Water Quality Index, Correlation and Regression Analysis in Temple Pond Water Study

P. Meenakshi and G. Sriram

Abstract This research article explains the prediction of parameters that mostly affect the water quality index by using correlation and regression analysis. This research work was carried out in January 2018 in 17 temple ponds of the holiest city Kanchipuram. The pond water samples were tested for 11 parameters: pH, dissolved oxygen, total hardness, calcium, magnesium, total dissolved solids, chloride, sulfate, total nitrogen, total phosphate, and iron. The calculated water quality index that varies from 202 to 387 indicates that the water is unfit for drinking purposes. This greater value is due to the total phosphate exceeding the limit. Correlation analysis indicates that WQI has a good correlation with total phosphate, total nitrate, and chloride (r = 0.956, 0.908, and 0.803). In regression analysis, WQI with total phosphate shows a greater R^2 value (0.914). The evaluation of experimental and expected values of the dissimilar water quality parameters reveals that the correlation and regression analysis are very useful for finding the parameter mostly affecting the water quality index.

Keywords Correlation · Regression · Water quality index · Pond water · Standards

1   Introduction

Water is the major resource for the nutrition of life. Freshwater will be an inadequate resource in the future. To assemble the water quality potential, surface water resources are also a requirement to keep groundwater [1]. The dissimilar resources of freshwater on earth are lakes, ponds, rivers, streams, runoff, snow, groundwater, and an underground stream. Freshwater is a significant ecological resource for which there is no alternative. In the total freshwater supply, the superior part of the freshwater is changed into the structure of ice and the remaining 90% is groundwater [2]. Water is an essentially expensive resource in the lifeline of all existing organisms. Ponds are a significant part of the earth's water cycle. Anthropogenic behavior such

P. Meenakshi (✉) · G. Sriram
Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya Enathur, Kanchipuram, Tamil Nadu 631 561, India
e-mail: meenathavamani82@gmail.com

as the release of domestic, engineering, and other main actions have caused major pollution harm to these rivers [3]. The chemical pollutants of industrial, domestic, and agricultural origin discover their way into ponds through surface runoff and precipitation and enlarge the stage of pollutants [4]. Quantitative estimation of water quality is one of the necessary aspects of efficient water source management. The water quality index value indicates the worth of water in terms of the index number for any proposed use. It is defined as a rating that indicates the composite power of different water quality parameters for the calculation of water quality index [5]. The water quality index value has been used in the assessment of potable water; analysis has shown very limited study has been passed out to evaluate the water for agriculture purpose [6]. The current research work is for the measurement of water quality parameters, finding the water quality index, and statistical analysis in the form of correlation and regression. The measurement components are obtained during the period January 2018 in temple ponds in Kanchipuram.

2 Materials and Methods

2.1 Study Area

This research work pays attention to temple ponds filled with water in Kanchipuram town. Kanchipuram city has a total area of 11.60 km square. The study area (temple ponds) has an elevation of 83.2 m (273 ft) above sea level. The land and temple ponds around Kanchipuram city are flat and slope towards the south and east. It is one of the prominent cities of temples in South India. Kanchipuram town is the northern segment of Tamil Nadu state. The temple pond location of the study area is shown in Fig. 1.

2.2 Source of Sample Water

The main source is precipitation; other sources are temple usage water. The pollution created in the pond is due to some anthropogenic activities like people washing clothes, bathing, taking a deep dip, washing their hands and legs, and disposing of limited household waste.

2.3 Sampling of Water

The sampling was done in January 2018. The pond water sample was collected in a clean polythene bottle (1 l capacity). It was rinsed with corresponding pond water
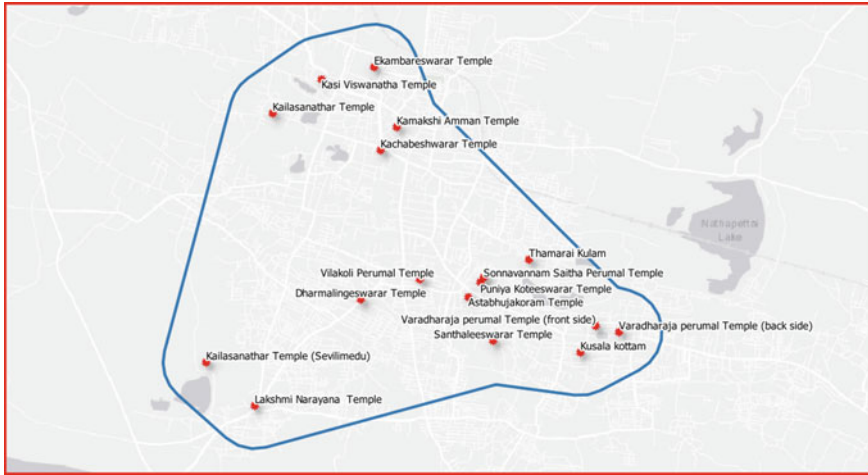
Fig. 1 Temple pond location of the study area

