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# Statistical Evaluation of Hydrobiological Parameters of Silicon City Lakes, India

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The present study deals with the study of physico-chemical parameters of lakes of silicon city, (Bangalore), India. Systematic calculation of correlation coefficient between water quality parameters has been done with the objective of minimizing the complexity and dimensionality of large set of data. The significant correlation has been further verified by using t-test. The water samples were collected and analyzed for three consecutive years 2003-2005. In the study an appreciable significant positive correlation was found in Byramangala lake for pH with BOD, temperature, alkalinity and total hardness (TH); conductivity with dissolved oxygen (DO), sulphate, nitrate, potassium and phosphate with nitrate, sulphate. A significant negative correlation was found for pH-DO, DO-BOD, TDS-turbidity, turbidity-sulphate, COD and DO-COD. In Hebbal lake significant positive correlation was found for temperature-COD, sulphate-nitrate, TDS-nitrate, TDS-conductivity, TH-alkalinity and significant negative correlation was found in temperature-DO, TH-potassium, DO-BOD, TDS-TH and in Yelahanka lake significant positive correlation was found for pH-temperature, BOD, COD, TDS-phosphate, TDS-potassium, phosphate-sulphate, conductivity-phosphate, conductivity-nitrate and potassium, TH-BOD, COD and significant negative correlation was found in pH-turbidity, pH-DO, temperature-turbidity, turbidity-TH, COD and conductivity-TH. The results revealed that most of the water samples were below or out of limited according to the WHO and BIS standards.

**Keywords: Statistical analysis, Physico-chemical parameters, Lake water.**

## INTRODUCTION

The water quality of water resources is a subject of ongoing concern. The assessment of long-term water quality changes is also a challenging problem. During the last decades there has been an increasing demand for monitoring water quality of many lakes by regular measurement of various water quality variables. Water quality monitoring has one of the highest priorities in environmental protection policy [1]. The main objective is to control and minimize the incidence of pollutant-oriented problems and to provide water of appropriate quality to serve various purposes such as drinking water supply, irrigation water, *etc*. The quality of water is identified in terms of its physical, chemical and biological parameters [2].

The quality of water is identified by its physical, chemical and biological properties; the particulate problem in case of water quality monitoring is the complexity associated with analysis of the large number of measured variables [3]. The data sets contain large information about the behaviour of the water body. The classification, modeling and interpretations of monitoring data are the most important steps in the assessment of water quality and water quality parameters interact with each other. To define the resource water quality many researchers treated water quality parameters individually by describing the seasonal variability and their causes. It is a very difficult and laborious task to regularly monitor all the parameters even if adequate manpower and laboratory facilities are available. For this reasons, in recent years an easier and simpler approach based on statistical correlation has been developed using mathematical relationship for comparison of physio-chemical parameters [4]. The data sets contain rich information about the behaviour of the water resources. Interrelationship studies between different variables are very helpful tools in promoting research and opening new frontiers of knowledge. The study of correlation reduces the range of uncertainty associated with decision making. The significance of the observed correlation coefficients have been tested by using 't' test [5].

The typical nature of lakes of Bangalore city is manmade and generally built for hydrological reasons. These lakes store water during monsoon and release water slowly during summer months. They impound the rain runoff during monsoon and help to recharge and maintain groundwater table, checking floods and to reduce soil erosion [6]. These water sheets have a significant impact on the climate of the city and the biological and ecological roles played by the lakes are significant in supporting the growth of several vegetation and habitats.

Considering all these facts, it's really a pity that many lakes of Bangalore city are lost and few that exist are polluted with industrial and domestic sewage.

**Study area:** The present investigation was carried out in Bangalore city, is located in the heart of South Deccan of peninsular India, situated in the South-Eastern corner of Karnataka state (12°39'-13°18' N latitude and 77°22'-77°52' East longitude) covering a geographical area of about 8005 sq. km and at an average elevation of 900 m above the mean sea level. The Bangalore enjoys a very agreeable climate and is free from extremes. The climate is classed as the dry trophical savana climate with seasons. The dry season with clear bright weather is from December to February. The summer season from March to May is followed by the South west monsoon from June to September, while October and November constitute the post monsoon season. The marked thunder storm activity with occasional hailstorms occurred in April and May. Post monsoon season September to October predominant low clouding and the more or less steady temperature with small diurnal variation and during the months of October to February with an early morning dew and mist or fog.

