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# ASSESSMENT OF PHYSICO-CHEMICAL PARAMETERS OF PERUMAL ERI

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**Abstract - Tamilnadu is deficit in Water Resources. It is a major fresh water lake in the cuddalore district of tamilnadu. It is located almost 7 kilometers (4.3 mi) from Alapakkam,The rainfall is seasonal and often erratic in timing and geographical distribution, resulting in frequent droughts and occasional floods. To mitigate the adverse effects, serious attention is required to rehabilitate the existing irrigation structures, canal systems, anicuts and tanks to make them functionally more effective, conserve and utilize the water for optimum use.This paper deals with an assessment of water quality parameters of Perumal eri(lake) situated at Alapakkam in Cuddalore district.Samples have collected at five different locations in Perumal eri during pre-monsoon period.Then laboratory analysis has done and the results are compared with BIS and WHO drinking water standards.Then by using "Inverse Distance Weighting"(IDW) method geostatistical analysis has done.Based on the results obtained mapping contaminants in lake has done by using ArcGIS software.According to the results suitable solution will be given to treat the water in the lake.**

## I INTRODUCTION

Lakes are one of the important ecosystem in our earth.India has a large number of beautiful lakes and water bodies. It providesimportant habitat and food resources to the diverse aquatic life. But these lakes are subjected to a range of physical, chemical and biological problems due to human activities, climate change is of major concern as it can diminish their aesthetic beauty,recreational value, water quality and habitat suitability of the lakes, especially near residential areas are polluted becauseof anthropogenic activities. The deterioration of lake wateraffects the aquatic life and causes hindrance in its traditional uses.

In our India many of the villages depends on lake water for both domestic and agriculture.Similarly, it is located on highway NH 45A, en route to Chidambaram town. It is 19 km from cuddalore and 29 km from Chidambaram town. Perumal lake is located near the villages. The village consists of more than 1000 acres (4.0km2) of arable land and about 1000 homes. it had been drawing water for supply to wards till it was polluted around 1990. Huge volume of plastic waste is found choking supply channels from them, by virtue of its location close to shops, hospitals and restaurants, has taken the brunt of pollution. Some quantity of sewage get mixed to the lake. This changes the water quality parameter widely and make it unfit for various purposes. This study aims to assess the water quality of lake on pre-monsoon and post-monsoon period and also to provide remedial measures to restore the lake and to meet the water demand.

### A. OBJECTIVE

- To measure the water quality in pre-monsoon and post-monsoon period
- To analyse the measured data and mapping the contaminants using ArcGIS
- To bring remedial measures for restoration of lake

### B. SELECTION OF METHOD

Analysis done by interpolation methods. Interpolation method predicts values for cells in a raster from a limited number of sample data points. It can be used to predict unknown values for any geographic point data, such as elevation, rainfall, chemical concentrations, noise levels, and so on.The available interpolation methods are listed below.

**IDW**

The (Inverse Distance Weighted) tool uses a method of interpolation that estimates cell values by averaging the values of sample data points in the neighborhood of each processing

cell. The closer a point is to the center of the cell being estimated, the more influence, or weight, it has in the averaging process.

**Kriging**

Is an advanced geostatistical procedure that generates an estimated surface from a scattered set of points with z-values. More so than other interpolation methods, a thorough investigation of the spatial behavior of the phenomenon represented by the z-values should be done before you select the best estimation method for generating the output surface.

**Natural neighbour**

Interpolation finds the closest subset of input samples to a query point and applies weights to them based on proportionate areas to interpolate a value (Sibson, 1981). It is also known as Sibson or "area-stealing" interpolation.

**Spline**

The tool uses an interpolation method that estimates values using a mathematical function that minimizes overall surface curvature, resulting in a smooth surface that passes exactly through the input points.

**Spline with Barriers**

The tool uses a method similar to the technique used in the Spline tool, with the major difference being that this tool honors discontinuities encoded in both the input barriers and the input point data.

