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Physico-chemical Properties of Water Samples from Barak River System

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Abstract

Physico-chemical properties of water flowing through River Barak which passing through Silchar town is considered in the present study. Water sample were collected from three different stations of River Barak. Different physic-chemical parameters as Turbidity, Total dissolved solids, pH, Conductivity, Total hardness, Nitrogen, Ammonia were investigated. Multiple regression analysis has been used to develop mathematical relationship among some physico-chemical parameters to determine concentration of certain parameters with the use of minimal equipments. Water of the river did not show any significant pollution during the present study.

Keywords: Physico-chemical property, Barak ,River, Station, Turbidity, Regression.

1.Introduction

Water is the most vital resource for nourishment of life as well as development activity. Rivers are the major water resource. But, rivers are polluted by extensive disposal of sewage and industrial waste, which affects Physico-chemical and Microbiological quality.Water quality is continuously deteriorating due to population growth , industrialisation,intensive agricultural practice and discharge of huge amount of waste water into the river.

River Barak is one of the major rivers of south Assam. Source of river Barak is the hills of Manipur. It then flows through Mizoram and Assam. Later it enters Bangladesh where it bifurcates into Surma and Kushiyara.

About 71% of earth's surface is covered with water. But, only a small amount is available for human consumption. It is important to know the amount of Physico-chemical parameters of a sample of river water and compare with permissible limits set by regulatory bodies.

The exact concentration of the parameters can be known by testing the water with standard equipment as well as reagents, which could be expensive and time-consuming. .so it is very necessary to develop a means of reducing the time which is spent in analyzing the water quality as well as the cost incurred.

This could be done by building an equation out of earlier studies that will act as a representation of reality without directly interfering with the quality of the result.So in this study, regression analysis is done to develop mathematical relationship among some physicochemical parameters and quantity of certain parameters could be found out using minimal equipment.

Water quality monitoring focuses on the physical, chemical, and biological activities of the water through Water Quality Parameters (WQPs). pH, Conductivity, Turbidity, Total Dissolved Solids (TDS), Dissolved Oxygen and Temperature are the major WQPs used to detect the level of contaminations in water. TDS is used to measure the inorganic salts and small amounts of organic matter present in the water. pH is the measure of hydrogen ion concentration present in the water. It is used to classify the alkalinity and basic properties of water. Conductivity is used for measuring the concentration of ions in water. The conductivity of contaminated water is higher than pure water. The temperature can alter the metabolic rates of the water. It has a significant impact on other WQP. Dissolved Oxygen is used to measure the amount of gaseous oxygen (O2) dissolved in water.

2.Objective : The objective of the study is to relate Physico-chemical parameters of water quality in Barak river flowing through Silchar town area of Assam.

3.Methodology -

Regression is a statistical method used for determining the significance and potential of the relationships between a dependent and a series of independent variables, Two basics types of regression are

Simple Linear Regression

Multiple Linear Regression

Linear regression attempts to identify the connection between the two variables along a straight line. Simply, this model is used to predict or show the relationship between a dependent variable and an independent variable.

Multiple linear regression model is used for this purpose. It is the extension of simple linear regression that predicts the value of a dependent variable on the basis of two or more independent variables.

It is a method of statistical analysis that provides the statistical significance to explanatory variables, or which potential explanatory variables are crucial predictors for a given responsevariable. It can be used to understand the changes in the dependent variable while making changes in the independent variables

Assumptions for MLR

While choosing multiple regression to analyze data, part of the data analysis process incorporates identifying that the data we want to investigate may actually be analyzed using multiple linear regression via assuring some assumptions, listed below

Relationship between dependent and independent variables

The very first assumption is that there should be linear relationships between a dependent variable and each of the independent variables. Best mean to check this linear relationship is a scatter plot, which is created and then inspected for linearity.

If the relationship presented in the scatter plot is non-linear, then the non-linear regression is executed.

The independent variables are not much correlated with each other

The data values must not exhibit multicollinearity; this takes place when the explanatory variables are highly correlated to each other. However, when the independent variables display multicollinearity, this can make it difficult in fetching the concerned variable that contributes to the variance in the dependent variable. To test this assumption, a Variance Inflation Factor method is employed.

The residual variance is constant

In multiple linear regression, it is assumed that the quantity of errors in the residuals is identical at each point of the linear model which is noted as Homoscedasticity.

While examining the data, you should plot the standard residuals against predicted values in order to check whether the points are correctly distributed over all the values of independent variables.

To test this assumption, scatter plots can be used or by using any statistical software to make scatter plots, including the entire model.