3–4 times, and the samples were collected by submerging the bottle half feet below the water surface. The water sample was collected fully in the bottle and tightly sealed with the cap. The collected water was identified as P1 to P17, and the sample water was sent for testing. The parameters pH, dissolved oxygen, total dissolved solids, chlorides, sulfate, total hardness, calcium, magnesium, total nitrogen, total phosphate, and iron were tested in the laboratory for 17 samples, and the measured water quality parameters were shown in Table 1.

3   Water Quality Index

The calculation of the water quality index is the most efficient tool to give information on the quality of water [7]. WQI is defined as a rating that reflects the complex influence of dissimilar water quality parameters [8, 9]. In the calculation of the water quality index in the present study, 11 parameters were considered. WQI—water quality index, WQP—water quality parameter.

There are three steps for calculating the WQI value:

1. The measured parameter was assigned a weight (wi) based on their effects on water, and the values are nearest to the WHO standard value. The assigned weight and standard value are shown in Table 2.

2. The parameters relative weight (Wi) is calculated by

$$Wi = \left[wi / \left(\sum_{n=1}^{n} wi \right) \right]$$

Table 1 Water quality parameter values of sample points

Sample point	Name of the temple	pH	DO mg/l	TDS mg/l	CL mg/l	SO$_4$ mg/l	TH mg/l	Ca mg/l	Mg mg/l	T N mg/l	TP mg/l	Fe mg/l
P1	Lakshmi Narayana Temple	7.03	6.8	159	56	22	106	21	13	8.9	5.6	0.07
P2	Kamakshi Amman Temple	7.32	6.5	744	84	53	172	42	16	9.7	4.8	0.09
P3	Kailasanathar Temple (Sevilimedu)	9.31	6.3	164	41	19	90	13	14	12.9	8.3	0.04
P4	Kasi Vishwanathar Temple	8.26	6.2	436	30	17	99	18	13	9.6	5.8	0.03
P5	Astabhujakoram Temple	7.91	6.2	148	28	16	122	32	10	9.5	5.7	0.08
P6	Puniya Koteeswarar Temple	7.68	6.4	183	35	13	133	40	8	8.7	5.7	0.03
P7	Kusala Kottam	8.04	7.6	744	158	94	203	43	23	13.4	8.6	0.08
P8	Kachabeeswarar Temple	6.86	6.8	114	32	17	85	24	6	11.6	7.3	0.02
P9	Vardharaja Temple (Front)	7.58	6.5	172	32	14	99	18	13	10.6	6.4	0.07
P10	Varadharaja Perumal Temple (Back)	7.62	7.5	740	130	67	261	56	29	11.9	6.7	0.07
P11	Sonnavanam saitha Perumal Temple	7.8	7.4	1146	312	138	221	45	26	12.7	7.2	0.03
P12	Dharmalingeshwarar Temple	8.86	6.2	1160	349	184	139	29	16	13.8	8.6	0.02

(continued)

Table 1 (continued)

Sample point	Name of the temple	pH	DO mg/l	TDS mg/l	CL mg/l	SO$_4$ mg/l	TH mg/l	Ca mg/l	Mg mg/l	T N mg/l	TP mg/l	Fe mg/l
P13	Ekambareswarar Temple	7.52	7.5	117	32	18	83	18	9	9.2	4.7	0.03
P14	Santhaleeswarar Temple	7.46	6.9	1076	206	148	310	69	33	12.8	7.4	0.05
P15	Vilaku Oli Perumal Temple	7.45	7.2	750	167	76	316	38	53	10.8	8.3	0.06
P16	Kailasanathar Temple	7.66	6.4	547	108	57	185	21	32	12.8	7.7	0.04
P17	Thamarai Kulam	7.42	7.8	1204	318	126	254	55	28	13.7	8.5	0.07

Table 2 WHO standards and relative weight

Chemical parameter	WHO standards	Weight	Relative weight
pH	6.5–8.5	1	0.034
DO	5	5	0.172
TDS	500	4	0.138
Cl	250	3	0.103
SO4	150	1	0.034
TH	300	2	0.069
Ca	75	1	0.034
Mg	50	1	0.034
TN	50	1	0.034
TP	0.5	5	0.172
Fe	0.3	5	0.172
		29	0.996

where Wi indicates the relative weight, wi indicates the weight of each measured parameter, and n is the number of parameters.

