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ASSESSMENT OF HYDROCHEMICAL PROPERTIES OF AQUIFER IN PUDUCHERRY URBAN REGION

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Abstract- The study emphasis on the assessment of hydro-chemical characteristic from the groundwater sources of the Puducherry region. For the study, water samples were collected from twenty identified locations and tested for pre and post monsoon aquifer inferences the hydro chemical characteristics and quality assessment of drinking water in ground water from Puducherry region. The various physico-chemical parameters such as pH, electrical conductivity (EC), Total dissolved solids, Alkalinity, Hardness, chloride, nitrate and fluoride were analyzed. This result indicated that hydro-chemical characteristics and quality assessment parameters were within drinking water quality, by using hydro-chemical data to understand enhanced about evaluation of drinking water quality, by using hydro chemical data to understand the factors influencing contamination due to anthropogenic impacts.

Keywords: Ground water pollution, Contaminant, Puducherry region, physico-chemical parameters.

1. INTRODUCTION

Water plays an important role in human life and other living organisms. So the water must be clean and free from the micro-organisms. Water can be obtain by either rain or from ground water a resources feeder for the ground water recharge [1]. Certain developmental activities such as industrialization and rapid urbanization had drastically increased the population rate in the surface water resources by discarding the industrial effluents and urban waste directly on the lake and river[2&3]. These activities had initiated the demand for water from the ground resources. Due to increasing contamination and scarcity of surface water resources, a major stress has been shifted to groundwater resources. More over due to industrial effluent and pest control activates on agricultural land the contaminated effluent percolates through the ground and reaches the ground water and contaminates the water body which would possibly cause serious health related issues in human and animal life[4]. Numerous experimental studies had been carried out to identify the contamination of ground water.

From the guidance of the literature survey for the assessment of various physico-chemical parameters of ground water, the study had been conducted on the identify locations of the Puducherry region [5&6]. From the result analysis it was found that, the pollution level varies and responds to seasonal variation, from the observation made on the literature survey, there is no data s for ground water quality assessment on time series were available.

2. STUDY AREA

For the present study the Puducherry region, a union territory which lies along the southern east coast of Indian subcontinent with an latitude 11º45' and 12º03' N and longitudes of 79º37' and 79º53' E was considered. The average area of Puducherry region is about 293sq.km.The study area receives a mean rainfall of about 1272.7m from the northeast monsoon[15]. The Puducherry urban region mainly depends on ground water. Red, Black, Alluvial and colluvial are the major soil type present in the region. Confined and semi-confined aquifer are the two types of aquifer are present in the region[10], which are continuously exploited for the fulfilment of the demand sectors by means of bore wells, dug well and open well.

