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Quick Determination of Water Quality through Electrical Conductance

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Abstract: ***The present study was designed to find the relation between Physico-Chemical Parameters of Sutlej river water using Pearson's correlation coefficient(r).The Different Parameters vary from site to site. Conductance of water is very important. Correlation coefficients show that there is strong positive relationship of Conductance with parameters- Alkalinity, Chloride, Hardness, TDS, Lead, Magnesium, Nitrate, Phosphate, Nitrite; moderate with Zinc, Bicarbonates, Carbonates, Calcium, Fluoride, Iron pH and Temp. ;weak with BOD, Chromium, Sulphate and Sulphite .However there is Strong Negative correlation between Conductance and DO.***

Keywords: Sutlej River Water, Physico-Chemical Parameters, Pearson's Correlation Coefficient, Conductance, Probable Error.

1. Introduction

Rivers carry water and nutrients to areas all around the Earth. Rivers are source of drinking water, can be used for irrigation purpose, fertilize land and electricity production. In India, there are serval major rivers with their numerous tributaries. Sutlej is tributary of Indus and most extensive of five rivers which flow through state of Punjab in North India. The Sutlej river is 1500 km long, runs from west to south-west, enters in Punjab near Nangal. Beas joins this river in Hari-Ke-Pattan, Amritsar(Punjab).Sutlej river is located at 30°20'N ,81°25'E at elevation of 4633m above the sea level. In Punjab, many Industrial and domestic wastes get mixed with its water. In the present study an attempt has been made to determine pollutant content in Sutlej river at six sites as shown in Figure-1, Physico-Chemical Parameters[1] and their correlation coefficients[2],[3] are calculated.

Correlation coefficients can be useful statistical tools. They can help us identify some kinds of statistically significant relationships between pairs of variables, and they can tell us about sign(positive and negative) of these relationships.

2. Material and Method

Surface water samples were collected in 2L Polythene bottles. Before sampling, bottles were rinsed with 0.1N chromic acid and then twice washed with distilled water. Physico-Chemical parameters of these samples were determined by using standard procedures [4] and [5].

1) The samples were collected from following six sites-
2) Gobind Sagar (site-1):- About 13 km from Nangal, Near Entry of Sutlej in Punjab.
3) Nangal Dam Reserviour (site-2):- Before Mixing of effluents from PNFC (Punjab National Fertilizer and Chemical Ltd.,Naya Nangal).
4) Nangal Dam Reserviour (Site-3):- After Mixing of effluent from PNFC.
5) Munjwal village(Site-4):About 4km from Nangal Dam, After mixing of NFL(National fertilizer limited) effluent and Sewage from Nangal township.
6) Gholani village(site-5):-About 4km from Munjwal, surrounded by Heaps of ash from NFL.
7) Bunga Sahib(site-6):- 32km from Nangal Dam and 24km from Gholani.

The Sample were collected Monthly for one year on monthly basis. The map shows the collection sites-

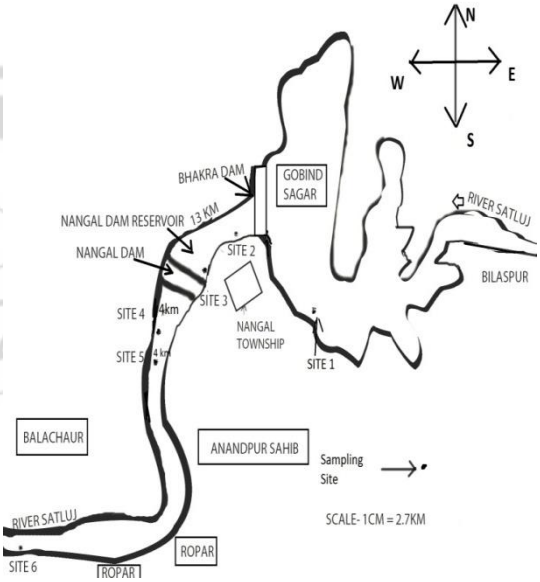

Figure 1: Map showing collection sites.