Independence of observations

The MLR model assumes that all the observations should be independent of each other, or in other words, residuals values should be independent of one another.

Multivariate normality

When the residuals are normally distributed appropriately, then the multivariate normality occurs. For testing this assumption, it is necessary to check how the residual values are distributed by several methods like histograms with a superimposed normal curve or the normal probability plot.

The relationship between physical and chemical parameters using multiple linear regression equations for forecasting.

Multiple regression analysis:

Ordinary linear regression usually is not enough to take into account all of the real-life factors that affect an outcome.

Multiple regression analysis is done to see that if there is a statistically significant relationship between sets of variables. It is used to find trends in those sets of data.

Simple regression analysis uses a single x variable for each dependent “y” variable. For example: (x1, Y1).

Multiple regression uses multiple “x” variables for each independent variable: (x1)1, (x2)1, (x3)1, Y1).

$$Y = b0 + b1\ x1 + b0 + b1\ x2 \ldots b0 \ldots b1\ Xn.$$

The output would include a summary, similar to a summary for simple linear regression that includes:

R (the multiple correlation coefficient),

R squared (the coefficient of determination),

Adjusted R-squared,

The standard error of the estimate.

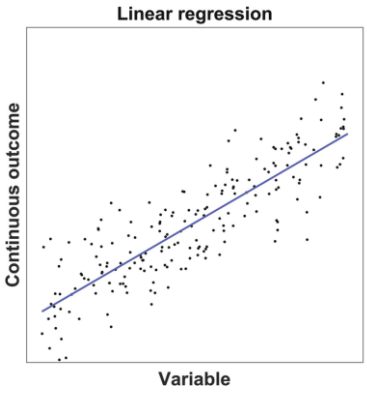
These statistics help to figure out how well a regression model fits the data. The table in the output shows the p-value and f-statistic

Steps –

i. Collection of Training/Testing data

ii..Feature determination

iii. Feature scaling.
iv. Regression model selection
v. Regression model learning
vi Hyper parameter tuning etc.



Graph of linear regression

4.Study area:-

The study area considered in the present work is Barak river basin. The Sub-basin of Barak River covers the state of Assam, Nagaland, Manipur, Mizoram, Tripura and Meghalaya with an area of about 27,658 sq. km. The water quality monitoring stations are Kanakpur, Sadarghat and Malugram.

5.Data collection:-

Water sampling was done in the morning before sunrise so that photosynthesis will not affect the water quality parameters. There are 3 sampling stations Kanakpur, Sadarghat and Malugram which are near to city and are densely populated. Sampling was done once in a week for a period of 3 months and water quality parameters are noted. Performing of experiments are done using field test kits.

6.Results :-

Station : KANAKPUR
Regression equation:
DO = 52.3 – 1.538T + 0.1409 CL -0.2125 TDS

Station : SADARGHAT
Regression equation:
DO = 40.08 – 1.060 t – 0.0875 TDS – 0.0513 CL

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DATE	T	TDS	PH	C	TH	N	NH3	RCL	CL	DO	Cal DO	Error	Error square
D1	21.8	65	6.9	100	55	0	0	0.2	20	10	10.045	-0.045	0.00203
D2	21.9	68	6.9	102	50	0	0	0.2	40	9	9.0444	0.0444	0.00197

D3	21.8	63	7	97	42	0	0	0	30	10	10.0115	0.0115	0.00013
D4	22.8	68	6.5	107	50	0	0	0	40	8	7.878	0.122	0.01488
D5	21.4	67	7	98	46	0	0	0	30	10	10.0863	0.0863	0.00745
D6	22.2	71	7	110	50	0	0	0	40	8	8.3229	0.3229	0.10426
D7	22.4	70	6.5	107	48	0	0	0	40	8	8.1746	0.1746	0.03049
D8	22.2	72	6.5	111	50	0	0	0	30	9	8.495	0.505	0.25503
D9	21.4	62	7	96	48	0	0	0	20	11	10.9238	0.0762	0.00581
D10	22.8	67	6.5	107	52	0	0	0	40	8	7.9889	0.0111	0.00012
MEAN	22.07	67.3	6.09	103.5	49.1	0	0	0.04	33	9.1			0.42216
			RMSE	0.64974									

Station : MALUGRAM
Regression Equation
DO = 43.0 - 0.544T – 0.217 TDS – 0.1325 Cl

7.Conclusion:
Amount of pollutant present in the river water is not significant.As the sediment flow is more, turbidity is more. Therefore, the water cannot be used directly without primary treatment.

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