The lakes of Bangalore occupy about 4.8% of the city's geographical area (640 sq. km) covering both urban and rural areas, Hebbal lake, Yelahanka lake and Byramangala lake. In Hebbal lake, 13°02'-37.2" N latitude and 0.77°35'-25.7" E longitude which is one among the large lakes of Bangalore is located at the place of Hebbal along the Bangalore-Bellary Road in the northern part of Bangalore. The lake is about 8 km from the heart of Bangalore City. The Yelahanka lake, 13°06"-24.9" N latitude and 077°35'-47-6" E longitude it is also a large lake located at the place of Yelahanka extension, which is towards the north of Bangalore and covers an area of about 80.94 ha. The Byramangala lake (Vrishabhavathi reservoir), 12°45"-33.6" N latitude and 077°25'-05-0" E longitude it is created on the river Vrishabhavati, 18 km away from the city of Bangalore. The 437 ha manmade lake has been receiving a steady inflow of treated sewage from the city and wastes from many industrial establishments for the last two decades. It is located near Bidadi industrial area, Bangalore district.

## EXPERIMENTAL

Water samples were collected from four different spots during monthly over a period of 3 years (January 2003 to December 2005). Water samples were collected in plastic jerry cans, grab sampling was generally applied during the sampling water samples were analyzed standard methods [7]. Statistical studies have been carried out by calculating correlation co-efficients between pairs of parameters.

$$r = \sqrt{\frac{\Sigma(X-\bar{X})(Y-\bar{Y})}{\Sigma(X-X)^2\Sigma(Y-Y)^2}}$$

where $X$ = Individual reading of 1st parameter
$\bar{X}$ = Mean of $\Sigma X$
$Y$ = Individual readings of 2nd parameter
$\bar{Y}$ = Mean of $\Sigma Y$

The correlation among the different parameters will be true when the value of correlation co-efficient (s) is high and approaching to one. Correlation the relationship between two variables is closely related to protection. The greater the association between variables, the more accurately we can predict the outcome of events.

## RESULTS AND DISCUSSION

The computed data were subjected to correlation analysis, it is one of the most wide spread and useful statistics, is a single numeral that describes the degree of association amongst two variables under study. The basic statistics of the physical and chemical analysis data for the lakes is summarized in Tables 1-3. The correlation value above 0.56 is selected for analysis. In present analysis, Byramangala lake, during 2003, the following pairs of parameters like, pH-BOD (r = 0.769), temperature-total hardness (r = 0.909), temp-BOD (r = 0.749), total hardness-BOD (r = 0.733), observed strong positive correlation and pH-temperature (r = 0.658), pH-total hardness (r = 0.649) pH-alkalinity (r = 0.624), pH-COD (r = 0.670) TDS-phosphate (r = 0.647), conductivity-DO (r = 0.704), conductivity-sulphate (r = 0.651), conductivity-nitrate (r = 0.613), conductivity-potassium (r = 0.611), phosphate-sulphate (r = 0.682), phosphate-nitrate (r = 0.608) and sulphate-potassium (r = 0.663), observed moderate positive correlation in most pairs. Significant positive correlations of $NO_3^-$ with $SO_4^{2-}$, $PO_4^{3-}$, $Ca^{2+}$ and $Cr^{3+}$ suggest their identical source of origin in the watershed. These are mainly emanated from anthropogenic activities such as application of phosphate, sulphate and nitrate fertilizers and discharge of industrial effluents, such as tanneries [8]. BOD is defined as the amount of oxygen required by the bacteria while stabilizing decomposable organic matter under aerobic conditions. A quantitative relationship exits between the amount of oxygen required to convert a definite amount of any organic matter to $CO_2$, water and $NH_3$ [8]. However, a good negative correlation is observed between the pairs like pH-DO (r = -0.794), DO-BOD (r = -0.747), (Table-1).

During 2004, in Byramangala lake the following pairs of parameters like pH-temperature (r = 0.777), temperature-BOD (r = 0.772), temperature-COD (r = 0.722), TDS-conductivity (r = 0.798) TDS-sulphate (r = 0.786), TDS-nitrate (r = 0.822), conductivity-nitrate (r = 0.841), TH-COD (r = 0.829), DO-COD (r = 0.790), sulphate-nitrate (r = 0.712), observed good positive correlation. This is due to the fact that conductivity depends on total dissolved solids and the main constituents of TDS in water are $Na^+$, $Cl^-$ and $SO_4^{2-}$ and TDS-phosphate (r = 0.630) TH-BOD (r = 0.636) and phoshate-nitrate (r = 0.651), observed modelate positive correlation. However, a good negative correlation shows by the pairs like TDS-turbidity (r = -0.731) turbidity-sulphate (r = -0.894) and DO-COD (r = -0.585) (Table-1).