2.1 pH

The pH is determined by Elico, model LI.120 Digital pH meter which gives direct value of pH.

2.2 Temperature

The temp. is determined by using Mercury filled Celsius Thermometer with an accuracy of 0.1°C.

2.3.Conductance

Conductance is determined by using digital conductivity

meter. The conductivity meter used is Lovibond made Senso Direct Con.200.

2.4 Hardness
50ml water sample is titrated against 0.01M EDTA(Disodium Salt) solution by using EBT as an indicator. The EDTA of Qualigens is used with 98% purity.This gives the Hardness of Water.

2.5 Alkalinity
Alkalinity of water sample is determined by titrating it against standard acid solution using Indicators like Phenophthalein & Methyl orange.

2.6 Chloride
It is determined by titrating the water sample against 0.02M silver nitrate solution using potassium chromate as an indicator.

2.7 Sulphate
This is determined by Nephelometer.

2.8 Dissolved Oxygen
DO is determined by Lovibond made Senso Direct oxi.

2.9 Biochemical Oxygen Demand
DO is determined by Winkler method both at the start and after Incubation at 200×°C in a BOD incubator.

2.10 TDS
50 ml of water sample is filtered through ordinary filter paper and water is collected in evaporating dish of known weight.After that it is heated and water is totally evaporated whatever dissolved solid matter is present gets accumulated at bottom of evaporating dish.Dish is cooled and weighted by weight difference method .

2.11 Carbonate
50ml of aliquot of sample is titrated with HCl, the level of carbonate are then calculated from titre results.

2.12 Calcium
Calcium is determined by titrimetric method following APHA-AWWA –WPCF[4].The value was computed in the formula:
Calcium mg/L= (A × B ×400.8) ÷ ml sample
A=ml EDTA titrant.
B=mg $CaCO_3$ equivalent to 1 mL of EDTA solution.

2.13Magnesium
Magnesium content was calculated in mg/L by deducting the value of calcium Hardness in total hardness and was multiplied by a conversion factor as given in APHA-AWWA-WPCF[4].

2.14 Sulphate
Determined using Turbidimetric method.

2.15 Sodium
Measured by flame emission photometric method by following APHA-AWWWA-WPCF[4].

2.16 Chromium
The Colorimetric Method(3500-Cr B is used for determination of Cr).

2.17 Phosphate
Determined by Vanadomolybdophosphoric acid method.

To find relationship between two parameters x and y, Pearson's Correlation coefficient [2] is use-

$$r = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2}\sqrt{\sum_i (y_i - \bar{y})^2}}$$

where
$\bar{x}$ = mean value of x element
$\bar{y}$= mean value of y element
x_i = i^{th} value of x element
y_i = i^{th} value of y element

Or
Pearson's Correlation coefficient [3] can be use-

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{(n\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2)(n\sum_{i=1}^{n} y_i^2 - (\sum_{i=1}^{n} y_i)^2)}}$$

Where symbols have their usual meaning.

Probable error [6] between two parameters x and y is calculated using formula:

$$P.E. = \pm 0.6745\left(\frac{1-r^2}{\sqrt{n}}\right)$$

r: correlation coefficient
√n: square root of number of pair.

Correlation value = r ± P.E. [6]

Table 1: Physico-Chemical Parameters – average values of 12 measurements in mg/L except pH, Temp., DO and Conductance

Parameter	*Site 1*	*Site 2*	*Site 3*	*Site 4*	*Site 5*	*Site 6*
Conductance(mhos)	260.85	264.91	397.5	418.33	505	359.58
Alkalinity	76.25	73.16	76.5	115.83	126.66	84.33
BiCarbonate	241.66	159.83	159.83	295.41	385	240.8
Biochemical Oxygen Demand(BOD)	3.82	3.72	3.47	3.93	4.1	3.83
Carbonate(CO_3)	4.54	4.06	4.06	5.25	5.95	4.2
Calcium (Ca)	22.04	23.10	21.35	29.47	32.04	25.03
Chromium (Cr)	0.63	1.32	0.94	1.08	1.17	0.83