$$Qi = [(Ci/Si) \times 100]$$

where Qi = quality rating, Ci = concentration of each parameter in each water sample in mg/l, and Si = WHO water standard

$$SI = Wi\,Qi$$

$$WQI = \sum_{i=1}^{n} SI$$

where SI is the subindex of the ith parameter; Qi is the rating based on the concentration of ith parameter and n is the number of parameters. The calculated subindex and WQI values are shown in Table 3. The subindex values of total phosphate are greater than other parameters, which influence the higher value of the water quality index.

The calculated WQI values are classified into five categories: excellent to unsuitable for drinking purpose. WQI < 50 = Excellent, 50–100 = Good, 101–200 = Poor, 201–300 = Very poor, > 300 = Unsuitable.

Table 3 Subindex and water quality index values of sample points

S. no.	Sample point	SI = (pH)	SI = (DO)	SI = (TDS)	SI = (Cl)	SI = (SO4)	SI = (TH)	SI = (Ca)	SI = (Mg)	SI = (TN)	SI = (PO4)	SI = (Fe)	WQI
1	P1	3.68	23.39	4.39	2.31	0.50	2.44	0.95	0.88	0.61	192.64	4.01	235.80
2	P2	3.83	22.36	20.53	3.46	1.20	3.96	1.90	1.09	0.66	165.12	5.16	229.27
3	P3	4.87	21.67	4.53	1.69	0.43	2.07	0.59	0.95	0.88	285.52	2.29	320.62
4	P4	4.32	21.33	12.03	1.24	0.39	2.28	0.82	0.88	0.65	199.52	1.72	245.17
5	P5	4.14	21.33	4.08	1.15	0.36	2.81	1.45	0.68	0.65	196.08	4.59	237.32
6	P6	4.02	22.02	5.05	1.44	0.29	3.06	1.81	0.54	0.59	196.08	1.72	236.63
7	P7	4.21	26.14	20.53	6.51	2.13	4.67	1.95	1.56	0.91	295.84	4.59	369.04
8	P8	3.59	23.39	3.15	1.32	0.39	1.96	1.09	0.41	0.79	251.12	1.15	288.34
9	P9	3.96	22.36	4.75	1.32	0.32	2.28	0.82	0.88	0.72	220.16	4.01	261.58
10	P10	3.99	25.80	20.42	5.36	1.52	6.00	2.5	1.97	0.81	230.48	4.01	302.90
11	P11	4.08	25.46	31.63	12.85	3.13	5.08	2.04	1.77	0.86	247.68	1.72	336.30
12	P12	4.63	21.33	32.02	14.38	4.17	3.20	1.31	1.09	0.94	295.84	1.15	380.05
13	P13	3.93	25.80	3.23	1.32	0.41	1.91	0.82	0.61	0.63	161.68	1.72	202.05
14	P14	3.90	23.74	29.70	8.49	3.35	7.13	3.13	2.24	0.87	254.56	2.87	339.98
15	P15	3.90	24.77	20.70	6.88	1.72	7.27	1.72	3.60	0.73	285.52	3.44	360.26
16	P16	4.01	22.2	15.10	4.45	1.29	4.26	0.95	2.18	0.87	264.88	2.29	322.29
17	P17	3.88	26.83	33.23	13.10	2.86	5.84	2.49	1.90	0.93	292.4	4.01	387.49

4 Statistical Analysis

SPSS 18 software was used to carry out the statistical analysis in the study. Statistical parameters correlation coefficient and regression coefficient for physicochemical parameters are determined. Correlation analysis deals with the closeness of the relationship between measured variables [10, 11]. The coefficient values vary between 1 and −1, which show the great linear relationship between the two measured variables. To find out the closeness of the relationship among 11 tested water quality parameters and calculated WQI, Karl Pearson correlation matrix has been deployed. Correlation is the common relationship between the two variables. The correlation analysis explains if an increase or decrease in the value of one parameter is connected with a subsequent increase or decrease in the worth of other parameters [12]. In the current study, the arithmetical values of the correlation coefficient (r) for the 11 water quality parameters are tabulated in Table 4.