In 2005, the Byramangala lake the following pairs of parameters like, pH-temperature (r = 0.907), pH-BOD (r = 0.829), temperature-TH (r = 0.775), temperature-BOD (r = 0.770), temperature-COD (r = 0.842), TDS-phosphate (r = 0.801), TDS-potassium (r = 0.723), conductivity-phosphate (r = 0.934), conductivity-sulphate (r = 0.0.726), conductivity-nitrate (r = 0.730), conductivity-potassium (r = 0.793), BOD-COD (r = 0.0.817), phosphate-sulphate (r = 0.782), phosphate-nitrate (r = 0.770), phosphate-potsssium (r = 0.901), sulphate-potassium (r = 0.770) and nitrate-potassium (r = 0.774), shows

TABLE-1
CORRELATION MATRIX BETWEEN SOME PHYSICO-CHEMICAL PARAMETERS OF BYRAMANGALA LAKE DURING 2003-2005

| | pH | Temp. | TDS | Turbidity | Conductivity | TH | Alkalinity | DO | BOD | COD | Phosphate | Sulphates | Nitrates | Potassium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2003 | | | | | | | |
| pH | 1 | .658(*) | 0.263 | -0.473 | -0.447 | .649(*) | .624(*) | -.794(**) | .769(**) | .670(*) | -0.07 | 0.143 | -0.379 | -0.099 |
| Temp. | | 1 | 0.435 | -0.251 | -0.111 | .909(**) | 0.376 | -0.567 | .749(**) | 0.297 | -0.07 | 0.067 | 0.146 | -0.202 |
| TDS | | | 1 | -0.339 | 0.217 | 0.352 | -0.206 | 0.101 | 0.299 | 0.179 | .647(*) | 0.53 | 0.444 | 0.323 |
| Turbidity | | | | 1 | -0.277 | -0.195 | -0.208 | 0.057 | -0.337 | -.657(*) | -0.504 | -.654(*) | -0.108 | -0.42 |
| Conductivity | | | | | 1 | -0.084 | -0.094 | .704(*) | -0.334 | -0.054 | 0.367 | .651(*) | .613(*) | .611(*) |
| TH | | | | | | 1 | 0.475 | -0.478 | .733(**) | 0.458 | -0.126 | 0.192 | -0.014 | -0.113 |
| Alkalinity | | | | | | | 1 | -0.527 | 0.468 | 0.56 | -0.263 | 0.121 | -0.27 | 0.046 |
| DO | | | | | | | | 1 | -.747(**) | -0.315 | 0.439 | 0.417 | 0.444 | 0.464 |
| BOD | | | | | | | | | 1 | 0.474 | -0.072 | 0.053 | -0.047 | 0.002 |
| COD | | | | | | | | | | 1 | 0.358 | 0.563 | -0.166 | 0.054 |
| Phosphates | | | | | | | | | | | 1 | .682(*) | .608(*) | 0.316 |
| Sulphates | | | | | | | | | | | | 1 | 0.354 | .663(*) |
| Nitrates | | | | | | | | | | | | | 1 | 0.213 |
| Potassium | | | | | | | | | | | | | | 1 |
| | | | | | | | 2004 | | | | | | | |
| pH | 1 | .777(**) | -0.204 | 0.119 | -0.001 | 0.454 | 0.228 | 0.076 | 0.388 | 0.505 | -0.381 | -0.213 | -0.158 | 0.429 |