India maps with provinces collected samples location

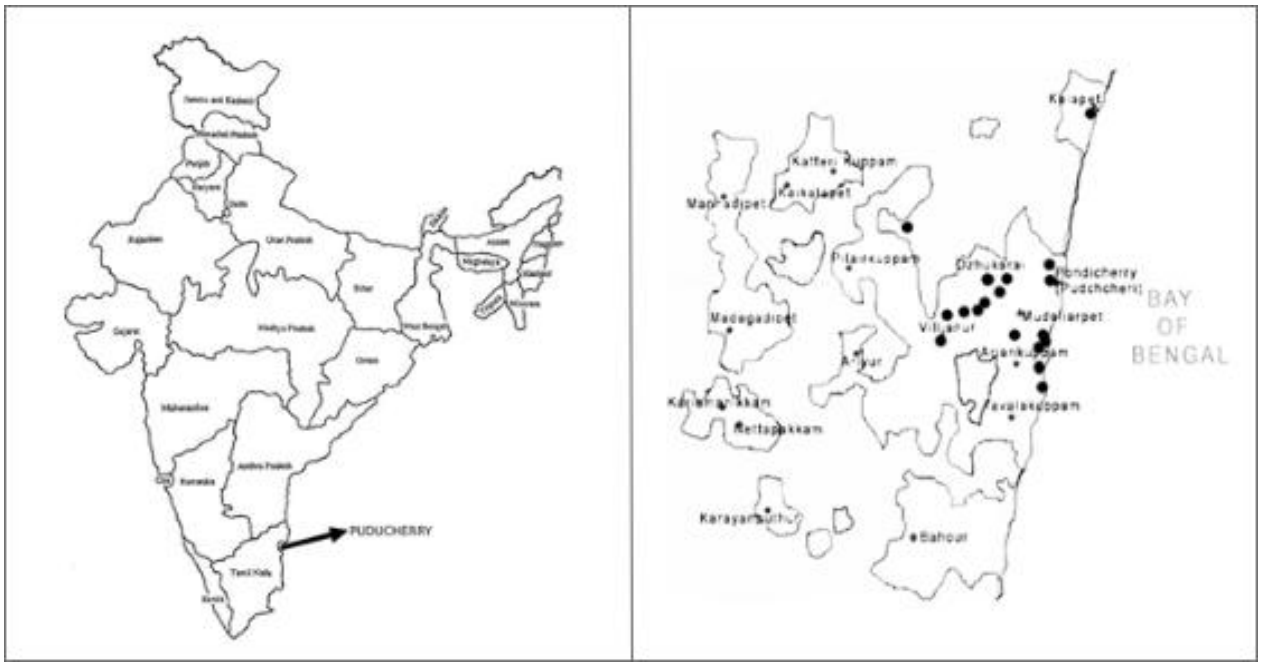

Figure- 1: Map showing the selected region in Puducherry

Table 1. Study region of Puducherry

PUDUCHERRY URBAN REGION				
LOCATION NO	**LOCATION**	**SOURCE**	**L ATTITUDE**	**LONGITUDE**
S1.	VEERAPATINAM	BORE WELL	11°53"91 N	79°47"47 E
S2.	THENGAITHITTU	BORE WELL	11°53"59 N	79°45"40 E
S3.	NONAKUPPAM	BORE WELL	11°53"12 N	79°47"42 E
S4.	MURNGAPAKKAM	BORE WELL	11°54"51 N	79°48.22 E
S5.	VELARAMPET	BORE WELL	11°55"40 N	79°48"47 E
S6.	OTHIAMPATTU	BORE WELL	11°54"25 N	79°46"36 E
S7.	VILLIANUR	BORE WELL	11°90"98 N	79°75"59 E
S8.	VILLANUR (MARKET)	BORE WELL	11°90"98 N	79°75"59 E
S9.	VILLANUR (HOUSING BOARD)	BORE WELL	11°90" 98 N	79°75"59 E
S10.	NAINAR MADABAM	BORE WELL	11°54"43 N	79°4817 E
S11.	OLGARATE	BORE WELL	11°55"48 N	79°42"48 E
S12.	MOHAN NAGAR	BORE WELL	11°55"50 N	79°47"12 E
S13.	THIRU NAGAR	BORE WELL	11°54"45 N	79°45"31 E
S14.	MUTHRIYAPALYAM	BORE WELL	11°55"42 N	79°47"18 E

S15.	MOOLAKULAM	BORE WELL	11°55"25 N	79°42"44 E
S16.	VELRAPET	BORE WELL	11°55"42 N	79°48"47 E
S17.	LAWSPET	BORE WELL	11°99"55 N	79°81"88 E
S18.	LAWSPET (ECR)	BORE WELL	11°99"55 N	79°81"88 E
S19.	OSUDU LAKE AREA	BORE WELL	11°96"14 N	79°74"46 E
S20.	KALAPET	BORE WELL	12°03"70 N	79°85"52 E

3. METHODOLOGY

To assess the impact of pollution level in the ground water, the samples were collected from the identified locations (20 Locations) of the Puducherry urban region. The samples were collected from the month of September to October 2019 (Pre-monsoon) and February to march (Post-monsoon).The ground water samples were collected from the bore well between a depth of 75-200 ft. The water samples were collected after running the well for about 10 mins which removes water in contact with the metal-well casing from the well-bore[7].The water samples were collected in hard plastic bottle of 1lts and then bottles are washed with 2% nitric acid and rinsed three times with distilled water[1]. The parameters like pH, electrical conductivity (EC), total dissolved solids (TDS) are measured in situ using the portable_pH.EC, TDS meter HI 98130(Hanna instrument). Alkalinity were measured by the standard titration method. Total hardness were measured by the EDTA method and chloride (cl^-) by argentometric method. Nitrate and fluoride were measured by DR 5000 UV- Spectrometer having the wavelength of 190-1100 nm. To assess the drinking water quality, water quality indices have been calculated for every selected location of the study areas. The values tabulated and represented graphically.