Correlation Coefficient (r):

Consider x and y are the two different variables having n pairs of calculated values and differ from 1, 2, 3, 4, 5, …, n. The correlation coefficient r is given by Eq. (1):

$$r = \frac{\left[n \sum x\, y - \sum x \sum y \right]}{\sqrt{\left[n \sum x^2 - \left(\sum x \right)^2 \right] \times \left[n \sum y^2 - \left(\sum y \right)^2 \right]}} \tag{1}$$

Multiple linear regression analysis is a statistical tool for understanding an outcome variable and several predictors (independent variables) that best represents the relationship in a population. The regression is given by Eq. (2). The regression equation and coefficient values are tabulated in Table 5.

Regression equation

Table 4 Correlation coefficient values for measured parameters

	pH	DO	TDS	Cl	SO4	TH	Ca	Mg	TN	TP	Fe	WQI
pH	1	−0.38	0.090	0.154	0.175	−0.209	−0.273	−0.106	0.366	0.371	−0.266	0.282
DO		1	0.398	0.405	0.328	0.534	0.513	0.424	0.294	0.224	0.222	0.354
TDS			1	0.932	0.941	0.752	0.706	0.612	0.677	0.529	0.063	0.749
Cl				1	0.960	0.610	0.560	0.508	0.725	0.624	−0.085	0.803
SO4					1	0.641	0.619	0.509	0.738	0.604	−0.080	0.786
TH						1	0.834	0.898	0.442	0.449	0.303	0.630
Ca							1	0.505	0.340	0.217	0.323	0.430
Mg								1	0.423	0.532	0.216	0.643
TN									1	0.882	−0.116	0.908
TP										1	−0.128	0.956
Fe											1	−0.049
WQI												1

Table 5 Regression study between WQI and WQP

Regression	R2	Regression Coefficient	Remarks
WQI = 0.002pH + 6.900	0.079	0.002	Positive
WQI = −0.003DO + 5.857	0.125	0.003	Positive
WQI = 5.141TDS−963.8	0.560	5.141	Positive
WQI = 1.489Cl−318.4	0.644	1.489	Positive
WQI = 0.731SO4-154.0	0.618	0.731	Positive
WQI = 0.831TH−77.84	0.396	0.831	Positive
WQI = 0.130Ca−18.69	0.413	0.130	Positive
WQI = 0.115 Mg−0.117	0.185	0.115	Positive
WQI = 0.027TN + 3.193	0.823	0.027	Positive
WQI = 0.021TP + 0.544	0.914	0.021	Positive
WQI = −2E.05×Fe + 0.057	0.002	−2E.05	Negative

$$y = ax + b \qquad (2)$$

where y = dependent variable, x = independent variable, and a = regression coefficient.

The correlation and regression analysis was carried out using the software SPSS 18.

5 Results and Discussion

5.1 Water Quality Parameters

The pH is the hydrogen ion concentration that plays an important role in the biological processes of almost all aquatic living organisms. In the sampling points, measured pH values vary from 6.86 to 9.3, with pond water alkaline in nature [13]. P3 pond has a greater value of pH due to washing clothes and bathing. Dissolved oxygen represents how much quantity of oxygen is dissolved in a water medium [14]. A