## II STUDY AREA

**Perumal eri** is situated in kurijipadi taluk of cuddalore district.it is located at 24.9 km east of neyveli and 16.7 km south of cuddalore. The recharge source of lake is from the Gadilam river and Walaja tank and it is also get water from Neyveli aquifers. According to 2011 sensus Kurijipadi had a population of 32,439 with a sex-ratio of 1,032 females for every 1,000 males, much above the national average of 929. A total of 2,936 were under the age of six, constituting 1,493 males and 1,443 females.The geographical coordinates are 11.10° N, 79.37° E.


Figure 1.1 Cuddalore taluk map


Figure 1.2 Tamil Nadu district map

## A. CLIMATOLOGY

Comprehensive dataare available for Class-A plan evaporation, temperature, humidity sunshine, and wind velocity from the year 1964 onwards for the **K.Paramathy watershed** which is the representative for the agro-climatological zone to which the tank belongs.

The coordinates of the station are:

**Rain-fall data** are available from Kurijipadi station

The co-ordinates of the station are:

Latitude : $11^{O}09'$ 00”

Longitude : $78^{O}36'$ 00”

Altitude : 114.630 M

Years of observation : 1995 - 2016

**Climatologically the year is divided into four seasons. (2016)**

- South west Monsoon (June to September) - **275.31**mm
- North East Monsoon (October to December) - **344.59**mm
- Winter period (January and February) - **2.70**mm
- Summer period (March to May) - **169.88**mm

**TOTAL - 792.48**mm

### B. HYDROLOGY

Tank receives drainage from the free catchment of 2.273 Sq.Km and intercepted catchment of 80.780 Sq.Km.

The catchment is classified as Average. The ground water is observed in 20 to 30 m depth below ground level.

### C. SOILS

Reconnaissance or detailed soil survey have not been carried out for the ayacut area, but one soil profile in KurijipadiTaluk has been described.

### D. SOCIAL ASPECTS

Population of village is about 232 inhabitants most of them being agriculturalists and labourers. There is sufficient labour

in the village, available throughout the year. The wages of labour are being paid as recommended by the Government ieRs 341 Per day.(as per current schedule of rates) The number of families benefiting from the project is 59 and the number of beneficiaries is about 232 ( 3 adults per family ).

The average size of farm holding is 0.53 ha. The relevant farm size and the number of farmers as follows:

- Less than 1 ha Marginal: 42 farmers
- Between 1 to 2 ha Small: 10 farmers
- Above 2 ha Big : 7 farmers

These figures confirm that almost all beneficiaries are marginal and small farmers.

### E. PRESENT LAND-USE

Land-use particulars have been collected from village officer of Thuraiyur

| SL.NO | LAND USE | CROP | ACTUAL AREA(ha) | CULTIVATED AREA(ha) |
|---|---|---|---|---|
| 01 | Irrigated area under different crops | | | |
| 02 | Permanent crop | Coconut | Nil | Nil |
| 03 | Annual crop | (i)Sugarcane | `Nil | Nil |
| 04 | | (ii)Plantain | Nil | Nil |
| 05 | First season crops | (i)Rice | 22.180 | 22.180 |
| 06 | | (ii)Second season crops | Nil | Nil |
| 07 | Irrigated area | Geographical | 22.180 | Nil |
| 08 | Cultivated area | Geographical | 22.180 | Nil |
| 09 | | Cropped | 12.910 | Nil |
| 10 | Not cultivated | | 9.270 | Nil |
| 11 | Cultivable area | | 22.180 | Nil |
| 12 | Permanent gap | | 0.06 | Nil |
| 13 | Registered Ayacut | | 31.45 | Nil |

## III METHODOLOGY

The samples has been collected and various physio-chemical parameters are tested in laboratory according to standard American Public Health Organisation manual.After the samples being tested the obtained results are compared with Bureau of Indian Standards.

