

## Groundwater quality of Arattupuzha coastal region of Kerala, India: A study based on pollution index

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### Supplementary Tables

Table S1 — Water quality parameters and test procedures adopted for the study

Water quality parameters	Analytical methods	Instrument make
Temperature (°C)	Thermometry	Oakton Digital thermometer
TDS (mg/L)	Gravimetric method	LABLINE Laboratory oven
EC (µS/cm)	Digital conductivity meter	DELUX Conductivity meter 601.
pH	Electrometric method	Systronics Digital pH meter model µ pH System 361.
TA (mg/L)	Titrimetric method	Titrimetry
DO (mg/L)	Azide modification method	Titiametry
BOD (mg/L)	Azide modification method	Incubator - Gambak Enterpries Madras 94
TH (mg/L)	EDTA titration	Titrimetry
Ca <sup>2+</sup> (mg/L)	EDTA titration	Titrimetry
Mg <sup>2+</sup> (mg/L)	EDTA titration	Titrimetry
Na <sup>+</sup> (mg/L)	Flame photometry	ELICO CL378 Flame photometer
K <sup>+</sup> (mg/L)	Flame photometry	ELICO CL378 Flame photometer
Cl <sup>-</sup> (mg/L)	Argentometric titration	Titrimetry
SO <sub>4</sub> <sup>-</sup> (mg/L)	Turbidimetric method	Systronics PC based double beam Spectrophotometer 2202
NO <sub>3</sub> <sup>-</sup> (mg/L)	Ultraviolet screening method	Systronics PC based double beam Spectrophotometer 2202
Total iron (mg/L)	1,10-Phenanthroline method	Systronics PC based double beam Spectrophotometer 2202

Table S2 — Percentage of groundwater samples above permissible limit of BIS drinking water standards IS: 10500 (2012)

Parameters	BIS IS:10500 (Acceptable limit)	Pre-monsoon		Monsoon		Post-monsoon	
		Dug wells	Bore wells	Dug wells	Bore wells	Dug wells	Bore wells
		No. of samples above permissible limit	% of samples above permissible limit	No. of samples above permissible limit	% of samples above permissible limit	No. of samples above permissible limit	% of samples above permissible limit
pH	6.5–8.5	0	0	0	0	0	0
EC ( $\mu\text{S}/\text{cm}$ )	1500*	4	36	4	36	6	55
TDS (mg/L)	500	1	9	1	9	1	9
Alkalinity (mg/L)	200	8	73	5	45	5	45
TH (mg/L)	200	4	37	3	27	3	27
Cl <sup>-</sup> (mg/L)	250	1	9	1	9	0	0
Iron (mg/L)	0.3	5	45	9	82	11	100
SO <sub>4</sub> <sup>2-</sup> (mg/L)	200	0	0	0	0	0	0
NO <sub>3</sub> <sup>-</sup> (mg/L)	45	0	0	0	0	0	0
Na <sup>+</sup> (mg/L)	200*	0	0	1	9	0	0
K <sup>+</sup> (mg/L)	12*	1	9	1	9	8	73
Ca <sup>2+</sup> (mg/L)	75	4	36	1	9	2	18
Mg <sup>2+</sup> (mg/L)	30	1	9	0	0	0	0

\*Based on WHO (2017) guidelines

Table S3 — Hydrochemical facies of groundwater samples during pre-monsoon, monsoon and post-monsoon seasons