DO value greater than 4 mg/l is essential, and for drinking purpose the value is 6 mg/l [15]. At sample points, the DO values vary between 6.2 mg/l and 7.8 mg/l. The total dissolved solids are the presence of different kinds of minerals in water and are denoted by total dissolved solids. TDS is directly connected with the purity of water. The sum of the cations and anions concentration is equal to TDS. As per IS:10500-2012 standards, the acceptable limit is 500 mg/l. In the present study, the TDS values vary from 114 mg/l to 1160 mg/l. P12 pond has the maximum value. The greater value of TDS is due to anthropogenic activities. Chloride is present in all types of natural waters, and the amount of chloride present is widely varying in concentration. When the mineral content in the water increases, the chloride content will automatically increase. Human activities will increase the concentration of chloride. As per IS:10500-2012, the acceptable limit of chloride is 250 mg/l. In the present study, the chloride content varies from 28 to 349 mg/l. P11, P12, and P17 are sample points having greater value, due to the leaching of deep sediments from the soil by rainwater. Sulfate is a naturally occurring mineral. Minerals dissolve for a long time for mixing into groundwater. The acceptable limit is 150 mg/l. In the present study, it varies from 13 to 184 mg/l. P12 pond has the greater value. Total hardness indicates the sum of calcium and magnesium hardness in mg/l[15]. The degree of hardness of clean water has been classified in terms of equivalent $CaCO_3$ concentration as follows: Soft nature: 0–60 mg/l, Medium: 60–120 mg/l, Hard nature: 120–180 mg/l, and terribly hard nature greater than 100–80 mg/l. In the present study, TH varies from 83 to 316 mg/l. Pond water is hard in nature. Calcium and magnesium are necessary nutrients required for an organism. A calcium value varies from 13 to 69 mg/l. A magnesium value varies from 6 to 53 mg/l. The acceptable limits for hardness in calcium and magnesium are 300, 75, and 50 mg/l. Total nitrogen is the combination of organic, inorganic nitrogen, and ammonia. It varies from 8.7 to 13.8 mg/l. Acceptable limit is 50 mg/l. Total phosphate is essential nutrition up to a standard limit. The acceptable limit is 0.5 mg/l. In the current study, it varies from 4.8 to 8.6 mg/l. The greater amount of phosphate is due to stormwater runoff and the decomposition of waste into the ponds. It creates water quality index of high value. Iron is an important nutrient element for humans. It is a significant mineral for the production of hemoglobin and myoglobin [16]. Iron is a significant water quality variable in aquaculture, and it is considered a necessary element for plants, bacteria, and animals. In the photosynthesis of plants, iron plays an important role. Iron is a dissolved nutrient essential in minor quantities by both aquatic plants and animals. Oxidation of ferrous iron into ferric iron often outcomes in reddish deposits of ferric hydroxide on pond bottoms. In many aquaculture systems, the presence of iron concentrations above 0.1 mg/l will damage the gills of the fish. The value of iron in the current study varies in the ranges from 0.02 to 0.09 mg/l.
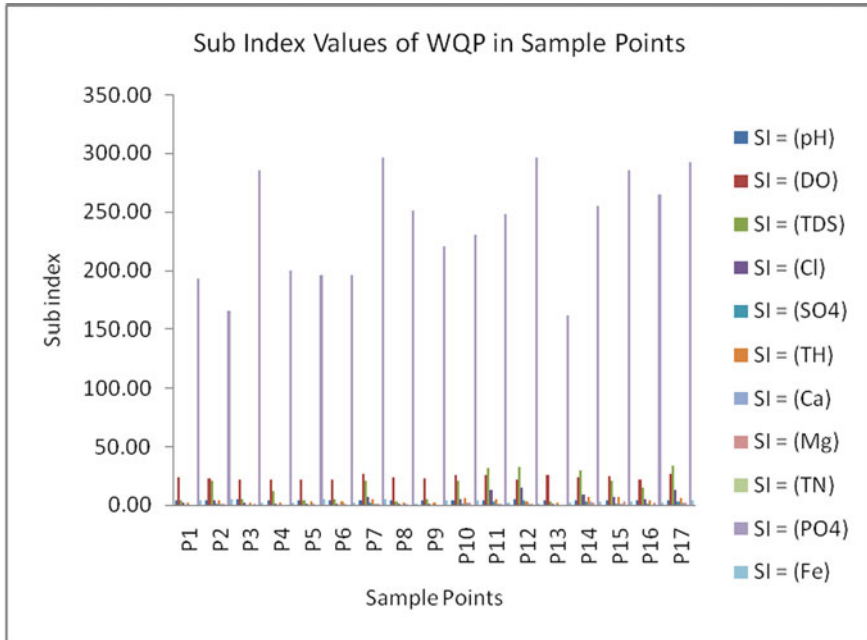
Fig. 2 Calculated subindex values of measured parameters

5.2 Water Quality Index

The subindex values of measured parameters and water quality index values for 17 sample points were calculated and tabulated in Table 3. The graphical representation of subindex values is shown in Fig. 2. The subindex values of total phosphate are majorly affecting the water quality index; it reflects in correlation and regression analysis. The sample points P3, P7, P10, P11, P12, P14, P15, P16, and P17 have a WQI value of 200–300. It shows the pond water is in very poor condition. The sample points P1, P2, P4, P5, P6, P8, P9, and P13 have a WQI value of greater than 300, so it is unsuitable for drinking purpose. The variation of water quality index values on the sample points is shown in Fig. 3. The higher value of WQI is due to the higher value of total phosphate.