| Temp. | | 1 | -0.408 | 0.035 | -0.327 | 0.556 | 0.347 | -0.176 | .772(**) | .722(**) | -0.474 | -0.24 | -0.363 | 0.536 |
| TDS | | | 1 | -.731(**) | .798(**) | 0.116 | -0.453 | -0.388 | -0.399 | -0.038 | .630(*) | .786(**) | .822(**) | 0.001 |
| Turbidity | | | | 1 | -0.356 | -0.505 | 0.354 | 0.536 | -0.049 | -0.404 | -.590(*) | -.894(**) | -0.562 | -0.349 |
| Conductivity | | | | | 1 | -0.024 | -0.429 | -0.252 | -0.265 | -0.103 | 0.488 | 0.537 | .841(**) | -0.035 |
| TH | | | | | | 1 | 0.24 | -0.471 | .636(*) | .829(**) | -0.055 | 0.431 | 0.222 | 0.41 |
| Alkalinity | | | | | | | 1 | -0.1 | 0.3 | 0.106 | -0.513 | -0.359 | -0.208 | 0.083 |
| DO | | | | | | | | 1 | -0.416 | -.589(*) | 0.105 | -0.574 | -0.278 | -0.056 |
| BOD | | | | | | | | | 1 | .790(**) | -0.387 | -0.028 | -0.161 | 0.405 |
| COD | | | | | | | | | | 1 | -0.346 | 0.359 | -0.042 | 0.273 |
| Phosphates | | | | | | | | | | | 1 | 0.541 | .651(*) | 0.368 |
| Sulphates | | | | | | | | | | | | 1 | .712(**) | 0.085 |
| Nitrates | | | | | | | | | | | | | 1 | 0.107 |
| Potassium | | | | | | | | | | | | | | 1 |
| | | | | | | | 2005 | | | | | | | |
| pH | 1 | .907(**) | 0.258 | -.783(**) | 0.037 | .654(*) | .692(*) | -.726(**) | .829(**) | .820(**) | -0.074 | 0.008 | -0.462 | -0.272 |
| Temp. | | 1 | 0.184 | -.815(**) | 0.047 | .775(**) | .626(*) | -.687(*) | .770(**) | .842(**) | -0.062 | 0.104 | -0.306 | -0.196 |
| TDS | | | 1 | -0.31 | .695(*) | -0.072 | .640(*) | 0.08 | 0.215 | 0.345 | .801(**) | .585(*) | 0.307 | .723(**) |
| Turbidity | | | | 1 | -0.205 | -.801(**) | -.605(*) | 0.568 | -.591(*) | -.751(**) | -0.092 | -0.035 | 0.157 | 0.161 |
| Conductivity | | | | | 1 | -0.209 | 0.398 | -0.004 | -0.125 | 0.105 | .934(**) | .726(**) | .730(**) | .793(**) |
| TH | | | | | | 1 | 0.424 | -0.392 | 0.425 | 0.514 | -0.362 | -0.216 | -0.39 | -0.465 |
| Alkalinity | | | | | | | 1 | -0.173 | 0.516 | 0.479 | 0.412 | 0.425 | 0.085 | 0.232 |
| DO | | | | | | | | 1 | -.716(**) | -.783(**) | 0.162 | 0.22 | 0.424 | 0.413 |
| BOD | | | | | | | | | 1 | .817(**) | -0.107 | -0.123 | -0.494 | -0.277 |
| COD | | | | | | | | | | 1 | 0.073 | 0.041 | -0.318 | -0.101 |
| Phosphates | | | | | | | | | | | 1 | .782(**) | .770(**) | .901(**) |
| Sulphates | | | | | | | | | | | | 1 | .651(*) | .770(**) |
| Nitrates | | | | | | | | | | | | | 1 | .774(**) |
| Potassium | | | | | | | | | | | | | | 1 |

