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MULTIPLE REGRESSION MODELLING OF WATER QUALITY IN HOHKA WETLAND, ASSAM

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ABSTRACT

The present work deals with the multiple regression modelling of water quality of Hohkawetland, Assam, India with regards to various physico-chemical parameters like, Dissolved oxygen (DO), Biological oxygen demand (BOD), Chemical oxygen demand (COD), Total hardness (TH), Total dissolved solids (TDS), in the year 2015.The dependent variable was TDS and the independent varibles were BOD, COD, DO, TH. Multiple regression analysis is done by using data analysis tool of MS Excel at 95 % confidence level. R^2value, in the regression statistics has been obtained.

Key Words : Multiple regression, MS Excel, Dependent variable, Independent variable, Water quality

INTRODUCTION

Water quality concept has been studied by many researchers on the ground of studying various environmental effects[1]. Water quality and sediment characteristics of wetla-nds regarding the geo-environmental consid-erations provide a major milestone in the study of wetlands[2]. Wetlands are regarded as 'duck factories' due to their high carrying[3]. Wetlands acts as transient region. The most important step for the conservation of wetland is to maintain a proper water quality.The water quality is directly related with the health of the wetland.

Study Area

The study was conduct in Hohkawetl and of Hajo, Kamrup district of Assam which is situated at the global position26^0 $14^/$ $52^{//}$N latitude and 91^0 $32^/$ $18^{//}$ E longitude, The wetland is covered by water along within aquatic vegetation almost throughout the year.

MATERIAL AND METHODS

Sampling sites and sampling

Nine sampling sites were selected. These sites were from the middle and two banks of the Hohka wetland .Water samples were collected randomly from the sites in 500 ml polythene bottles immersed about 20 cm below the surface of the water and filled up to the top, sealed and tested in laboratory following standard analysis technique[4-6].

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Statistical analysis

Calculation of Karl Pearson's Coefficient of correlation

Correlation coefficient (r) using Karl Pearson,'s coefficient between each pair of physico-chemical water parameters[7-9]. Acco-rding to Karl Pearson, coefficient of correlation (r) between two parameters x and y is calculated as

$$r = \Sigma [(x-\bar{x}) (y-\bar{y})] / \sqrt{\Sigma (x-\bar{x})^2 \Sigma (y-\bar{y})^2}$$

Where $x = x-\bar{x}$, $y = y-\bar{y}$

If the value of correlation coefficient (r) between two variables x and y is large , it implies that these two variables are highly correlated[10-11].

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 another variable[12-14].

$Y = a + bx$

Slope (b) of regression line

$b = r \lceil y / \lceil x$

Y = Intercept (a) of regression line :

$a = \bar{y} - b\bar{x}$

Multiple regression statistical model : In multiple regression there are many variables,

we can measure the effect of variations in the independent variable on those in the dependent variable by calculating R^2 [15].

$Y' = a + b_1x_1 + b_2x_2 + b_3x_3 + \ldots\ldots\ldots b_kx_k + \epsilon$

Y'=dependent variable

x's = independent variables

k= the number of independent variables in the equation

a = regression constant

ϵ = specification error

RESULTS AND DISCUSSION

The water quality is determined by various physico-chemical parameters. The values of parameters changes due to various natural as well as anthropogenic factors[16-18]. Five parameters i. e Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total Hardness (TH) were analyzed over a period of four seasons in the year 2015.The TDS value showed high i.e 127.7 mg/L in April, due to heavy rainfall which leached surface run off into the wetland.THS also showed high value i.e 178.7 mg/L.DO concentration ranged from 4.37 to 5.27 mg /L. High concentration of DO indicates low BOD, which ranged from 1.15 to 3.45 mg/L . Low BOD indicates high DO in the wetland.The BOD test measures the amount of oxygen consumed by micro organisms to degrade the organic matter. Decrease in DO results high value of BOD .The data table and figures related to water quality are illustrated in **Table 1 and Fig. 1** to **Fig. 4.**

Table 1 : Water quality parameters values in Hohka wetland in mg /L

TDS	TH	BOD	COD	DO
103.4	120.7	1.15	4.29	5.2
99.7	134.9	2.09	4.11	4.7
108.6	160.7	1.92	3.92	5
89.9	178.7	2.49	3.96	4.37
109	150.7	2.9	3.27	5.27
118.4	129.9	1.72	4.21	5.22
127.7	87.1	3.45	4.1	4.9