The following water quality parameters are tested:

**Table 2:List of parameters tested**

| S.No | Parameters | Methods/Instrument used |
|---|---|---|
| 01 | Ph | pH meter |
| 02 | Temperature | Thermometer |
| 03 | Total solids | Manual experiment |
| 04 | Turbidity | Turbidity meter |
| 05 | Electrical conductivity | Conductivity meter |
| 06 | Total hardness | Titration |
| 07 | Calcium hardness | Titration |
| 08 | Magnesium hardness | Titration |
| 09 | Total alkalinity | Titration |
| 10 | Phosphate | UV Spectrophotometer |
| 11 | Nitrate | UV Spectrophotometer |
| 12 | Sulphate | UV Spectrophotometer |
| 13 | Sodium | Atomic absorption Spectroscopy |
| 14 | Potassium | Atomic absorption Spectroscopy |
| 15 | DO | Titration |
| 16 | BOD | Titration |
| | | |

**Microbial test parameters**

| | | |
|---|---|---|
| 01 | Total coliform | |
| 02 | Fecal coliform | |
| 03 | E-coli | |

### A. DESCRIPTION OF PARAMETERS

pH was recorded with BDH indicator paper and also checked with pH meter (APHA, 1999). Temperature was recorded with thermometer and expressed as °C. Turbidity was recorded with Nephelo turbidity meter and expressed as NTU.

Electrical conductivity was found out using Electrical conductivity meter and expressed as µS/cm. TDS, TSS, TS, Total hardness, calcium hardness, BOD were estimated as per the standard methods (APHA 1999).

Total dissolved solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular suspended form (APHA, 1999).

The alkalinity of the waste water was identified using $H_2SO_4$ as the titrant, Phenolpthalein and methyl orange as indicator (APHA, 1999).

Total hardness is a measurement of the mineral content in water sample that is irreversible by boiling. Therefore, total hardness can be equivalent to the total calcium and magnesium hardness (APHA 1999).

The amount of oxygen present in water is called the dissolved oxygen (DO). The measurement of DO indicates the purity of water and it is important for maintaining aerobic conditions in the receiving water and it is the basis for BOD test which is used to evaluate the strength of water and the rate of biochemical oxidation (APHA, 1999).

Phosphate,Nitrate,Sulphate were analysed by using UV Spectrophotometer. Wavelength was adjusted to analyse the sample.

Potassium,sodium were analysed by using Atomic Absorption Spectroscopy (AAS). Wavelength was adjusted according to the type of the metals being analysed.

## IV MATERIALS USED

### SATELLITE AND ANCILLARY DATA

To perform a water quality assessment samples has collected at five different locations in Perumal eri

The sample locations and their corresponding geographical coordinates:

| Sample number | Station name | Latitude | longitude |
|---|---|---|---|
| 01 | Inlet | $^{o}$ 11 08’ 35”N | $^{o}$ 78 34’ 49”E |
| 02 | Sluice | $^{o}$ 11 08’ 24”N | $^{o}$ 78 34’ 09”E |
| 03 | Outlet | $^{o}$ 11 08’ 17”N | $^{o}$ 78 34’ 50”E |
| 04 | Near by weir | $^{o}$ 11 08’ 14”N | $^{o}$ 78 34’ 09”E |
| 05 | RCC pipe culvert | $^{o}$ 11 08’ 24”N | $^{o}$ 78 34’ 12”E |

**Table 1:Station name along with latitude and longitude**

### (A) REMOTE SENSING SATELLITE USED

CARTOSAT image(2016) is used to prepare slope maps.

### (B) GIS AND REMOTE SENSING SOFTWARES

### ARC-MAP

ArcMap is the main component of geospatial processing programs, and is used primarily to view, edit, create, and analyze geospatial data. ArcMap allows the user to explore data within a data set, symbolize features accordingly, and create maps. It includes all the functionality of ArcView and ArcEditor and adds advanced geoprocessing and data conversion capabilities**.**

### B. OTHER SOFTWARE

The purpose of the MS Word is to allow the users to type and save documents. Similar to other word processors, it has helpful tools to make documents.To integrate Microsoft Word with other programs as well, such as, using Excel tables, rows and columns or calculations**.**

## V RESULTS AND DISCUSSION

The toposheets have been collected from Survey Of India and kurijipadi boundary and the perumal yeri boundary has drawn using Arcmap.The samples being collected,tested and the following results have been obtained.