good positive correlation and pH-TH (r = 0.654), pH-alkalinity (r = 0.692), temperature-alklinity (r = 0.626), TDS-conductivity (r = 0.695), TDS-alklinity (r = 0.640), TDS-sulphate (r = 0.585) and sulphate-nitrate (r = 0.651), shows moderate positive correlation. However, a good negative correlation is shown by pairs like pH-turbidity (r = -0.783), pH-DO (r = -0.726) temperature-turbidity (r = -0.857), temperature-DO (r = -0.687), turbidity-TH (r = -0.801), turbidity-COD (r = -0.751), DO-BOD (r = -0.716) and DO-COD (r = -0.783) (Table-1).

In 2003, Hebbal lake the following pairs of parameters like temperature-COD (r = 0.794), sulphate-nitrate (r = 0.769) and nitrate-potassium (r = 0.746), shows good positive correlation and TDS-sulphate (r = 0.697), TDS-nitrate (r = 0.698), conductivity-nitrate (r = 0.638), phosphate-nitrate (r = 0.683) and sulphate-potassium (r = 0.663), shows moderate positive correlation. However, a good negative correlation is shown by the pairs like temperature-DO (r = -0.845), TH-potassium (r = -0.756) and DO-COD (r = -0.873) (Table-2). During 2004, in Hebbal lake the following pairs of parameters like. temperature-alkalinity (r = 0.830) temperature-BOD (r = 0.789), temperature-COD (r = 0.852), TDS-nitrate (r = 0.778), conductivity-nitrate (r = 0.753), sulphate-nitrate (r = 0.763) and sulphate-potassium (r = 0.744), shows good pasitive correlation and pH-temperature (r = 0.666). pH-BOD (r = 0.682), pH-COD (r = 0.602), TDS-Phospate (r = 0.629), TDS-sulphate (r = 0.647), TDS-conductivity (r = 0.638), conductivity-phosphate (r = 0.679), conductivity-sulphate (r = 0.608), TH-alkalinity (r = 0.595), alkalinity- BOD (r = 0.586), alkalinity-COD (r = 0.580) and BOD-COD (r = 0.697), shows moderate correlation. However, a good negative correlation is shown by pairs like conductivity-TH (r = 0.738), TH-phosphate (r = 0.839) and TH-nitrate (r = 0.722) (Table-2).

