

## Studies on Groundwater Quality in and Around Muvattupuzha Municipality, Kerala, India

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**Abstract :**The Water Quality Index (WQI) Is A Single Number That Expresses The Quality Of Water By Integrating The Water Quality Variables. This Paper Deals With The Assessment Of Ground Water Quality In And Around Muvattupuzha Municipality, Kerala State Of India. . For Calculating The WQI The Following 12 Physio-Chemical Parameters Such As Ph, Electric Conductivity, Total Dissolved Solids, Total Alkalinity, Chlorides, Total Hardness, Dissolved Oxygen, Fluoride, Calcium, Magnesium, Sulphate And Nitrate Have Been Considered. WQI Obtained Ranges From 31.38 To 507.14.High Value Of WQI Is Mainly Due To Higher Concentrations Of Iron Which Makes The Water Unsuitable For Drinking.

**Keywords:**Ground Water, Physio-Chemical Parameters, Water Quality Index, Water Quality

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### I. INTRODUCTION

The Fresh Water Is Of Vital Concern For Mankind Since It Is Directly Linked To Human Welfare. Ground Water Is An

Important Natural Source Of Water Supply All Over The World. Its Use In Irrigation, Industrial And Domestic Usage Continues To Increase Where Perennial Surface Water Source Are Absent. The Modern Civilization, Over Exploitation, Rapid Industrialization And Increased Population Has Lead To Fast Degradation Of Our Environment. The Quality Of Ground Water May Depend On Geology Of Particular Area And Also Vary With Depth Of Water Table And Seasonal Changes And Is Governed By The Extent And Composition Of The Dissolved Salts Depending Upon Source Of The Salt And Soil-Surface Environment.

Water Quality Index Provides A Single Number That Expresses Overall Water Quality At A Certain Location And Time, Based On Several Water Quality Parameters. The Objective Of Water Quality Index Is To Turn Complex Water Quality Data Into Information That Is Understandable And Usable For Common Man. A Single Number Is Not Enough To Describe The Water Quality: There Are Many Other Water Quality Parameters That Are Not Included In The Index. However, A Water Quality Index Based On Some Very Important Parameters Can Provide A Simple Indicator Of Water Quality. In General, Water Quality Indices Incorporate Data From Multiple Water Quality Parameters Into A Mathematical Equation That Rates The Health Of A Water Body With Number.

### II. STUDY AREA

For The Present Study, Muvattupuzha Municipality Of Ernakulum District Was Selected. It Is Located At A Latitude Of 9° 58' 47.46" N, And Longitude Of 76° 34' 25.72" E And Is In The Foothills Of The Western Ghats And Covers An Area Of 13.18 Km<sup>2</sup>. Ten Different Sampling Points Were Selected In The Study Area. The Locations Were Chosen Keeping In Mind That All The Areas Of Muvattupuzha Can Be Covered Properly.



Fig1.Studyarea

### III. METHODOLOGY

Water Samples Were Collected From Bore Wells And Open Wells During Monsoon A Season From The Studyarea. Samples Were Collected In Acid Washed Plastic Containers To Avoid Unpredictable Change In Characteristics As Per Standard Procedures. The Water Samples Were Analyzed For Different Physio-Chemical Parameters And Were Compared With The Values Of Various Quality Standards Such As World Health Organization (WHO), Bureau Of Indian Standards (BIS) And Indian Council For Medical Research (ICMR).

#### A. Calculation Of Sub Index Of Quality Rating ( $Q_n$ )

Let There Be N Quality Parameters Where The Quality Rating Or Sub Index ( $Q_n$ ) Corresponding To The Nth Parameter Is A Number Reflecting The Relative Value Of This Parameter In The Polluted Water With Respect To Its Standard Permissible Value. The Value Of  $Q_n$  Is Calculated Using The Following Expression.

$$Q_n = 100[(V_n - V_{io}) / (S_n - V_{io})]$$

Where,  $Q_n$  = Quality Rating For The Nth Water Quality Parameter

$V_n$  = Observed Value Of The Nth Parameter  $S_n$  = Standard Permissible Value Of Nth Parameter  $V_{io}$  = Ideal Value Of Nth Parameter In Pure Water.

All The Ideal Values ( $V_{io}$ ) Are Taken As Zero For Drinking Water Except For Ph=7 And Dissolved Oxygen=14.6mg/L

#### B. Calculation Of Quality Rating For Ph

For Ph The Ideal Value Is 7.0 (For Natural Water) And A Permissible Value Is 8.5(For Polluted Water). Therefore The Quality Rating For Ph Is Calculated From The Following Relation:

$$Q_{ph} = 100(V_{ph} - 7.0) / (8.5 - 7.0) \text{ Where,}$$

$V_{ph}$  = Observed Value Of Ph During The Study Period.