Season	Groundwater facies	Characteristics	Station ID
Pre-monsoon	Ca-Na-HCO <sub>3</sub> -Cl	Alkali earth-alkali-bicarbonate-chloride	DW1, DW2, DW5, BW4
	Ca-Mg-HCO <sub>3</sub>	Alkali earth-bicarbonate	DW10
	Ca-Na-HCO <sub>3</sub>	Alkali earth-alkali-bicarbonate	BW1, BW5, DW4
	Ca-HCO <sub>3</sub>	Alkali earth-bicarbonate	BW2, BW3
	Na-Ca-HCO <sub>3</sub> -Cl	Alkali-alkali earth-bicarbonate-chloride	DW5, DW6
	Na-Ca-Mg-HCO <sub>3</sub> -Cl	Alkali-alkali earth-bicarbonate-chloride	DW3
	Ca-Mg-Na-HCO <sub>3</sub>	Alkali earth-alkali-bicarbonate	BW1
	Ca-Mg-HCO <sub>3</sub>	Alkali earth-bicarbonate	BW2
Monsoon	Na-Ca-HCO <sub>3</sub>	Alkali-alkali earth-bicarbonate	DW3, DW4, DW5, DW6
	Ca-Na-HCO <sub>3</sub>	Alkali earth-alkali-bicarbonate	BW3, DW1
	Na-Ca-Mg-HCO <sub>3</sub>	Alkali-alkali earth-bicarbonate	BW4, BW5
	Na-Cl	Saline	DW2
	Ca-Na-HCO <sub>3</sub>	Alkali earth-alkali-bicarbonate	BW1, BW3, DW1, DW3, DW5, DW6
	Na-K-Ca-HCO <sub>3</sub>	Alkali-alkali earth-bicarbonate	BW5, DW4
Post-monsoon	Ca-Na-Cl-HCO <sub>3</sub>	Alkali earth-alkali-chloride-bicarbonate	DW2,
	Ca-Na- Mg-HCO <sub>3</sub>	Alkali earth-alkali-bicarbonate	BW4
	Ca-Na-Cl-HCO <sub>3</sub>	Alkali earth-alkali-chloride-bicarbonate	DW2
	Ca-K-HCO <sub>3</sub>	Alkali earth-alkali-bicarbonate	BW2

Table S4 — Seasonal Water Quality Index (WQI) for the Dug Well (DW) and Bore Well (BW) stations during the year 2019

Station ID	Pre-monsoon	Water quality	Monsoon	Water quality	Post-monsoon	Water quality
DW1	106.4	UDP*	87.4	Very Poor	355.1	UDP
DW2	15.6	Excellent	18.5	Excellent	268.2	UDP
DW3	15.1	Excellent	112.4	UDP	291.2	UDP
DW4	16.9	Good	272.5	UDP	85.2	Very Poor
DW5	37.2	Good	269.6	UDP	162.6	UDP
DW6	255.9	UDP	330.9	UDP	188.8	UDP
Mean±SD	74.5±95.5	Poor (P)	181.9±125.3	UDP	225.2±97.9	UDP
BW1	185.2	UDP*	889.9	UDP	222.9	Poor (P)
BW2	485.4	UDP	499.4	UDP	522.2	UDP
BW3	426.6	UDP	288.9	UDP	423.4	UDP
BW4	134.5	UDP	254.6	UDP	327.7	UDP
BW5	343.9	UDP	135.9	UDP	535.8	UDP
Mean±SD	315.1±151.4	UDP	413.8±296.7	UDP	406.4±132.6	UDP

\*UDP – Unfit for Drinking Purpose

Table S5 — Pollution Index of Groundwater (PIG) for dug well and bore well groundwater sources

Station ID	Pre-monsoon		Monsoon		Post-monsoon	
	PIG	Water condition	PIG	Water condition	PIG	Water condition
DW 1	0.5	Insignificant pollution	0.4	Insignificant pollution	1.0	Low pollution
DW 2	0.5	Insignificant pollution	1.7	Moderate pollution	1.3	Low pollution
DW 3	0.2	Insignificant pollution	0.5	Insignificant pollution	0.7	Insignificant pollution
DW 4	0.2	Insignificant pollution	0.6	Insignificant pollution	0.3	Insignificant pollution
DW 5	0.5	Insignificant pollution	0.8	Insignificant pollution	0.8	Insignificant pollution
DW 6	1.0	Low Pollution	0.7	Insignificant pollution	0.8	Insignificant pollution
Mean±SD	0.5±0.3	Insignificant pollution	0.8±0.5	Insignificant pollution	0.8±0.3	Insignificant pollution
BW 1	0.2	Insignificant pollution	1.6	Moderate pollution	0.5	Insignificant pollution
BW 2	0.9	Insignificant pollution	1.0	Low pollution	1.0	Low pollution
BW 3	0.8	Insignificant pollution	0.6	Insignificant pollution	0.7	Insignificant pollution
BW 4	0.5	Insignificant pollution	0.5	Insignificant pollution	0.8	Insignificant Pollution
BW 5	0.5	Insignificant pollution	0.5	Insignificant pollution	1.1	Low pollution
Mean±SD	0.6±0.3	Insignificant pollution	0.8±0.5	Insignificant pollution	0.8±0.2	Insignificant pollution