### PERUMAL BOUNDARY MAP

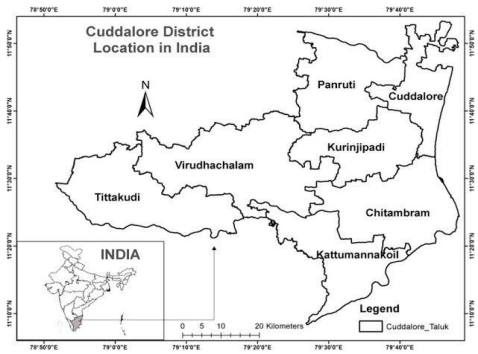
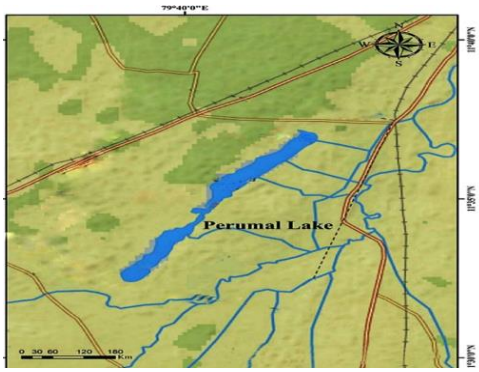



**Figure1:** Cuddalore district

**Figure2:** Kurijipadi boundary


**Figure3:** It denotes the location of samples collected in Perumaleri




**WATER QUALITY PARAMETERS-PREMONSOON**

**Table 3-Temperature,Ph,Total solids**

**Table4:Electricalconductivity,Totalhardness,calciumhardness,magnesiumhardness,DO, BOD**

| Sample number | Station name | Latitude | longitude | Temperature | pH | Total Solids (mg/l) |
|---|---|---|---|---|---|---|
| 01 | Inlet | 11° 08' 35"N | 78° 34' 49"E | 34.9° C | 7.0 | 2126.5 |
| 02 | Sluice | 11° 08' 24"N | 78° 34' 09"E | 32.5° C | 7.6 | 1940.4 |
| 03 | Outlet | 11° 08' 17"N | 78° 34' 50"E | 33.6° C | 7.4 | 1010.9 |
| 04 | Near by weir | 11° 08' 14"N | 78° 34' 09"E | 32.9° C | 7.4 | 2188.8 |
| 05 | RCC pipe culvert | 11° 08' 24"N | 78° 34' 12"E | 34.3° C | 7.3 | 3120.6 |

| Parameter Sample | Electrical Conductivity (µs/cm) | Total Hardness (mg/l) | Calcium hardness (mg/l) | Magnesium hardness (mg/l) | DO (mg/l) | BOD (mg/l) |
|---|---|---|---|---|---|---|
| 01 | 1710 | 328 | 250 | 78 | 16.55 | 165 |
| 02 | 1090 | 247 | 156 | 91 | 12.02 | 145 |
| 03 | 1100 | 198 | 142 | 56 | 11.23 | 154 |
| 04 | 1060 | 350 | 295 | 55 | 8.67 | 175 |
| 05 | 1520 | 360 | 215 | 145 | 9.66 | 192 |

From the table 4 Hardness value at three stations below 300 mg/l is considered drinkable(ICMR, 1975). But the value at station 3 and 4 is below the desirable limit.The hardness in water may deliver from dissolved CO2, release by bacteria found in water. The mean value of total hardness value exceeded the desirable limit of WHO (300 ppm) at all stations in the lake. The high concentration of total hardness may cause heart disease and kidney problem

**Table 4 :**

**Chloride,phosphate,nitrate,sulphate,totalalkalinity,sodium ,potassium**

| Parameter Sample | Chloride (mg/l) | Phosphate (mg/l) | Nitrate (mg/l) | Sulphate (mg/l) | Total alkalinity (mg/l) | Sodium (mg/l) | Potassium (mg/l) |
|---|---|---|---|---|---|---|---|
| 01 | 35 | 5.2 | 78.6 | 43.7 | 975 | 220 | 20 |
| 02 | 60 | 3.9 | 62.7 | 32.5 | 920 | 198 | 18 |
| 03 | 85 | 4.2 | 67.5 | 39.2 | 935 | 205 | 22 |
| 04 | 115 | 4.5 | 82.3 | 48.5 | 955 | 235 | 27 |
| 05 | 140 | 6.5 | 93.7 | 52.6 | 990 | 240 | 30 |