5.3 Correlation and Regression Analysis

The correlation and regression model analysis is helping interpret pond water excellence numbers and relate them to definite hydro environmental processes [17, 18]. These model analyses are relatively useful in characterizing and getting first-hand matters of the pond water system than really departing through difficult methods [19,
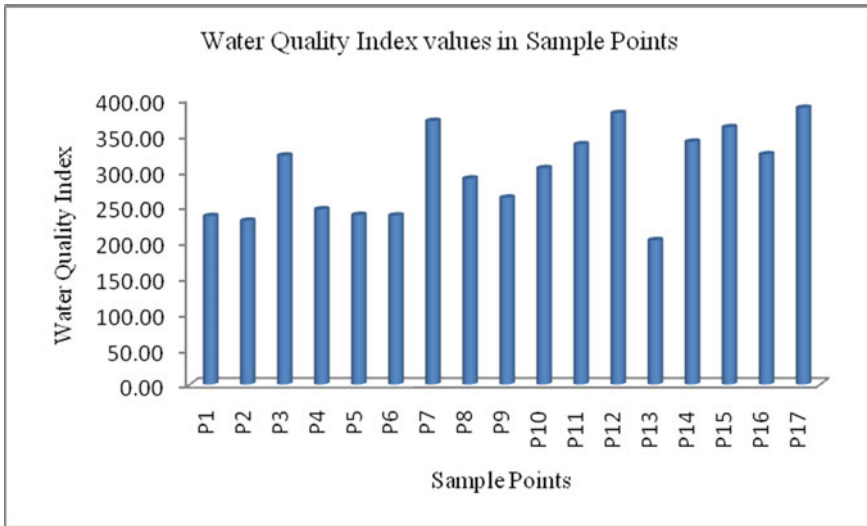
Fig. 3 Water quality index variation of sample points

20]. Correlation and regression analysis done with the SPSS software, the correlation coefficient values, and regression coefficient values were tabulated in Tables 5 and 6. WQI having a good positive correlation with TP, TN ($r = 0.956, 0.908$) and Cl, SO$_4$, TDS ($r = 0.803, 0.786, 0.749$). Good positive correlations TDS with SO$_4$, Cl, TDS, Ca ($r = 0.941, 0.932, 0.752, 0.706$). Cl with SO$_4$, TN ($r = 0.960, 0.725$). SO$_4$ with TN ($r = 0.738$). TH with Ca, Mg ($r = 0.834, 0.898$). TN with TP ($r = 0.882$). WQI moderate correlation with Mg, TH ($r = 0.643, 0.630$). WQI weak correlation with pH, DO, Ca ($r = 0.282, 0.354, 0.430$). WQI has a negative weak correlation with Fe ($r = -0.049$). From the result the greatest positive r value is WQI with TP ($r = 0.956$). This representation indicates a greater water quality index value due to total phosphate.

The significant effect of all the independent variables on the dependent variable has been identified by regression analysis. The effects of WQI with all measured parameters have been determined with ra egression plot. The graphical representation of the regression graph is shown for the following WQI with pH, DO in Fig. 4, WQI with TDS, Cl, SO$_4$ in Fig. 5, WQI with TH, Ca, Mg in Fig. 6, WQI with TN, TP in Fig. 7, and WQI with Fe in Fig. 8. The prediction of WQI with total phosphate is good. The multiple R^2 values (0.914) indicate that 91.4% of the variability in WQI might be recognized as the effect of total phosphate.
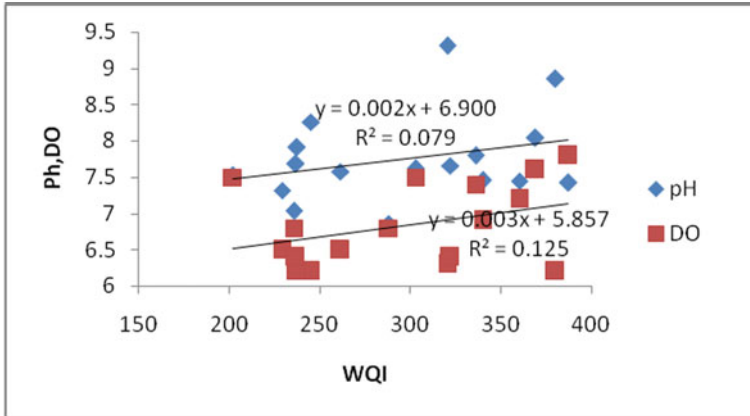
Fig. 4 Regression graph between WQI and pH, DO
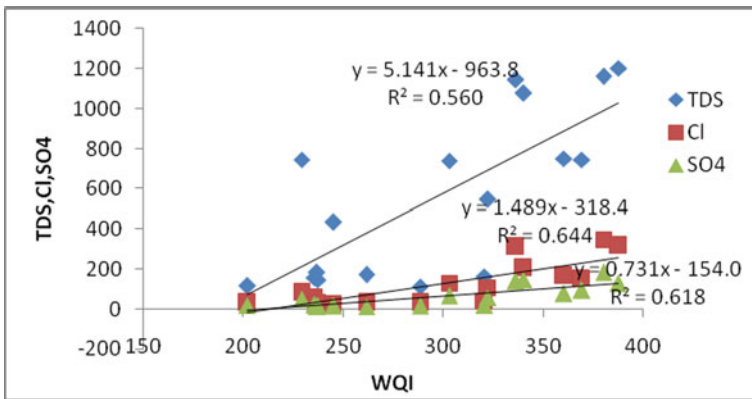
Fig. 5 Regression graph between WQI and TDS, Cl, SO$_4$

