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Assessment of pollution by Physicochemical Water Parameters Using Regression Analysis: A Case Study of Gagan River at Moradabad- India

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ABSTRACT

A study carried out in river Gagan (India) to assess the extent of pollution by different industrial and domestic activities. Water samples collected from river Gagan at two sites and analyzed for alkalinity, biological oxygen demand (BOD) and chemical oxygen demand (COD) during summer, winter & rainy season. The collected data subjected to statistical analysis and good correlation between alkalinity & BOD and alkalinity & COD is established. Regression equations also established between above parameters to predict the level of pollution of river Gagan. In the present study regression, equation established between two parameters, which can used to predict the value of one parameter if value of other is known. The above study gives us a tool to find the value of physicochemical parameters and extent of pollution theoretically, which is not only time saving but also cost effective.

Key Words: Correlation Coefficient, Regression Equation, Physicochemical Parameters, Scatter diagram, Gagan River.

INTRODUCTION

Water is the commonest fluid in nature. Water is also a vital resource for agriculture, manufacturing and other human activities. In urban areas, the careless disposal of industrial effluents and other wastes in rivers & lacks may contribute greatly to the poor quality of river water [1-4]. Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. African countries and Asian countries experiencing rapid industrial growth and this is making environmental conservation a difficult task [5]. Moradabad is a major city in Northern India and it situated at the banks of Ram Ganga River. Its altitude from sea level is about 670 feet and is at 28°20', 29°15' N and 78°4', 79°E having urban population more than 3.7 million and has seen rapid industrialization during last few decades. The city is full of brass, steel & glass cottage industries. A paper industry, some electroplating

plants & other small-scale industries situated in the heart of the city. The annual turn over of the city is nearly rupees 10,000 million. All these industries are in unorganized sector and thus have unplanned growth leaving to high degree of air, water and soil pollution. The most of the industries are dumping their effluents in two major rivers of the city- Gagan & Ram Ganga (Fig.1).

A number of investigators attempted before to check the quality of water and its physicochemical parameters. Some people give empirical relationship [6-8] to measure the quality of water but nobody establish a correlation between physicochemical parameters as it pollute water. Analytical techniques are used to produce reliable results but generally the laboratory methods are time consuming and very costly. However, some models can develop which will provide easy, reliable and cost effective methods to collect data and provide information of the level of pollution by different parameters. In the present work, an attempt made to analyze quantitatively the physicochemical parameters and to establish a mathematical relation between them. For that, correlation coefficient calculated to understand the nature of correlation between physicochemical parameters and established a regression equation to understand the extent of pollution by parameters.

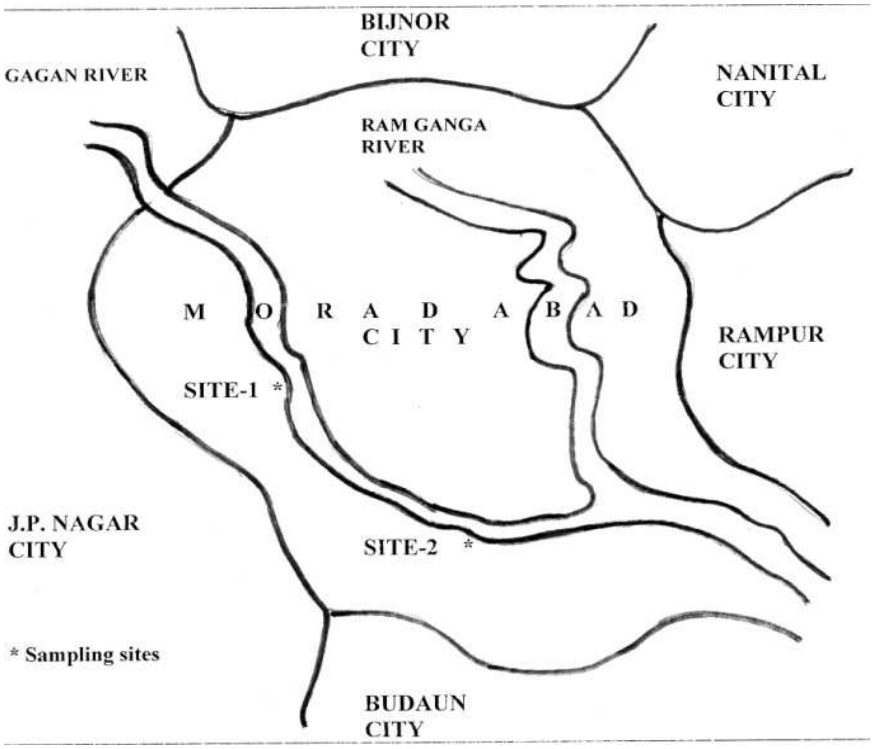

Fig. 1 : Map of sampling sites

MATERIALS AND METHODS

***Sampling sites*:** Two different sampling sites (S1& S2) chosen to study the physicochemical parameters of Gagan River where animal & industrial pollution is high. Map of the sampling sites given in Fig. 1 and following were two sampling sites:

(i) Moradabad – Delhi Gagan Bridge (S1): this is the site at which little small-scale industries situated and discharging lot of untreated industrial waste.
(ii) Moradabad – Sambhal Gagan Bridge (S2): It is about 3.5 km away from site (S1).It is the site at which cattle bathing and laundering of cloths are the main activities.

Samples collected from each site for six times in a year according to three main seasons. In India, Individual seasons defined as the summer season (May-June), rainy season (August-September) and winter season (November-December). The present study conducted from May 2010 to December 2010.