The water quality index is a representation of large numbered data into a single numerical value and used to identify the significance of various parameters on the overall quality assessment of water. In this study, the water quality index has been calculated considering eight important parameters[4&6] using the standard quality of drinking water recommended by the WHO (World health organization)[7].The calculation was achieved by considering three major steps. First step, the acquired eight parameters been assigned with certain weight-age (wi) indicating its relative importance in assessment of water quality. In the second step, the relative weight (Wi) is calculated with the help of following equations.

$$Wi = wi/\sum_{i=1}^{n} wi$$

where, Wi is the relative weight, wi is the weight of each parameter and n is the number of parameter. In third step, a quality rating scale (qi) for each parameter is calculated by the following equations.

$$qi= (Ci/SI) X 100$$

Where, Ci is the concentration of each chemical parameters in each water sample in mg/l, and Si is the Indian drinking water standard for each chemical parameter in mg/l according to the guidelines of WHO.Using the relative weight and quality rating scale values SI for each parameter calculated. WQI is thus calculated using the equation mentioned below

$$SIi = Wi \cdot qi$$

$$WQI = \Sigma SIi$$

The weights assigned and relative weights for each parameter have been given in table (4), Water quality index values have been presented in table (4). The graphical representation of water quality are shown in figure 2.

4. RESULTS AND DISCUSSION

The water samples collected from the various ground water sources (from 20 different location)and analyzed for quality assessment for pre and post monsoon are shown in the (table2) below and the result were compared with the drinking standard recommended by the WHO.

Table 2. Physico-Chemical Parameters of Ground Water for Pre monsoon in Puducherry region

LOCATION NO	pH	EC (µs\cm)	TDS (mg/l)	ALKALINITY ($HCO3^-$) (mg/l)	HARDNESS (mg/l)	Cl (mg/l)	NO3 (mg/l)	F (mg/l)
S1	5.8	1408	543	653.11	514	301.35	-	0.15
S2	5.7	1494	747	528.15	620.35	310.187	-	0.30
S3	7.2	1942	946	732	728.57	430.7	0.49	0.38
S4	5.6	684	342	607.56	285.7	262.48	-	0.31
S5	5.8	4092	2046	611.2	860	262.35	-	0.55
S6	7.5	1172	587	162.7	178.5	180.8	-	0.80
S7	7.1	888	442	623.2	164.28	111.67	-	0.41
S8	7.1	1008	504	656.3	157.14	145.35	-	0.73
S9	7.3	1046	523	133.2	214.28	177.25	-	0.40
S10	6.2	1045	1035	138.9	142.80	233.98	-	0.33
S11	6.0	1526	776	280.06	692.30	272.96	3	-
S12	6.07	2010	1005	567.3	853.84	868.52	1	-
S13	6.4	634	300	152.5	307.69	83.30	21	-
S14	6.2	750	374	381.25	430.76	102.80	47	-
S15	5.9	312	160	381.25	230.71	60.26	43	-
S16	6.2	1008	504	570.35	361.53	198.52	11	-
S17	5.8	180	91	381.25	153.84	21.27	11	-
S18	5.6	2054	1020	521.25	538.46	556.5	7	-
S19	5.9	570	282	1525	276.92	72.67	7	-
S20	7.2	638	319	762.5	353.84	62.03	28	0.01

Table 3.Physico-Chemical Parameters of Ground Water for Post monsoon in Puducherry region

LOCATION NO	pH	EC (µs\cm)	TDS (mg/l)	ALKALINITY ($HCO3^-$) (mg/l)	HARDNESS (mg/l)	Cl (mg/l)	NO3 (mg/l)	F (mg/l)
S1	5.2	1399	650	525	525	267	-	0.09
S2	5.3	1459	852	512.24	625	286	-	0.27
S3	6.0	1967	752	850	712	362	0.69	-
S4	5.8	752	265	582	298	258	-	-
S5	5.2	4120	2015	620	875	253	-	0.27
S6	7.2	1185	458	125	198	165	-	0.50
S7	6.8	896	456	618	180	102.5	0.25	0.26
S8	6.8	1008	512	623	159	120	-	0.53
S9	7.1	1023	650	128	217	136.2	0.95	0.25
S10	7.2	1145	1026	150	159	245.8	-	0.29
S11	6.5	1425	856	290	725	263.72	6.2	-
S12	6.7	1985	950	502	890	596.4	2.5	-
S13	6.2	735	850	148	320	95.25	37	-
S14	5.5	820	350	372	478	112.5	68	-
S15	5.4	216	175	378	264	45	48	-
S16	6.1	1015	520	358	372	168	26	-
S17	5.5	198	102	362	158	20	8	-
S18	5.5	2102	1050	498	564	320	12.2	-
S19	5.4	850	298	1539	280	68.2	9.2	-
S20	7.1	785	329	756.2	394	55.2	36	-