6   Conclusions

Maintaining the water quality of pond water at a good level is important to monitor regularly. Water quality monitoring study is useful for understanding the water quality and controlling the pollution effects. The variations have been noticed in definite pond water quality material among the sample water collected from various temple ponds and may be recognized to various anthropogenic activities, land utilization, and land coat factors. The calculated water quality value varies between very poor to unsuitable for drinking purposes. P17, P12, P7, and P3 ponds are unsuitable for drinking. These ponds need primary production in the form of fencing around the circumference. However, a significant correlation has been noticed between the water quality index and tested water quality parameters. There is a good positive correlation
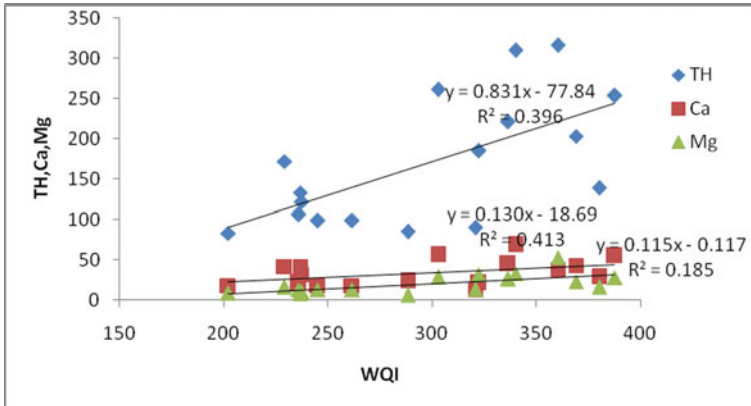
Fig. 6 Regression graph between WQI and TH, Ca, Mg
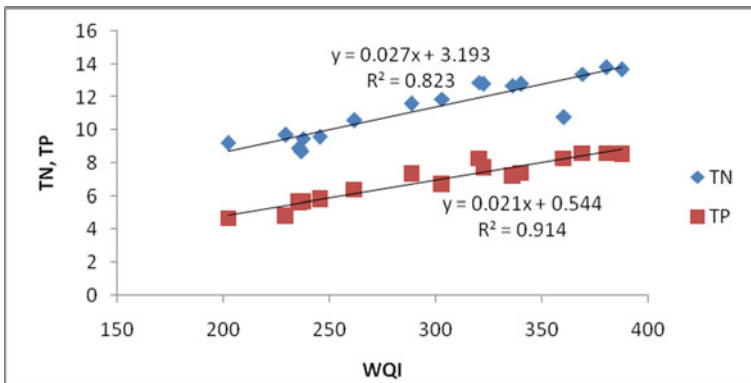
Fig. 7 Regression graph between WQI and TN, TP

that exists between WQI and water quality parameters (TP, TN, Cl, SO4, TDS). The significant effect between WQI and water quality parameters has been identified by regression analysis. The effect of total phosphate in WQI calculation is about 80%, which has more impact than other measured parameters. Total phosphate with WQI is a significantly positive correlation of 95.6%. The multiple regression model predicted WQI with total phosphate has 91.4% of R^2 value. This result indicated the presence of high total phosphate concentration and is the potential pressure for pollution of pond water. The correlation and regression model gives a good result for finding the most affected parameter in water quality. The above results have indicated a good relationship existing between water quality index and correlation, and regression analysis. It is recommended that the pond water conventional treatment followed by disinfection will give better results before drinking and potable uses. The present water is recommended for fish culture and temple usage.
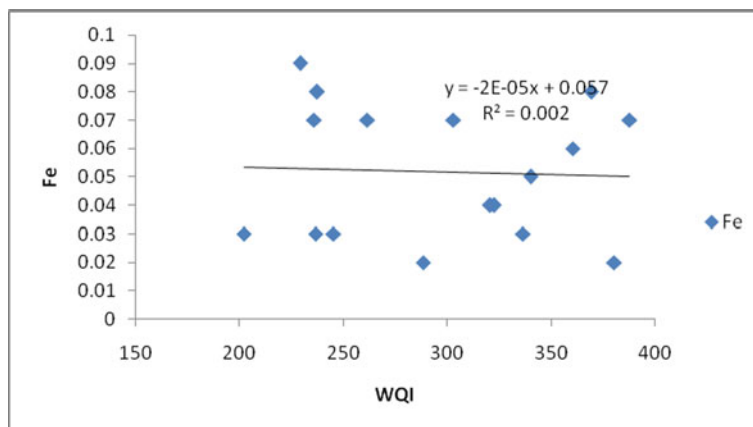
Fig. 8 Regression graph between WQI and Fe