During 2005 in Hebbal lake, the following pairs of parameters like pH-temperature (r = 0.879), pH-BOD (r = 0.708), pH-COD (r = 0.726), TDS-sulphate (r = 0.909), TDS-nitrate (r = 0.753), TDS-potassium (r = 0.741), conductivity-nitrate (r = 0.836), conductivity-potassium (r = 0.883), TH-alkalinity (r = 0.816), alkalinity- BOD (r = 0.768), DO-nitrate (r = 0.708), BOD-COD (r = 0.839) and sulphate-potassium (r = 0.830), observed good positive correlation and pH-alkalinity (r = 0.684), pH-BOD (r = 0.708), temperature-alkalinity (r = 0.609), temperature-BOD (r = 0.629), temperature-COD (r = 0.681), TDS-conductivity (r = 0.692), TDS-DO (r = 0.672), conductivity-sulphate (r = 0.697), sulphate-nitrate (r = 0.658), nitrate-potassium (r = 0.668), observed moderate positive correlation. However, a good negetive correlation is shown by the pairs like TDS-TH (r = -0.852), TDS-alkalinity (r = -0.747), alkalinity-DO (r = -0.716) and DO-BOD (r = -0.749) (Table-2).

During 2003 in Yelahanka lake, the following pairs of parameters like, pH-temperature (r = 0.907), pH-BOD (r = 0.829), pH-COD (r = 0.820), temperature-BOD (r = 0.770), temperature-COD (r = 0.842), TDS-phosphate (r = 0.801), TDS-potassium (r = 0.723), conductivity-phosphate (r = 0.934), conductivity-sulphate (r = 0.726), conductivity-nitrate (r = 0.730), conductivity-potassium (r = 0.793), phosphate-sulphate (r = 0.782), phosphate-nitrate (r = 0.770), phosphate-potassium (r = 0.901), sulphate-potassium (r = 0.770) and nitrate-potassium (r = 0.774), observed good positive correlation and pH-TH (r = 0.654), pH-alkalinity (r = 0.692), temperature-alkalinity (r = 0.626), TDS-conductivity (r = 0.695), TDS-alkalinity (r = 0.640), TDS-sulphate (r = 0.585) and sulphate-nitrate (r = 0.651), shows modrate correlation. However, a good negative correlation is shown by the pairs like pH-turbidity (r = -0.783), pH-DO (r = -0.726), temperature-turbidity (r = -0.815), turbidity-TH (r = -0.801), turbidity-COD (r = -0.751), DO-BOD (r = -0.716) and DO-COD (r = -0.783) (Table-3).

During 2004 in Yelahanka lake, the following pairs of parameters like pH-temperature (r = 0.862), pH-BOD (r = 0.881), pH-COD (r = 0.778), temperature-TH (r = 0.768), temperature-BOD (r = 0.944), temperature-COD (r = 0.867), conductivity-phosphate (r = 0.932), conductivity-nitrate (r = 0.827), conductivity-potassium (r = 0.809), TH-BOD (r = 0.834), TH-COD (r = 0.848), BOD-COD (r = 0.841), phosphate-nitrate (r = 0.888) and phosphate-potassium (r = 0.845), observed excellent positive correlation. Alkalinity is a relarted concept that is commonly used to indicates a systems capacity to buffer against acid impacts. Buffering capacity is the ability of a body of the water to resist or dampen changes in pH. Alkaline compounds in water such as bicarbonates, carbonates and hydroxides remove $H^+$ ions and lower the acidity of the water and pH-TH (r = 0.667), turbidity-DO (r = 0.585), sulphate-nitrate (r = 0.604) and nitrate-potassium (r = 0.637), observed moderate positive correlation. However, a good negative correlation is shown by the pairs like pH-turbidity (r = -0.772), temperature-turbidity (r = -0.729), temperature-DO (r = -. 683), temperature-potassium (r = -0.591), turbidity-TH (r = -0.815), turbidity-BOD (r = -0.793), turbidity-COD (r = -0.745), conductivity-TH (r = -0.740), conductivity-BOD (r = -0.735), TH-phosphate (r = -0.711), TH-nitrates (r = -0.659), TH-potassium (r = -0.750) and DO-COD (r = -0.632) (Table-3).

During 2005 in Yelahanka lake, the following pairs of parameters like pH-alkalinity (r = 0.840), pH-BOD (r = 0.866), pH-COD (r = 0.775), temperature-alkalinity (r = 0.934), temperature-COD (r = 0.879), TDS-sulphate (r = 0.722), TDS-nitrate-(r = 0.791), conductivity-sulphate(r = 0.841), conductivity-nitrate (r = 0.827), alkalinity-BOD (r = 0.735), alkalinity-COD (r = 0.880) and sulphate-nitrate (r = 0.904), observed good positive correlation and pH-temperature (r = 0.704), pH-TDS (r = 0.700), temperature-BOD (r = 0.673), TDS-BOD (r = 0.690) and phosphate-nitrate (r = 0.614), observed moderate positive correlation. However, a good negative correlation and shown by the pairs like pH-DO (r = -0.778), temperature-DO (r = -0.899), TDS-turbidity (r = -0.851), turbidity-sulphate (r = -0.845), turbidity-nitrate (r = -0.939), conductivity-TH (r = -0.757), TH-sulphate (r = -0.853), alkalinity-DO (r = -0.821), DO-BOD (r = -0.797) and DO-COD (r = -0.895). BOD is a measure of the amount of oxygen removed from aquatic environments by aerobic micro-organisms for their metabolic requirements during the breakdown of organic matter and systems with high BOD tend to have low dissolved oxygen concetration (Table-3).

