg/l	127.5	137.1	198.1	598.3	431.8
7	Ca hardness	mg/l	23.66	26.4	46.1	168.3	85.2
8	Mg hardness	mg/l	16.79	14.86	20.28	43.51	57.7
9	Phosphates	mg/l	2.3	1.8	3.1	8.3	7.1
10	Sulphates	mg/l	83	69	149	108	683
11	Nitrates	mg/l	0.97	4.27	2.77	31.1	2.81
12	Sodium	mg/l	143	176	270	428	384
13	Potassium	mg/l	2	9	5	16	21
14	Total suspended solids	mg/l	14	15	26	24	38
15	BOD	mg/l	ND	ND	20	10	50
16	COD	mg/l	7	14.4	9.2	36.8	142

Table 6: Calculation of water quality index of river water

S. No	Parameters	Observed values	Standards	Unit weight(w_n)	Quality rating(q_n)	$W_n q_n$
1	pH	7.89	6.5-8.5	0.11764	92.8	10.9
2	Electrical conductivity	230	0	0	0.0	0.0
3	Total dissolved solids	161	500	0.02	66.6	1.3
4	Chlorides	41.8	250	0.004	20.7	0.1
5	Alkanity	280	200	0.005	178.5	0.9
6	Total hardness	127.1	300	0.0033	45.2	0.1
7	Ca hardness	24.4	75	0.013	34.3	0.4
8	Mg hardness	15.86	30	0.033	49.0	1.6
9	Phosphates	1.5	5	0.2	36.0	7.2
10	Sulphates	49	200	0.005	34.5	0.2
11	Nitrates	3.374	45	0.022	9.4	0.2
12	Sodium	156	100	0.01	176.0	1.8
13	Potassium	4	10	0.1	90.0	9.0
14	Total suspended solids	13	500	0.3317	5.6	0.0
				$\sum W_n$=0.536	$\sum q_n$= 838.7	$\sum W_n q_n$= 33.79
Water quality index= $\sum W_n q_n$/ $\sum W_n$= 62.98						

Table 7: Calculation of water quality index of lake water

S. No	Parameters	Observed values	Standards	Unit weight(w_n)	Quality rating(q_n)	$W_n q_n$
1	pH	6.59	6.5-8.5	0.11764	77.5	9.1
2	Electrical conductivity	280	0	0	0.0	0.0
3	Total dissolved solids	182	500	0.02	36.4	0.7
4	Chlorides	63.3	250	0.004	25.3	0.1
5	Alkanity	451	200	0.005	225.5	1.1
6	Total hardness	198.1	300	0.0033	65.4	0.2
7	Ca hardness	46.1	75	0.013	59.9	0.8
8	Mg hardness	20.28	30	0.033	66.9	2.2
9	Phosphates	3.1	5	0.2	62.0	12.4
10	Sulphates	149	200	0.005	74.5	0.4
11	Nitrates	2.77	45	0.022	6.1	0.1
12	Sodium	270	100	0.01	270.0	2.7
13	Potassium	5	10	0.1	50.0	5.0
14	Total suspended solids	26	500	0.0037	9.6	0.036
				$\sum W_n$=0.536	$\sum q_n$=1029.2	$\sum W_n q_n$=34.92
Water quality index= $\sum W_n q_n$/ $\sum W_n$= 65.07						

Table 8: Calculation of water quality index of bore water

S. No	Parameters	Observed values	Standards	Unit weight(w_n)	Quality rating(q_n)	$W_n q_n$
1	pH	8.12	6.5-8.5	0.11764	95.5	11.2
2	Electrical conductivity	421	0	0	0.0	0.0
3	Total dissolved solids	274	500	0.02	54.8	1.1
4	Chlorides	43.01	250	0.004	17.2	0.1
5	Alkanity	251	200	0.005	125.5	0.6
6	Total hardness	127.5	300	0.0033	42.1	0.1
7	Ca hardness	23.66	75	0.013	30.8	0.4
8	Mg hardness	16.79	30	0.033	55.4	1.8
9	Phosphates	2.3	5	0.2	46.0	9.2
10	Sulphates	83	200	0.005	41.5	0.2
11	Nitrates	0.97	45	0.022	2.1	0.0
12	Sodium	143	100	0.01	143.0	1.4
13	Potassium	2	10	0.1	20.0	2.0
14	Total suspended solids	14	500	0.0037	5.2	0.019
				$\sum W_n$=0.536	$\sum q_n$=671.9	$\sum W_n q_n$=52.73
Water quality index= $\sum W_n q_n$/ $\sum W_n$= 52.73						