The pH of the ground water samples in the urban region were not within the standard limit recommended by the WHO. In the collected samples eight sample out of twenty are within the limit in both pre and post monsoon. The pH Varies from 6.0-7.2 and 5.2-7.1 in the both seasons respectively. The lower pH of water in the region may be due to dissolved carbon dioxide, organic acids and agricultural wastes [8].Lower pH value of ground water may cause gastroientestial dioders especially hyeracidity, ulcers and burning sensation. The decrease in pH level in pre and post monsoons may be due to dissolutions of minerals or salts during rains[9].Electrical conductivity is the important parameters in water and will affect the taste.EC varied between 312-4092 µmhos/cm and 216-4120µmhos/cm in pre-monsoon and post monsoon seasons respectively. The increasing ternd of EC from pre and post monsoon season may be due to the presences of high amount of dissolved inorganic substances in ionized form [4&13].TDS is also increased in the post monsoon season may be due to dissolution of salt by rain water. The total hardness is increased in only eight samples in the both pre monsoon

and post monsoon respectively. The total hardness having the range of 620.35-728.52 mg/l and 625-890 mg/l in the both seasons. The ground water is passed between the calcium and magnesium carbonate type of rock is very high soluble in water and it is enhanced by dissolved carbon dioxide in water[9&16].This factor increases the total hardness in the region. The chloride(cl^-) having the range of 310.35-868.52 mg/l in pre-monsoon and 236.72-596.4 mg/l in post monsoon. The level of chloride is decreases in post monsoon. Due to The natural spikes in chloride concentration can occur during the summer seasons "low flow" periods when evaporation exceeds precipitation[11&14]. However, the increases of chloride concentration due to sewage contamination and erosion in the region[4].The concentration of nitrate(NO^-_3)in the range of 0.49-47 mg/l in pre monsoon and 0.25-68 mg/l and some region does not contain any nitrate. This nitrate(NO_3) is soluble and mobile is prone to leaching through soils with infifiltrating water. Decaying organic matter domestic wastes and fertilizers are the major sources nitrate in the groundwater that leads to methamoglobinemia (blue baby syndrome) in infants[12&17]. Flouride(F^-) are with in the limit in both pre and post monsoon prescribed standard limit by (WHO).

Table- 4 : Relative weight of measured parameters

Parameter	WHO Standard	Weight(wi)	Relative Weight (Wi)
ph	6.5	4	0.137931034
EC	2250	2	0.068965517
tds	1000	4	0.137931034
alkanity	732	3	0.103448276
hardness	600	3	0.103448276
cloride	1000	3	0.103448276
flouride	0.3	5	0.172413793
nitrate	100	5	0.172413793
		∑wi=29	∑Wi= 1

Table 5. Water index quality for Pre monsoon and Post monsoon

LOCATION NO	LOCATION	PRE MONSOON	POST MONSOON
S1.	VEERAPATINAM	53.94316081	48.69377545
S2.	THENGAITHITTU	65.58811195	64.08024686
S3.	NONAKUPPAM	83.56474055	57.16675405
S4.	MURNGAPAKKAM	52.74055344	34.29972794
S5.	VELARAMPET	110.859306	93.43864063
S6.	OTHIAMPATTU	80.82827232	60.89389983
S7.	VILLIANUR	60.24277853	51.30579319
S8.	VILLANUR (MARKET)	80.54966037	67.99216338
S9.	VILLANUR (HOUSING BOARD)	56.3096681	48.49455485
S10.	NAINAR MADABAM	56.44646816	58.07942899
S11.	OLGARATE	47.34799655	49.72534908
S12.	MOHAN NAGAR	64.79934918	68.39344273