Chemical Analysis: Water sample for physicochemical analysis collected in pre cleaned plastic containers from two sites twice in a month at a regular interval of 15 days. For one parameter, twelve values are obtain at each site and illustrated in Table-1. The samples were analyzed for alkalinity, biological oxygen demand (BOD) and chemical oxygen demand (COD) following standard analytical technique [9].

Statistical analysis: All the data obtained subjected to statistical analysis. In statistical analysis, a correlation developed between parameters by using KARL PEARSONS Coefficient of correlation and a regression equation is established.

Calculation of KARL PEARSON's Coefficient of correlation:
Correlation coefficient between two parameters X and Y calculated as

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}}$$

Where $x = X - \overline{X}$, $y = Y - \overline{Y}$, $\overline{X} = \frac{\sum X}{n}$, $\overline{Y} = \frac{\sum Y}{n}$ and n is the number of sites.
For good correlation value of r should be between - 1 < r < 1.

Calculation of Regression equation: The term regression stands for some sort of functional relationship between two or more related variables. It measures the nature and extent of correlation and predicts the unknown values of one variable from known values of another variable. Following regression equation is used to established correlation between parameters

$$Y - \overline{Y} = b_{yx}\left(X - \overline{X}\right).$$

The above equation called regression line equation of Y on X and b_{yx} called regression coefficient of Y on X and calculated as

$$b_{yx} = \frac{\sum XY}{\sum X^2}$$

Table-1: Values (mg/lit) of physicochemical parameters of Gagan river

Physicochemical parameters	Site(S1)			Site(2)		
	May-June	August - September	November - December	May-June	August- September	November- December
Alkalinity	130	100	155	240	270	160
	55.6	55	210	240.5	250	220
	140	150	205	230	229	151.6
	200	240	152	180	186	75
BOD	30	34	33	57	63	50
	23	28	52	53	60	40
	35	38	40	60	61	32
	42	55	29	40	55	30
COD	18.5	9.3	19	23.4	33	18
	12	9	23	25.3	30	19.7
	10	15	20.2	26.3	28	11.3
	13.2	29	19.2	21.4	26	14.3

RESULTS AND DISCUSSION

The values of physicochemical parameters illustrated in Table-1. The relationships between parameters in the form of scatter diagrams shown in fig. (2 and 3). The relationship between Alkalinity with COD & Alkalinity with BOD is established which give correlation coefficient r = 0.84 & r = 0.81 respectively shows a very good correlation as the values of r lies between -1 to +1.

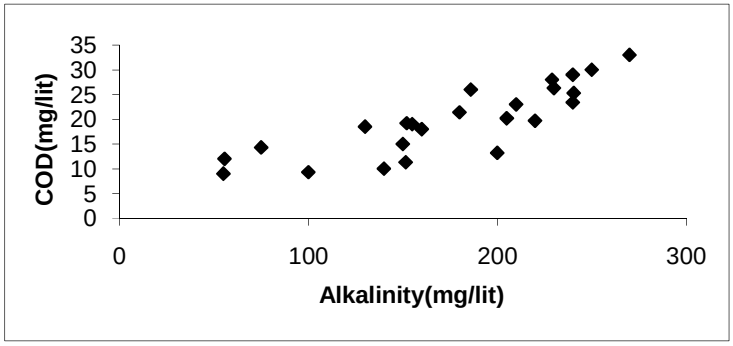

Fig. 2: Scatter diagram between Alkalinity and COD

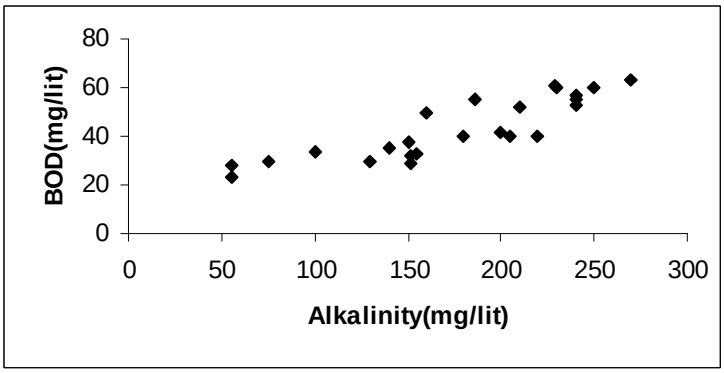

Fig. 3: Scatter diagram between Alkalinity and BOD

The alkalinity of water is due to the salt of carbonates, bicarbonates, borates, silicates and phosphates along with hydroxyl ions in the free State. The high value of alkalinity could be due to cattle bathing and laundering of clothes. Since most of the soaps have water softening agents such as washing soda and sodium carbonate, the use of these soaps might have increased the concentration of carbonates and hence alkalinity, while COD is the amount of Chemical oxidant required for the oxidation of organic matter present in the waste. High value of alkalinity indicates that the compound responsible for increase in alkalinity may work as chemical oxidant for COD and hence increase the value of COD. Since alkalinity regression equation **Y=0.1052 X + 1.2334** and **Y=1.0214 X – 136.46** used to estimate the values of COD and BOD respectively. It also made easy to find the value of BOD/COD ratio to analyze the extent of pollution and the biodegradability of water because BOD is the amount of oxygen required by the aerobic bacteria to biochemically oxidize the organic matter present in the waste. The high value of BOD suggest that oxygen present in water is consumed by aerobic bacteria's which leads to fish, plankton, mollusks and other aquatic organisms to be difficult to survive.

CONCLUSION

Two good correlations established between physicochemical parameters using regression equation and these equations can used to predict the level of contamination of Gagan river water by different parameters. The above analysis is also cost effective and time saving because statistical equations used for calculating the value of physicochemical parameters and to measure the extent of pollution in river Gagan so that some preventive action can taken before the detailed investigation and controlled the pollution to a certain extent.

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