**Microbial test results**

**Table 5-Total coliform,fecalcoliform,E-coli**

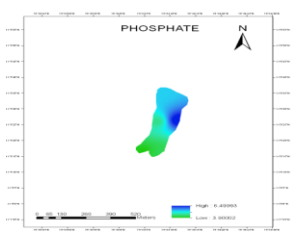
| Microbiological parameters (CFU/ml) | | | |
|---|---|---|---|
| Premonsoon | | | |
| Sample | Total Viable Count | Total Coliforms | E-coli |
| 01 | 21.3x10³ | 8.1x10² | Positive |
| 02 | 17.6x10³ | 6.1x10² | Positive |
| 03 | 19.2x10³ | 7.2x10² | Positive |
| 04 | 20.5x10³ | 9.6x10² | Positive |
| 05 | 26.4x10³ | 11.4x10² | Positive |

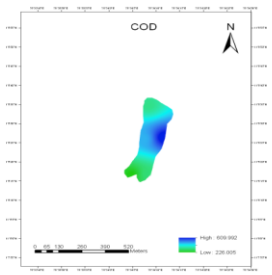
## RESULTS AND DISCUSSION-POSTMONSOON

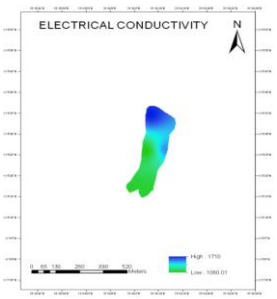
| Sample | pH | Odour (TON) | Colour | TDS (mg/l) | EC (µs/cm) | Turbidity (NTU) | TA (mg/l) |
|---|---|---|---|---|---|---|---|
| 01 | 7.0 | 3 | Grey | 960 | 1710 | 14 | 905 |
| 02 | 7.6 | 2 | Green | 905 | 1090 | 11 | 850 |
| 03 | 7.4 | 2 | Green | 920 | 1100 | 11 | 835 |
| 04 | 7.4 | 3 | Grey | 940 | 1060 | 13 | 913 |
| 05 | 7.3 | 4 | Grey | 1070 | 1520 | 16 | 930 |

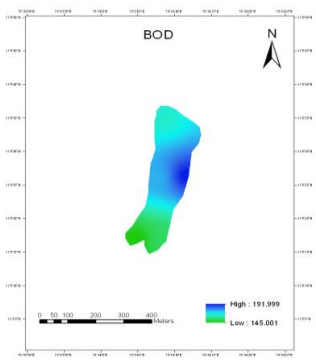
| Sample | Nitrate (mg/l) | SO4 (mg/l) | TA (mg/l) | Sodium (mg/l) | Chloride (mg/l) | $PO_4^{3-}$ (mg/l) | Potassium (mg/l) |
|---|---|---|---|---|---|---|---|
| 01 | 76.6 | 43.5 | 895 | 210 | 25 | 4.2 | 18 |
| 02 | 52.7 | 32 | 840 | 188 | 55 | 2.9 | 15 |
| 03 | 65.5 | 38.5 | 825 | 200 | 75 | 3.2 | 20 |
| 04 | 80.3 | 48.2 | 893 | 225 | 110 | 3.5 | 23 |
| 05 | 90.7 | 50.6 | 920 | 235 | 130 | 5.5 | 25 |