#### C. Calculation Of Quality Rating For Dissolved Oxygen

The Ideal Value ( $V_{io}$ ) For Dissolved Oxygen Is 14.6 Mg/L And Standard Permitted Value For Drinking Water Is 5 Mg/L. Therefore, Quality Rating Is Calculated From Following Relation:

$$Q_{do} = 100[(V_{DO} - 14.6) / (5 - 14.6)].$$

#### D. Calculation Of Unit Weight ( $W_n$ )

Calculation Of Unit Weight For Various Water Quality Parameters Is Inversely Proportional To The Recommended

Standards For The Corresponding Parameters.

$$W_n = K / S_n$$

Where,

$W_n$  = Unit Weight Of Nth Parameter

$S_n$  = Standard Value For The Nth Parameter

$K$  = Constant Of Proportionality And Is Given As (Kalavathy Et Al., 2011)

$$K = 1 / [1/V_{s1} + 1/V_{s2} + \dots + 1/V_{sn}]$$

#### E. Calculation Of WQI

WQI Is Calculated From The Following Equation

$$WQI = \frac{\sum Q_n w_n}{\sum W_n}$$

Table 1 Shows The Classification Of Water Quality Status Based On Water Quality Index.

**TABLE I. Water Quality Status**

Class	WQI	Water Quality Status
I	<50	Excellent
II	50-100	Good
III	100-200	Poor
IV	200-300	Very Poor
V	>300	Unsuitable For Drinking

**TABLE II. Observations In Post Monsoon Season**

**TABLE III. Observations In Summer Season**

Samples	Ph	DO	Hardness	Alkalinity	Cl-	NO <sub>3</sub> -	SO <sub>4</sub> <sup>2-</sup>	Ca	Mg	TDS	EC	Fe
Muvattupuzhatown1	6.28	10.8	54	16	13.9	1.285	1.5	10	48	160	110	0.5
Muvattupuzhatown2	6.5	8.6	30	18	4	0.428	1	12.5	16	120	40	0.5
Vazhapilly	5.88	7.8	24	14	8.9	0.857	2.5	27.5	35.5	120	100	0.4
Kadathy	5.78	6.6	30	12	6.49	1.285	0.5	37.5	12.9	200	70	1.7
Kakadassery	5.4	9.8	14	10	4.99	2.142	2.5	7.5	29.1	160	60	1
Kizhakekara	8.7	8.1	34	16	9.9	0.857	0.5	10	16	40	80	0.7
Arakuzha	6.48	10.4	24	14	5.49	1.28	2	30	12.9	80	60	0.4
Marady	6.38	9.7	22	18	4.99	0.428	1	15	9.7	160	50	0.1
Vellorkunnam	6.2	10.8	34	16	6.9	0.499	1	52.5	12.9	120	90	0.5
Adooparambu	5.9	9.6	40	14	4.99	0.210	2	45	35.5	80	30	0.9

Samples	Ph	DO	Hardness	Alkalinity	Cl-	NO <sub>3</sub> -	SO <sub>4</sub> <sup>2-</sup>	Ca	Mg	TDS	EC	Fe
Muvattupuzha Town1	6.5	9	30	20	4.99	1.435	1	15	35.5	80	115	0.6
Muvattupuzha Town2	6.3	9.2	60	60	13.49	0.625	1.5	10	32.2	120	44	0.6
Vazhapilly	6	8	40	40	10.49	0.955	2.7	30	35.5	240	110	0.4
Kadathy	5.9	6.2	22	10	6.48	2.15	0.5	40	22.5	160	55	1.6
Kakadassery	5.5	8.4	18	28	9.48	2.452	0.7	5	25.8	80	70	1
Kizhakekara	8.5	6.4	30	18	7.98	1.135	0.4	17.5	12.9	120	85	0.8
Arakuzha	6.6	6.8	22	14	4.49	1.715	1	27.5	16.1	160	65	0.4
Marady	6.35	9.4	20	26	7.48	0.39	2	12.5	6.4	80	65	0.1
Vellorkunnam	6.15	5.8	50	40	3.49	0.418	1.9	45	19.3	120	85	0.5
Adooparambu	6.2	8.3	40	24	7.98	0.429	2.4	25.75	41.9	80	42	0.9