## Conclusion

The study clearly indicates that the lentic water bodies in Bangalore metropolitan area is already remain below the standards of the drinking water qualities. Not only that even

TABLE-2
CORRELATION MATRIX BETWEEN SOME PHYSICO-CHEMICAL PARAMETERS OF HEBBAL LAKE DURING 2003-2005

| | pH | Temp. | TDS | Turbidity | Conductivity | TH | Alkalinity | DO | BOD | COD | Phosphate | Sulphates | Nitrates | Potassium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2003** | | | | | | | | | | | | | | |
| pH | 1 | 0.505 | 0.142 | 0.292 | 0.189 | 0.172 | -0.189 | -0.229 | -0.227 | 0.31 | -0.04 | 0.103 | 0.02 | -0.275 |
| Temp. | | 1 | 0.287 | -0.164 | 0.01 | 0.514 | 0.464 | -.845(**) | -0.474 | .794(**) | -0.119 | 0.09 | 0.184 | -0.302 |
| TDS | | | 1 | -0.431 | 0.308 | -0.438 | 0.06 | -0.025 | -0.251 | 0.113 | 0.351 | .697(*) | .698(*) | 0.413 |
| Turbidity | | | | 1 | -0.048 | 0.28 | -0.378 | 0.33 | 0.099 | -0.387 | -0.069 | -0.559 | -0.46 | -.591(*) |
| Conductivity | | | | | 1 | -0.515 | 0.071 | 0.163 | -0.463 | -0.271 | 0.327 | 0.34 | .638(*) | 0.499 |
| TH | | | | | | 1 | 0.331 | -.613(*) | -0.06 | 0.476 | -.619(*) | -.698(*) | -.580(*) | -.756(**) |
| Alkalinity | | | | | | | 1 | -0.424 | -0.045 | 0.359 | 0.041 | 0.102 | 0.415 | 0.211 |
| DO | | | | | | | | 1 | 0.428 | -.873(**) | 0.363 | 0.101 | 0.109 | 0.406 |
| BOD | | | | | | | | | 1 | -0.159 | 0.101 | 0.131 | -0.129 | 0.045 |
| COD | | | | | | | | | | 1 | -0.042 | 0.087 | 0.044 | -0.292 |
| Phosphates | | | | | | | | | | | 1 | 0.528 | .683(*) | 0.45 |
| Sulphates | | | | | | | | | | | | 1 | .769(**) | .663(*) |
| Nitrates | | | | | | | | | | | | | 1 | .746(**) |
| Potassium | | | | | | | | | | | | | | 1 |
| **2004** | | | | | | | | | | | | | | |
| pH | 1 | .666(*) | -0.171 | -0.23 | -0.192 | 0.21 | 0.518 | -0.373 | .682(*) | .602(*) | 0.132 | -0.201 | -0.431 | -0.259 |
| Temp. | | 1 | -0.089 | -0.382 | -0.342 | 0.527 | .830(**) | -0.575 | .789(**) | .852(**) | -0.307 | -0.149 | -0.319 | -0.535 |
| TDS | | | 1 | -0.535 | .638(*) | -.585(*) | -0.239 | -0.3 | 0.023 | 0.107 | .629(*) | .647(*) | .778(**) | 0.247 |
| Turbidity | | | | 1 | -.618(*) | 0.295 | -0.03 | 0.3 | -0.194 | -0.489 | -0.427 | -0.509 | -0.575 | -0.019 |
| Conductivity | | | | | 1 | -.738(**) | -0.498 | 0.196 | -0.317 | -0.16 | .679(*) | .608(*) | .753(**) | 0.507 |
| TH | | | | | | 1 | .595(*) | -0.339 | 0.574 | 0.262 | -.839(**) | -.591(*) | -.722(**) | -.593(*) |
| Alkalinity | | | | | | | 1 | -0.533 | .586(*) | .580(*) | -0.515 | -0.331 | -0.443 | -0.446 |
| DO | | | | | | | | 1 | -0.576 | -.655(*) | 0.212 | -0.239 | -0.082 | 0.142 |
| BOD | | | | | | | | | 1 | .697(*) | -0.202 | -0.303 | -0.459 | -.596(*) |
| COD | | | | | | | | | | 1 | -0.14 | 0.018 | -0.021 | -0.492 |
| Phosphates | | | | | | | | | | | 1 | 0.53 | 0.538 | 0.464 |
| Sulphates | | | | | | | | | | | | 1 | .763(**) | .744(**) |
| Nitrates | | | | | | | | | | | | | 1 | 0.429 |
| Potassium | | | | | | | | | | | | | | 1 |
| **2005** | | | | | | | | | | | | | | |
| pH | 1 | .879(**) | -.626(*) | -0.292 | -0.314 | 0.561 | .684(*) | -.694(*) | .708(**) | .726(**) | -0.505 | -0.296 | -0.544 | -0.188 |
| Temp. | | 1 | -0.429 | -0.416 | -0.258 | 0.437 | .609(*) | -0.536 | .629(*) | .681(*) | -0.289 | -0.092 | -0.47 | -0.067 |
| TDS | | | 1 | -0.316 | .692(*) | -.852(**) | -.747(**) | .672(*) | -0.44 | -0.484 | 0.351 | .909(**) | .753(**) | .741(**) |
| Turbidity | | | | 1 | -0.384 | 0.119 | -0.291 | 0.232 | -.625(*) | -0.569 | 0.035 | -0.564 | -0.181 | -.729(**) |
| Conductivity | | | | | 1 | -.625(*) | -0.438 | .622(*) | -0.187 | 0.008 | 0.189 | .697(*) | .836(**) | .883(**) |
| TH | | | | | | 1 | .816(**) | -.667(*) | 0.42 | 0.461 | -0.308 | -.704(*) | -0.526 | -.635(*) |
| Alkalinity | | | | | | | 1 | -.716(**) | .768(**) | .756(**) | -0.236 | -0.546 | -0.555 | -0.282 |
| DO | | | | | | | | 1 | -.749(**) | -0.549 | 0.35 | 0.497 | .708(**) | 0.385 |
| BOD | | | | | | | | | 1 | .893(**) | -0.194 | -0.179 | -0.492 | 0.102 |
| COD | | | | | | | | | | 1 | -0.207 | -0.201 | -0.313 | 0.158 |
| Phosphates | | | | | | | | | | | 1 | 0.126 | 0.207 | 0.127 |
| Sulphates | | | | | | | | | | | | 1 | .658(*) | .830(**) |
| Nitrates | | | | | | | | | | | | | 1 | .668(*) |
| Potassium | | | | | | | | | | | | | | 1 |