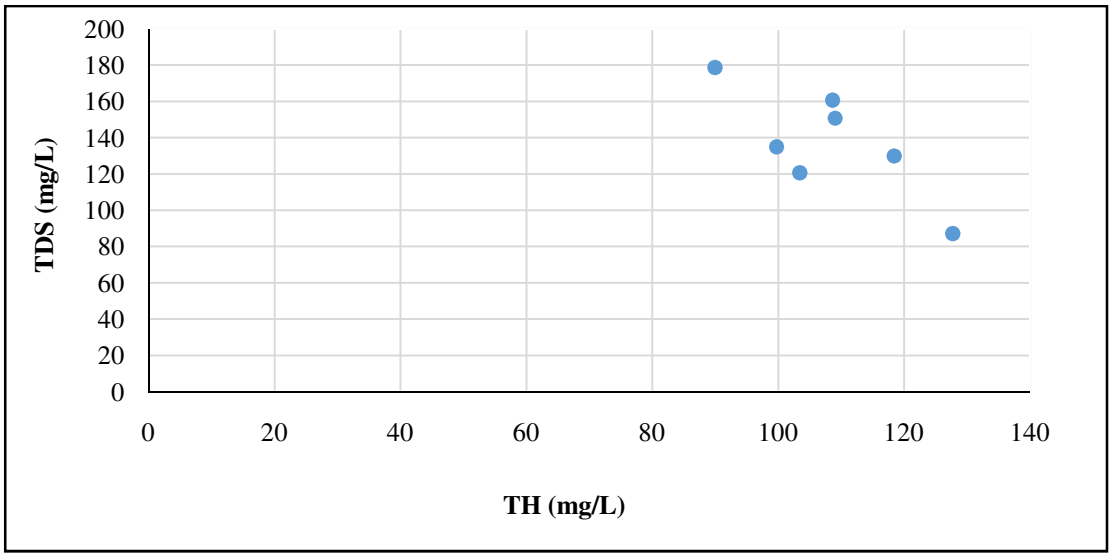

Fig. 1 : Scatter diagram between TDS and TH

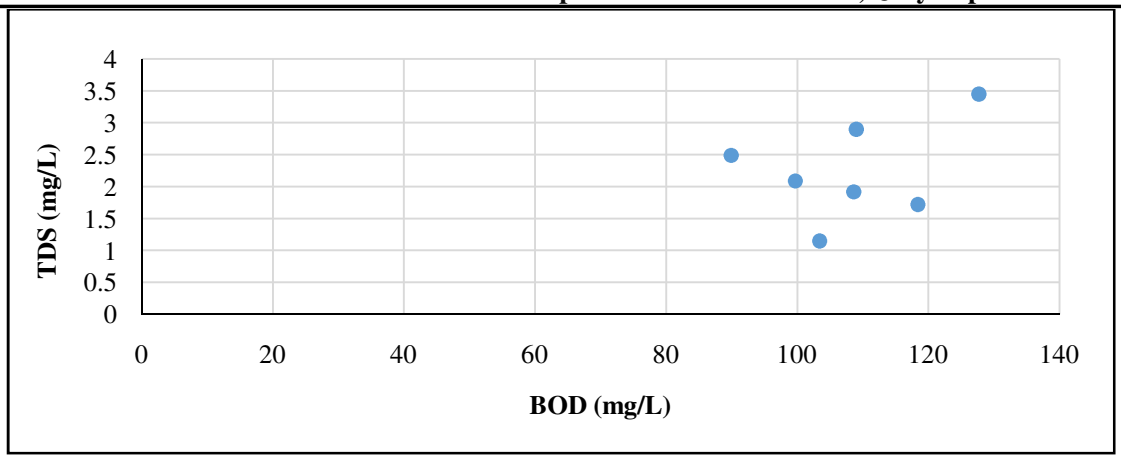

Fig. 2 : Scatter diagram between TDS and BOD

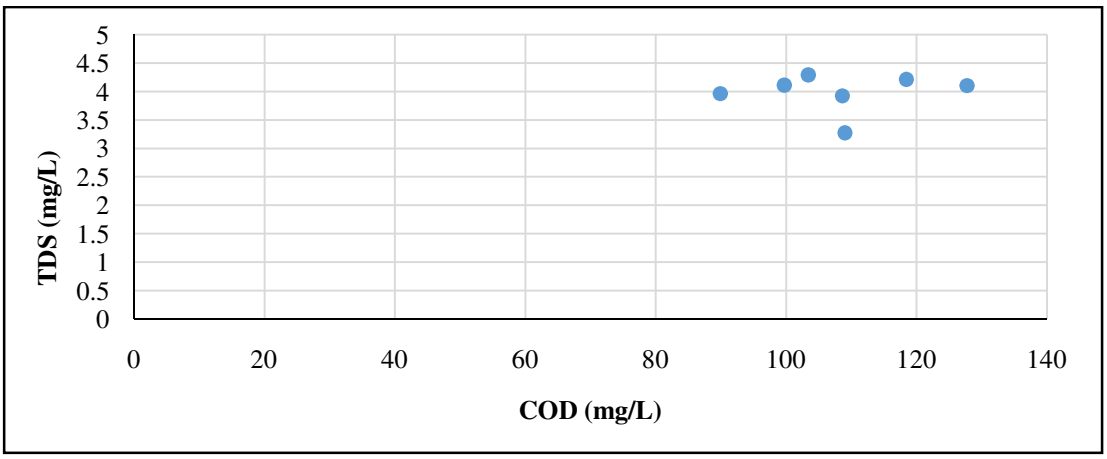

Fig. 3 : Scatter diagram between TDS and COD

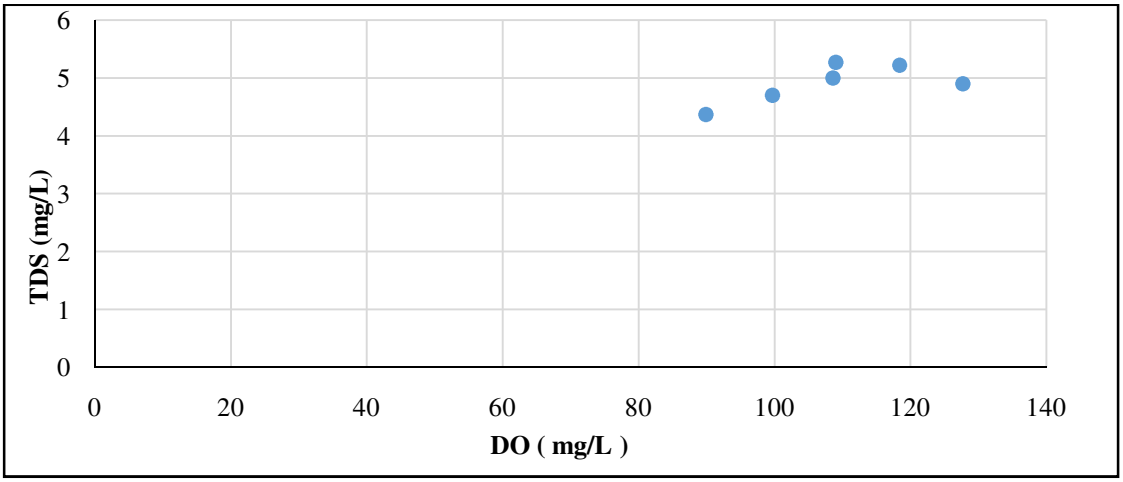

Fig. 4 : Scatter diagram between TDS and DO

Multiple regression model

The dependent variable was TDS and the independent variables were TH, BOD, COD, DO.The multiple regression model was established by using data analysis tool of MS Excel at 95 % confidence level and the regression equation relating with its dependent water quality parameters has been established.

Summary of multiple regression model analysis and the result is presented in **Table 2.**

The estimated regression equation

TDS = [- 417.076 + .228 (TH) + 23.497 (BOD) + 46.640 (COD) + 51.558(DO)] For the analysis of the regression equation model of multiple analysis, 95 % confidence level has been fixed. Thus, p value should be within 5 % confidence level i.e p value should be less than .05 for analysis to be accurate within the assumed confidence level .It has been observed from the **Table 2** (before standardization part) , the p value for TH is .269 and COD is .084. However, p value for BOD is slightly more than .05, i.e .057 – may be considered for analysis.As the two water quality parameters extends the assumed confidence limit , so there is no significance and