Table 9: Calculation of water quality index of well water

S. No	Parameters	Observed values	Standards	Unit weight(w_n)	Quality rating(q_n)	$W_n q_n$
1	pH	6.19	6.5-8.5	0.11764	72.8	8.6
2	Electrical conductivity	1270	0	0	0.0	0.0
3	Total dissolved solids	825	500	0.02	165.0	3.3
4	Chlorides	373.1	250	0.004	149.2	0.6
5	Alkanity	1470	200	0.005	735.0	3.7
6	Total hardness	598.3	300	0.0033	197.4	0.7
7	Ca hardness	168.3	75	0.013	218.8	2.8
8	Mg hardness	43.51	30	0.033	143.6	4.7
9	Phosphates	8.3	5	0.2	166.0	33.2
10	Sulphates	108	200	0.005	54.0	0.3
11	Nitrates	31.1	45	0.022	68.4	1.5
12	Sodium	428	100	0.01	428.0	4.3
13	Potassium	16	10	0.1	160.0	16.0
14	Total suspended solids	24	500	0.0037	8.9	0.033
				$\sum W_n$=0.536	$\sum q_n$= 2567.2	$\sum W_n q_n$=79.66
Water quality index= $\sum W_n q_n$/ $\sum W_n$= 148.44						

Table 10: Water quality status of different location

S. No	Type of Water	Water Quality Level	Water Quality Status
1	Lake water	65.07	Poor water quality
2	River water	62.98	Poor water quality
3	Bore water	52.73	Poor water quality
4	Well water	148.44	Unsuitable for drinking

Discussions

The results of the physico-chemical parameters of the different samples of pipe borne water, bore hole water and stream water analyzed are as shown in Tables 6, 7 and 8 respectively. From the results, it can be seen that the concentrations of the respective parameters are below the CPCB/APHA standards as shown in Table 5. Water quality index indicates the quality of water in terms of index number which represents overall quality of water[11].

The results obtained for the WQI from the different sampling stations were found 65.88 for lake water, 62.98 for river water, 52.73 for bore water, and 148.44 for well water. The results indicate that the different water samples analyzed from lake, river and bore water are safe for safe for human consumption and for other domestic purposes while the samples analyzed from well water are not safe for human consumption[11]

The above water quality index is supported by the following physico-chemical parameters, namely pH, total alkalinity, chlorides, sulphate, nitrate, total hardness,

calcium, magnesium, electrical conductivity, biochemical oxygen demand, total dissolved solids and total suspended solids. The variations of the above physico-chemical parameters observed among the different water samples. Among all the physico-chemical parameters selected for the WQI calculations[1].

A relatively higher concentration of Alkanity, TDS, calcium, magnesium, chlorides and sulphates also indicated the unsuitability of water for domestic use. Hence, application of water quality index technique for the overall assessment of the water quality of a water body is a useful tool[11].

Conclusion

From the application of water quality index for the determination of the quality of water from different sources in Sarasanapalli. It is concluded that all the lake water, river water and bore water samples analyzed in this study are fit and suitable for drinking after community water treatment like Distillation Systems, Disinfection, Boiling of water etc., and for other domestic applications while the well water samples are found unfit and unsuitable for human consumption based on the water quality index standards. It is reasoned that the phosphates focus was discovered more than CPCB principles in well water which is unsatisfactory for drinking and overabundance measures of phosphates released in water bodies prompts Eutrofication.

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