TABLE-3
CORRELATION MATRIX BETWEEN SOME PHYSICO-CHEMICAL PARAMETERS OF YELAHANKA LAKE DURING 2003-2005

| | pH | Temp. | TDS | Turbidity | Conductivity | TH | Alkalinity | DO | BOD | COD | Phosphate | Sulphates | Nitrates | Potassium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2003 | | | | | | | |
| pH | 1 | .907(**) | 0.258 | -.783(**) | 0.037 | .654(*) | .692(*) | -.726(**) | .829(**) | .820(**) | -0.074 | 0.008 | -0.462 | -0.272 |
| Temp. | | 1 | 0.184 | -.815(**) | 0.047 | .775(**) | .626(*) | -.687(*) | .770(**) | .842(**) | -0.062 | 0.104 | -0.306 | -0.196 |
| TDS | | | 1 | -0.31 | .695(*) | -0.072 | .640(*) | 0.08 | 0.215 | 0.345 | .801(**) | .585(*) | 0.307 | .723(**) |
| Turbidity | | | | 1 | -0.205 | -.801(**) | -.605(*) | 0.568 | -.591(*) | -.751(**) | -0.092 | -0.035 | 0.157 | 0.161 |
| Conductivity | | | | | 1 | -0.209 | 0.398 | -0.004 | -0.125 | 0.105 | .934(**) | .726(**) | .730(**) | .793(**) |
| TH | | | | | | 1 | 0.424 | -0.392 | 0.425 | 0.514 | -0.362 | -0.216 | -0.39 | -0.465 |
| Alkalinity | | | | | | | 1 | -0.173 | 0.516 | 0.479 | 0.412 | 0.425 | 0.085 | 0.232 |
| DO | | | | | | | | 1 | -.716(**) | -.783(**) | 0.162 | 0.22 | 0.424 | 0.413 |
| BOD | | | | | | | | | 1 | .817(**) | -0.107 | -0.123 | -0.494 | -0.277 |
| COD | | | | | | | | | | 1 | 0.073 | 0.041 | -0.318 | -0.101 |
| Phosphates | | | | | | | | | | | 1 | .782(**) | .770(**) | .901(**) |
| Sulphates | | | | | | | | | | | | 1 | .651(*) | .770(**) |
| Nitrates | | | | | | | | | | | | | 1 | .774(**) |
| Potassium | | | | | | | | | | | | | | 1 |
| | | | | | | | 2004 | | | | | | | |
| pH | 1 | .862(**) | 0.53 | -.772(**) | -0.525 | .667(*) | -0.042 | -0.568 | .881(**) | .778(**) | -0.333 | 0.133 | -0.364 | -0.363 |
| Temp. | | 1 | 0.259 | -.729(**) | -.717(**) | .768(**) | -0.102 | -.683(*) | .944(**) | .867(**) | -0.546 | -0.157 | -0.547 | -.591(*) |
| TDS | | | 1 | -0.203 | 0.199 | -0.02 | 0.125 | 0.149 | 0.322 | 0.172 | 0.476 | 0.486 | 0.285 | 0.512 |
| Turbidity | | | | 1 | 0.505 | -.815(**) | 0.229 | .585(*) | -.793(**) | -.745(**) | 0.427 | -0.268 | 0.288 | 0.569 |
| Conductivity | | | | | 1 | -.740(**) | 0.128 | .637(*) | -.735(**) | -.629(*) | .932(**) | 0.478 | .827(**) | .809(**) |
| TH | | | | | | 1 | -0.218 | -.645(*) | .834(**) | .848(**) | -.711(**) | 0.023 | -.659(*) | -.750(**) |
| Alkalinity | | | | | | | 1 | 0.349 | -0.069 | -0.298 | 0.089 | 0.004 | 0.071 | 0.403 |
| DO | | | | | | | | 1 | -0.562 | -.632(*) | 0.557 | 0.17 | 0.366 | .812(**) |
| BOD | | | | | | | | | 1 | .841(**) | -0.561 | 0.013 | -0.567 | -0.551 |
| COD | | | | | | | | | | 1 | -0.513 | -0.001 | -0.483 | -.629(*) |
| Phosphates | | | | | | | | | | | 1 | 0.568 | .888(**) | .845(**) |
| Sulphates | | | | | | | | | | | | 1 | .604(*) | 0.321 |
| Nitrates | | | | | | | | | | | | | 1 | .637(*) |
| Potassium | | | | | | | | | | | | | | 1 |
| | | | | | | | 2005 | | | | | | | |
| pH | 1 | .704(*) | .700(*) | -.601(*) | 0.237 | 0.14 | .840(**) | -.778(**) | .866(**) | .775(**) | -0.196 | 0.306 | 0.448 | -0.321 |
| Temp. | | 1 | 0.465 | -0.296 | -0.105 | 0.265 | .934(**) | -.899(**) | .673(*) | .879(**) | -0.158 | -0.057 | 0.151 | -0.175 |
| TDS | | | 1 | -.851(**) | 0.552 | -0.453 | 0.552 | -0.513 | .690(*) | 0.358 | 0.181 | .722(**) | .791(**) | 0.018 |
| Turbidity | | | | 1 | -.683(*) | 0.55 | -0.399 | 0.37 | -.616(*) | -0.128 | -0.462 | -.845(**) | -.939(**) | 0.115 |
| Conductivity | | | | | 1 | -.757(**) | -0.023 | 0.091 | 0.097 | -0.272 | 0.499 | .841(**) | .827(**) | 0.104 |
| TH | | | | | | 1 | 0.231 | -0.34 | 0.075 | 0.509 | -.657(*) | -.853(**) | -.692(*) | -0.397 |
| Alkalinity | | | | | | | 1 | -.821(**) | .735(**) | .880(**) | -0.209 | 0.054 | 0.21 | -0.302 |
| DO | | | | | | | | 1 | -.797(**) | -.895(**) | 0.171 | 0.047 | -0.245 | 0.095 |
| BOD | | | | | | | | | 1 | .700(*) | 0.048 | 0.295 | 0.451 | -0.233 |
| COD | | | | | | | | | | 1 | -0.457 | -0.24 | -0.05 | -0.111 |
| Phosphates | | | | | | | | | | | 1 | 0.56 | .614(*) | 0.184 |
| Sulphates | | | | | | | | | | | | 1 | .904(**) | 0.114 |
| Nitrates | | | | | | | | | | | | | 1 | 0.075 |
| Potassium | | | | | | | | | | | | | | 1 |

some times it is always below the human use qualities, the correlation co-efficient determination greatly facilitates the tasks of rapid monitorings of water quality parameters and control of water pollution. Another possible social benefit namely prevention of migration to urban areas, will result due to opening of new agricultural work areas. Achieving an optimum use will prevent the waste of water resources. Possible industrial and urban sources of surface waters and groundwater pollution will be identified and various measures of protection and premeditation will be put into action.

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