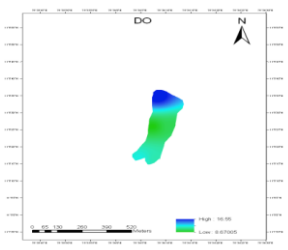
## MAPPING OF CONTAMINANTS

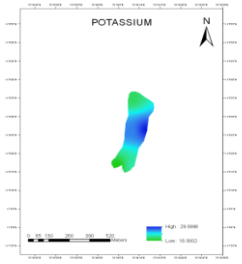


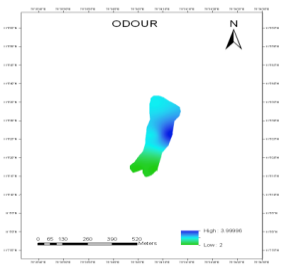



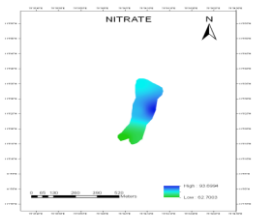



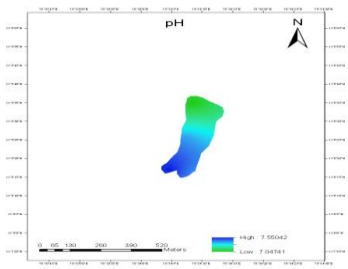



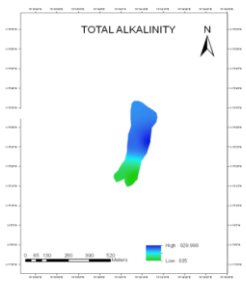



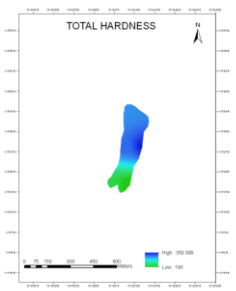



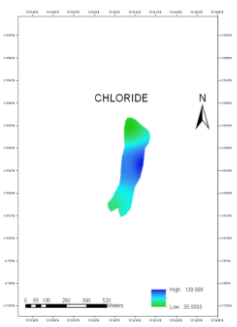



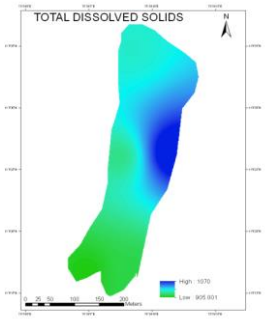



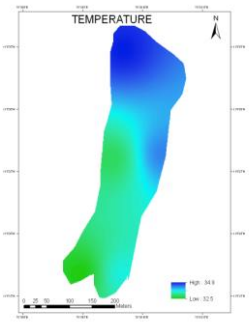

## PREMONSOON MAPS

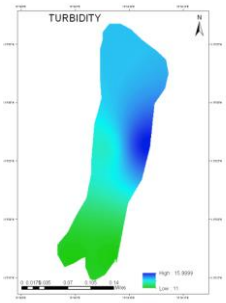


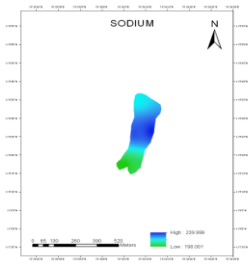



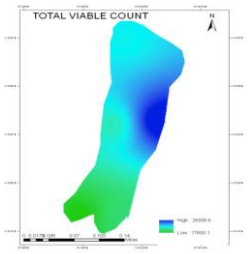



## REMEDIAL MEASURES

**Design of Sewage Treatment plant**

Population : 32411

Total water supply in Municipality : 3.59mld

60% area covers in drain to small tank : 2.15 mld

so the population calculate in sewage

Sewage calculate 90lpcd : 1.935 mld

**Total : 2mld**

Area require the treatment plant : 20m x 7m for 1mld = 2 Nos proposed

**Plant Capacity**

Plant Capacity : 1000m3/day Max

Operational Hours : 24 hrs operation including backwash of PSF and ACF

Flow Rate : 50.0m3/hr Max

## TREATMENT PROCESS

**Step - I** Recycling Plant employs a purely physio-chemical process. It incorporates processes like the addition of oxidizing chemicals, mixing/agitation and the photochemical oxidation, which is the heart of this treatment process.

**Step - II** The raw sewage entering the system will be fluctuating in terms of flow characteristics, BOD, COD, solid concentration etc. The efficiency of all the processes thereafter depends heavily on the characteristics of the raw sewage water. So, in order to achieve the maximum possible efficiency, a good retention time is provided in the **"Raw sewage collection tank"** to equalize the system.

**Step - III** Coagulating Alum is pumped in the raw sewage collection tank & is mixed homogeneously with the recirculation pump. The sewage from raw sewage collection tank is pumped to a flash mixer. A flocculent (Polymer) are dosed online at the inlet of flash mixer, where a thorough mixing is carried out by blower in the flash mixer.