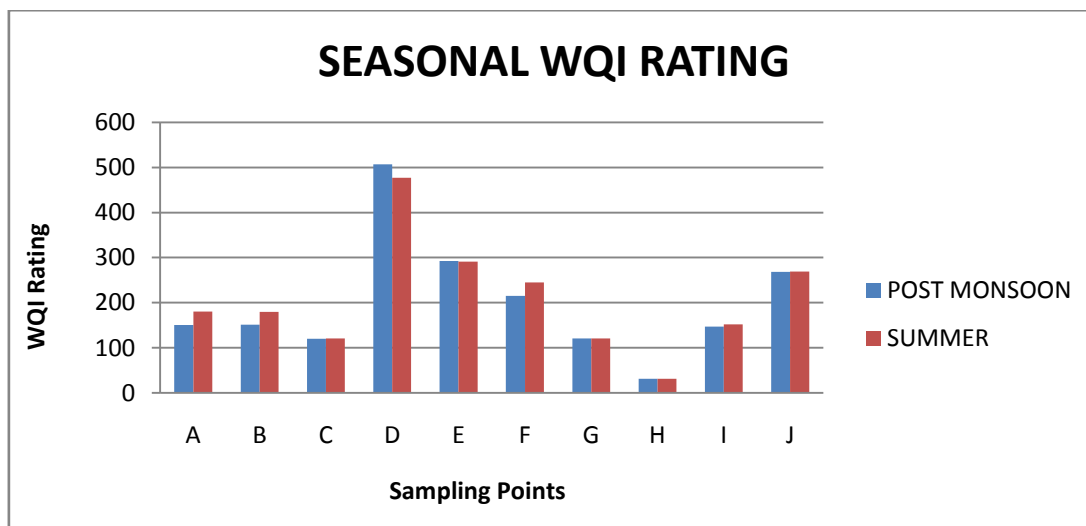
All Values Are Expressed In Mg/L, Except Ph And EC, Ph In Ph Unit, EC In M-S

**TABLE IV. Water Quality Index At Each Location: Post Monsoon Season**

Sample	Location	WQI	Remarks
A	Muvattupuzha Town1	150.298	Poor
B	Muvattupuzha Town2	151.196	Poor
C	Vazhapilly	120.240	Poor
D	Kadathy	507.140	Unsuitable
E	Kakkadassery	292.380	Very Poor
F	Kizhakkekara	215.316	Very Poor
G	Arakkuzha	120.390	Poor
H	Marady	31.381	Excellent
I	Vellorkunnam	147.330	Poor
J	Adooparambu	268.406	Very Poor

**TABLEIV. Water Quality Index At Each Location: Summer Season**

Sample	Location	WQI	Remarks
A	Muvattupuzha Town1	180.463	Poor
B	Muvattupuzha Town2	179.936	Poor
C	Vazhapilly	120.643	Poor
D	Kadathy	477.076	Unsuitable
E	Kakkadassery	291.38	Very Poor
F	Kizhakkekara	245.03	Very Poor
G	Arakkuzha	120.76	Poor
H	Marady	31.265	Excellent
I	Vellorkunnam	151.835	Poor
J	Adooparambu	269.239	Very Poor



#### IV. Results And Discussions

The Analytical Results Obtained For Different Study Parameters Such As Ph, Electrical conductivity, Total dissolved Solids, Total Alkalinity, Chloride, Total Hardness, Dissolved Oxygen, Calcium, Magnesium, Sulphate, Nitrate And Iron From Different Sampling Locations Of The Year 2017-2018 Are Summarized In Table II And III. The Results Obtained Are Discussed Below.

Ph Is An Important Parameter Which Determines The Suitability Of Water For Various Purposes. If The Water Has Ph Less Than 7, It May Cause Tuberculation And Corrosion While Higher The Values May Produce Incrustation, Sediment Deposits And Difficulties In Chlorination For Disinfection Of Water. In This Study The Ph In The Sampling Locations Are Found To Be Varying In Nature.

TDS Is An Important Parameter For Drinking Water And Other Uses. It Is Mainly Due To The Addition Of Solids From Runoff Water, Sewage And Other Effluents. In The Study TDS Was Found In The Range Of 40-240 Mg/L. The Permissible Limit Is 500 Mg/L As Per IS 10500 Standards.

Electrical Conductivity Of The Present Work Lies In The Range Of 30 To 115. It Is Within The Permissible Limit.

Alkalinity Is An Important If It Is Less Than 100 Ppm Is Desirable For Domestic Use. However In Large Quantities It Imparts Bitter Taste To Water In The Present Work It Is Found In The Range Of 10-60mg/L And The Sample Taken, It Is With In The Permissible Limit.

Chloride Occurs In All Types Of Natural Waters. The High Value Concentration Of Chloride Considered To Be An Indication Of Pollution Due To High Organic Waste Of Animal Origin. In This Study Chloride Ranges From 4 To 13.49 Mg/L. It Is Within The Permissible Limit.