S13.	THIRU NAGAR	31.60471406	47.45181138
S14.	MUTHRIYAPALYAM	42.59569402	41.95032559
S15.	MOOLAKULAM	33.08597431	29.3767491
S16.	VELRAMPET	41.44170551	37.81821197
S17.	LAWSPET	24.27151985	23.83524804
S18.	LAWSPET (ECR)	55.86207618	54.2553221
S19.	OSUDU LAKE AREA	46.44153755	51.66417075
S20.	KALAPET	44.55461032	40.06134089

Table 6. Water quality index classification and results.

WQI RANGE	WATER TYPE	PERCENTAGE OF SAMPLES	
		PRE-MONSOON	POST-MONSOON
<50	EXCELLENT WATER	35	45
50-100	GOOD WATER	50	50
100-200	POOR WATER	5	0
200-300	VERY POOR WATER	0	0
>300	UNSUITABLE FOR DRIKING WATER	0	0

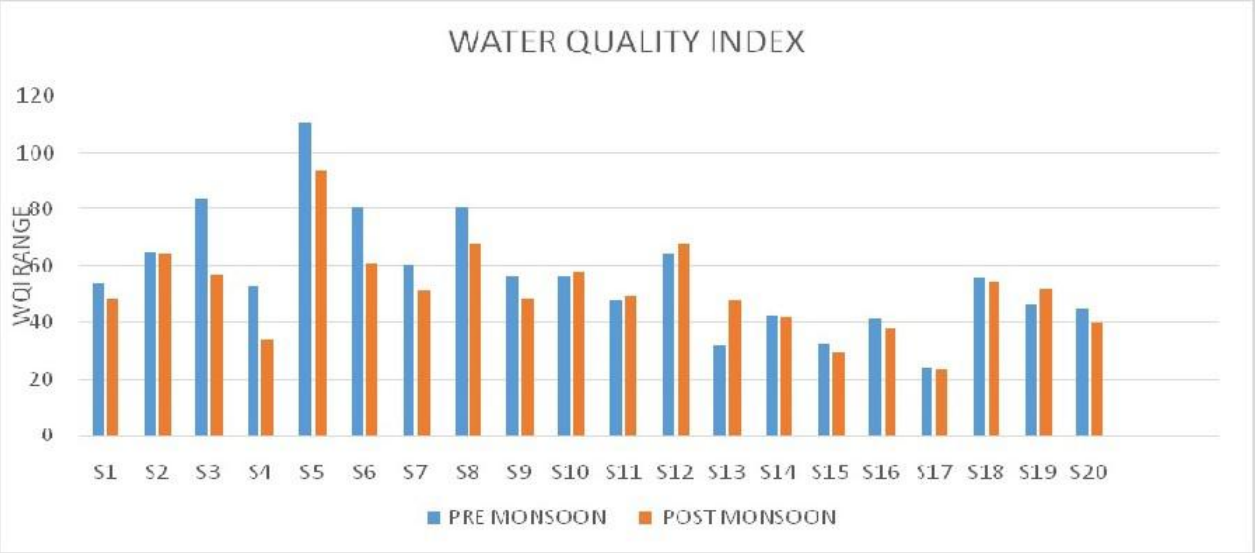

Figure -2: Graphical representation of water quality Index for pre monsoon and post monsoon

The calculated water quality index for pre monsoon reveals that 35% excellent water, 50% good quality water and only 5% of the water sample was found to be in poor quality. Whereas during post monsoon the quality assessment of water compared with the WHO reveals that 45% of water samples are excellent and 50% of water sample are found to be good and there is no poor quality water was identified during this season.

5. CONCLUSION

From the study on various parameters responsible for water quality using standard testing procedure it was found that, a slight variation in the quality of water was identified during post- monsoon and no significant

inferior quality of water was identified during the pre-monsoon and post monsoon period. The improvements in the quality of water during the post monsoon period are mainly due to the continuation in the supply of fresh water recharge. The water quality index gives an exact nature of water quality and acts as a decision support system for the suitability of the available ground water as potable. Hence this study on ground water quality has to be carried out on regular interval basis to monitor contamination. This study will gives useful information and promotes the further research in the ground water quality assessment.

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