**Step – IV** The overflow from flash mixture is fed to a hopper bottom-settling tank lying above ground. A retention time is provided for the coagulated particles to settle down. The settled underflow sludge will be sent to the **"Sludge holding cum digester tank"** tank by gravity. The overflow from the settling tank will be collected in the **"Clarified sewage collection tank".** The clarified sewage collection tank will be in RCC tank, positioned above ground level.

**Step – V** The The sewage from clarified collection tank is passed on through a sand filter by a horizontal centrifugal pump to strain out the flocs and the finely suspended particles. After a period of use, the sand filter will be completely clogged with flocs, and is backwashed to remove the flocs.

**Step – VI** The The outlet of the sand filter is given to a bag filter to remove turbidity which absorbs UV rays thereby reducing the efficiency of the photochemical reaction. Then it is passed on to a reactor in which ozone is purged and is recalculated with ozone recirculation pump.

**Step –VII** The The effluent with the oxidant is passed through the photochemical reactor. Photochemical oxidation is a rapid process that that enhances the oxidation of organic pollutants.

**Step –VIII** The The outlet from the photochemical reactor is passed to an Activated carbon filter to remove odor and color from treated sewage. The simple organic molecules formed after photochemical oxidation will be absorbed in carbon filter.

**Step - IX** The outlet from carbon filter is collected in Treated collection tank above ground in which some of the flow of ozone is purged through aeration grid. Also the treated sewage is recirculated through pump to inhibit the microbial growth.

## VI CONCLUSION

In this report I have collected the samples during pre-monsoon period and analyzed in the laboratory. The above values have obtained. Then the samples were collected during post-monsoon period and laboratory analysis had done in the phase II .Based on both values geospatial analysis will be done for zoning of contaminants and mapping has done using ArcGIS 10.5.Then the suitable solution has given to restore the lake and to make the water fit for drinking.

## REFERENCES

[1]. Comparative study of water quality parameters of lakewater (PerumalEri) with surrounding bore well watersamples, Kurijipadi (Tk), Cuddalore (Dt),Tamil Nadu.Sudha, R* and Sangeetha, T.PG and Research Department of Zoology, Nehru Memorial College (Autonomous),(Accredited with „A" Grade by NAAC) Puthanampatti-621 007, Tiruchirappalli. District, Tamil Nadu, India.2017

[2]. APHA.Standard methods for examinationof water and wastewater, 19th edn. Washington,D.C.1995.

[3]. Sensitivity of GIS-based interpolation techniques in assessing water quality parameters of Port Blair bay, Andaman*Dilip Kumar Jha, 2Anup Das, 3N. Saravanane, 1A.K. Abdul Nazar and 1R. Kirubagaran1National Institute of Ocean Technology, Ministry of Earth Sciences, Port Blair - 744103, India,2010.

[4].Comparison of spatial interpolation methods for the estimation of water quality index B. santhaveerana goud1 &basavaraj paruti21Professor and Former Chairman, Department of Civil Engineering, University Visvesvaraya College of Engineering,Bangalore University, Bangalore, Karnataka, India,2016.

[5]. Application of Inverse Path Distance Weighting for high density spatial mapping of coastal water quality patterns Joseph Stachelek South Florida Water Management District Christopher J. Madden,2015

[6]. Integrated remote sensing and GIS approach for water qualityanalysis of Gomti river, Uttar PradeshSomvanshi.S1, Kunwar.P2, Singh.N.B3, Shukla.S.P3, Pathak.VAmityInstitute of Environmental Sciences, Amity University, Sector-125, Noida, Forest Resources and Ecology Division, Remote Sensing Applications Centre, U.P., Sector-G, Jankipurm, Kursi Road, Lucknow, Uttar Pradesh, India,2012.

[7]. APHA Method 4500-P: Standard Methods for the Examination of Water and Wastewater, American Public Health Association,1992

[8]. APHA. Standard methods for examination of water and wastewater, 19th edn. Washington,D.C.1995.

[9]. Horton RK (1965) An index number system for rating water quality. Journal Of Water Pollution Control Federation 37: 300-306.

[10]. Brown RM, McClelland NI, Deininger RA, Tozer RG (1970) A water quality index: Do we dare? Water & Sewage Works 117: 339-343.