Hardness Is A Measure Of Ability Of Water To Cause Precipitation Of Insoluble Calcium And Magnesium Salts Of Higher Fatty Acids From Soap Solution. In This Study, The Total Hardness Ranges Between 14- 60 Mg/L. In Present Investigation Calcium And Magnesium Content Are Found In 5-52.5 Mg/L And 6.4-48 Mg/L Respectively. They Are Within The Permissible Limit.

Water Without Adequate Dissolved Oxygen May Be Considered As Waste Water. Presence Of Dissolved Oxygen In Water May Be Due To Direct Diffusion From Air And Photosynthetic Activity Of Autotrophs. Concentration Below 5mg/L May Adversely Affect The Functioning And Survival Of Biological Communities. The DO Values Obtained In The Present Study Ranges From 5.8 – 10.8mg/L. Therefore It Is Within The Permissible Limit.

Sulphate Ion Does; Not Affect The Taste Of Water, If Present In Low Concentrations. Abnormal concentrations Of Sulphate May Be Due To The Presence Of Sulphate Ore Bodies Like Pyrite, Lignite And Coal. The Desirable Limit Of Sulphate In Drinking Water Is 250mg/L. The Range Of Sulphate Obtained Is 0.4 – 2.7mg/L And It Is Within The Permissible Limit.

Nitrate Is The Most Important Nutrient In An Ecosystem. Generally Water Bodies Polluted By Organic Matter Exhibit Higher Values Of Nitrate. Nitrate Value Obtained In The Study Ranges From 0.215 -2.45mg/L. The Permissible Limit Of Nitrate Is 45 Mg/L And Observed Values Are Within The Permissible Limit.

The Iron Content Of Water Ranges From 0.1 – 1.7mg/L. The Permissible Limit Is 0.3 Mg/L. The Maximum Value Of Iron Content Is Reported As 1.7 Mg/L At Kadathy And Makes The Water Unsuitable For Drinking. The Main Source Of Iron Content In Water Is Interaction With Lignite Rocks.

### **V. Ground Water Quality Assessment**

The Groundwater Quality Is Assessed Based On WQI. The Values Of WQI In All The Sampling Locations were Summarized In Table IV And V. On The Basis Of WQI The Quality Of Water Is Categorized From Excellent To Unsuitable For Drinking. The WQI Computed For Sample Kadathy (C) Revealed That The Water Is Unsuitable For Drinking. The Water Samples From Kakkadasery, Kizhakkemkara, Adooparambu Is Of Very Poor Quality. The Poor Quality Of Water Samples May Be Due To Presence Of Iron Content.

### **VI. Conclusions**

The Quality Of Water Obtained From Tube Well Is Poor When Compared To Open Well. Iron Content Can Be A Reason For The Poor Quality Of Water. Higher WQI Indicates That Proper Water Treatment Method Should Be Adopted Before Consumption. WQI In This Study Has Been Found Useful In Assessing The Overall Quality Of Water. This Method Appears To Be More Systematic. It Is Also Helpful For Public To Understand The Quality Of Water As Well As Being A Useful Tool In Many Ways In The Field Of Water Quality Management.

### **References**

- [1] APHA (1995). Standard Methods (18 Ed.) For The Examination Of Water And Waste Water, APHA, AWWA, WPCF, Washington DC.
- [2] Bhaven N. Tandel, JEM Macwan And Chirag K. Soni (2011). Assessment Of Water Quality Index Of Small Lake In South Gujarat Region, India, Proceedings Of ISEM-2011, Thailand. BIS 10500, (1991), Specifications For Drinking Water, Indian Standard Institutions (Bureau Of Indian Standards), New Delhi.
- [3] Brown R.M, N.J. McClelland, R.A. Deiniger, M.F.A. Oconnor (1972). Water Quality Index – Crossing The Physical Barrier, Proc. Int. Conf. On Water Pollution Research, Jerusalem, 6, 787-797.
- [4] ICMR Manual Of Standards Of Quality For Drinking Water Supplies (1975). ICMR, New Delhi.
- [5] Kalavathy S., T. Rakesh Sharma And P. Sureshkumar (2011), Water Quality Index River Cauvery In Tiruchirappalli District, Tamilnadu, Arch. Environ. Sci., 5, 55-61.
- [6] Ramakrishnaiah C.R, C. Sadashivaiah And G. Ranganna (2009). Assessment Of Water Quality Index For The groundwater In Tumkur Taluk, Karnataka State, India; E-Journal Of Chemistry, 6(2), 523-530.
- [8] Srinivasa Kushtagi And Padaki Srinivas (2012). Studies On Chemistry And Water Quality Index Of Ground Water In Chincholi Taluk, Gulbarga District, Karnataka India, International Journal Of Environmental Science, 2, 1154-1160.
- [10] WHO (1992). International Standards For Drinking Water. World Health Organization, Geneva, Switzerland

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