References

1. Sukla SP, Agrawal V (2011) Water quality index of surface water in an industrial area in Kanpur City. J Instit Eng 92:1–5
2. Prashant Bhausaheb R, Jadhav MV (2016) The analysis of ground water quality status using linear regression method. Int J Eng Trends and Technol 38:23–228
3. Abhishek S, Khambete AK (2013) Statistical analysis to identify the main parameters to the astewater quality index of CETP : a case study at Vapi, Gujarat, India. J Environ Res Developm 7:1294–1304
4. AkshathaK N (2012) Assessment of water quality of a polluted pond at mysore using national sanitation foundation-water quality index (NSF-WQI). Nat Environ Pollut Technol 11:311–314
5. Puri PJ, Yenkie MKK, Rana DB, Meshram SU (2015) Application of water quality index (WQI) for the assessment of surface water quality (Ambazari Lake). European J Experim Biol 5:37–52
6. Ali Al-Dahhan NA, Hussein Al-Atwi AK, Murad.Al-Zubaidi MG (2019) Water quality index for surface water assessment by using remote sensing and GIS techniques, AL- Najaf, Al-Manathera district, Iraq. J Phys: Conf Ser 7:1–14
7. Krishnan S, Pushkaran P (2017) Water quality assessment and algal analysis of two temple ponds in the industrial area, Kollam District, Kerala. J Adv Biol Sci 4:68–71
8. Elayaraj B, Selvaraju M, Ajayan KV (2016) Assay on water quality variations of Pasupatheswarar Temple Pond, Annamalai Nagar, Tamil Nadu, India. J Int Acad Res Multidisciplinary 3:97–108
9. Bansal J, Dwivedi AK (2018) Assessment of ground water quality by using water quality index and physico chemical parameters: review paper. Int J Eng Sci Res Technol 7:170–174
10. Ambiga K, Annadurai R (2015) Development of water quality index and regression model for assessment of groundwater quality. Int J Adv Remote Sensing GIS 4:931–943
11. Saleem A, Dandigi MN, Vijay Kumar K (2012) Correlation-regression model for physico-chemical quality of groundwater in the South Indian City of Gulbarga. African J Environm Sci Technol 6:353–364
12. Chaubey S, Patil MK (2015) Correlation study and regression analysis of water quality assessment of Nagpur City, India. Int J Sci Res Publication 5:753–757
13. Chaudhary S, Kuniyal JC, Vaidya N, Puri S (2019) Water quality assessment in headwater of the Satluj Basin, Northwestern Himalaya, India. J Himalayan Ecol Sustain Develop14:19–33

14. Khatoon N, Khan AH, Rehman M, Pathak V (2013) Correlation study for the assessment of water quality and its parameters of Ganga River, Kanpur, Uttar Pradesh, India. J Appl Chem 5:80–90
15. Shrestha AK, Basnet N (2018) The correlation and regression analysis of physicochemical parameters of river water for the evaluation of percentage contribution to electrical conductivity. J Chem 1–9
16. Garg RK, Rao RJ, Uchchariya D, Shukla G, Saksena DN (2010) Seasonal variations in water quality and major threats to ramsagar reservoir, India. Afr J Environ Sci Technol 4:61–76
17. Rastogi GK, Sinha DK (2011) A novel approach to water quality management through correlation study. J Environm Res Developm 5:1029–1035
18. Shil S, Singh UK, Mehta P (2019) Water quality assessment of a tropical river using water quality index (WQI), multivariate statistical techniques and GIS. Appl Water Sci 9:1–21. https://doi.org/10.1007/S13201-019-1045-2
19. Harichandan PHS, Panda R, Sethy KM (2008) Water quality assessment of Bhubaneswar temple pond by using statistical method and water quality index. J Pollution Effect and Control 6:1–4
20. Nayak SK (2020) Assessment of water quality of brahmani river using correlation and regression analysis. 5:1–25