Chloride (Cl^-)	26.37	28.75	31.25	38.33	46.25	24.58
Dissolved Oxygen(DO)	9.1	9.25	9.0	8.75	8.64	8.94
Fluoride (F^-)	1.3	1.26	1.41	1.37	1.36	1.29
Hardness	175.68	201.66	203.76	286.25	301.66	195.41
Iron (Fe)	0.35	0.34	0.38	0.38	0.42	0.32
Lead (Pb)	0.22	0.22	0.23	0.24	0.24	0.22
Magnesium (Mg)	30.25	31.16	31.58	39.36	40.46	31.77
Nitrate (NO^{2-})	3.1	3.06	3.97	11.83	13.16	3.37
Nitrite (NO^{3-})	0.56	0.89	0.92	1.05	1.52	0.74
pH	8.26	8.37	8.41	8.52	8.52	8.25
Phosphate (PO_4^{3-})	4.0	4.01	4.85	5.52	5.82	4.26
Sulphate (SO_4^{2-}).	424.31	472.59	475.70	493.6	453.75	434.72
Sulphite (SO_3^{2-})	3.06	2.71	3.19	2.86	2.26	3.08
Total dissolved solid(TDS)	429.58	389.16	440.83	789.16	799.25	476.25
Temperature(°C)	20.29	19.64	19.91	20.8	22.16	19.34
Zinc(Zn)	2.3	2.35	1.99	2.8	2.87	2.16

Table2: Correlation coefficient of Conductance with Different parameters with their Probable error.

Parameter	*Correlation value = r + P.E.*	*Relationship*
Alkalinity	0.84 + 0.08	Strong positive
Chloride	0.84 + 0.08	Strong positive
Hardness	0.84 + 0.08	Strong positive
TDS	0.82 + 0.09	Strong positive
Lead	0.88 + 0.06	Strong positive
Magnesium	0.84+ 0.08	Strong positive
Nitrate	0.83+ 0.09	Strong positive
Phosphate	0.94+ 0.03	Strong positive
Nitrite	0.86 + 0.07	Strong positive
Zinc	0.55 + 0.19	Moderate positive
Bicarbonates	0.70 + 0.13	Moderate positive
Carbonate	0.74 + 0.13	Moderate positive
Calcium	0.78+ 0.11	Moderate positive
Fluoride	0.72 + 0.13	Moderate positive
Iron	0.79 + 0.10	Moderate positive
pH	0.75 + 0.12	Moderate positive
Temp	0.72 + 0.13	Moderate positive
BOD	0.44 + 0.22	Weak postive
Chromium	0.29 + 0.25	Weak postive
Sulphate	0.32 + 0.25	Weak postive
Sulphite	0.50 + 0.21	Weak postive
DO	-0.93 + 0.04	Strong Negative

3. Results and Discussion

The average values of Physico-Chemical Parameters recorded for one year on monthly basis from different sites are listed in Table-1 and Correlation between Parameters have been given in Table-2.According to Pearson's correlation coefficient, relationship is said to be strong if $r \geq 6 \times$ Probable error(Δr) ;moderate if $r \approx 6 \times \Delta r$ and weak if $r \leq 6 \times \Delta r$. Thus Correlation of Conductance with Alkalinity, Chloride, Hardness, TDS, Lead, Magnesium, Chloride, Nitrate, Phosphate, Nitrite is strong; moderate positive with Zinc, Bicarbonates, Carbonates, Calcium, Fluoride, Iron, pH, Temp; weak positive relation with BOD, Chromium, Sulphate, Sulphite.There is only one Strong Negtive correlation between Conductance and DO.

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