the regression equation is invalid and necessary corrections has to be made in the equation. Hence, new regression equation has been established by excluding the mentioned above two parameters. The new modified multiple linear regression equation model has been formed.The final linear modified empirical regression equationis given below after the standardization part shown in **Table 3.**

The final regression equation

TDS= [-42.193 + 8.691(BOD) + 26.411(DO)]

Table 2 : Before Standardization

Regression Statistics					
Multiple R	0.983557108				
R Square	0.967384585				
Adjusted R Square	0.902153754				
Standard Error	3.863264694				
Observations	7				
ANOVA					
	df	***SS***	***MS***	***F***	***Significance F***
Regression	4	885.3504	221.337593	14.8301742	0.064167066
Residual	2	29.84963	14.9248141		
Total	6	915.2			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	
Intercept	-417.0762998	145.6272	-2.863999539	0.10335654	
TH	0.228973976	0.151436	1.512020167	0.26966668	
BOD	23.49775352	5.865293	4.006236767	0.05702796	
COD	46.64054982	14.51988	3.212184878	0.0847745	
DO	51.55829338	11.96375	4.309543636	0.04985198	

Table 3 : After Standardization

Regression Statistics					
Multiple R	0.766962				
R Square	0.588231				
Adjusted R Square	0.382347				
Standard Error	9.706323				
Observations	7				

ANOVA					
	df	***SS***	***MS***	***F***	***Significance F***
Regression	2	538.3492	269.1746	2.857094	0.169553573
Residual	4	376.8508	94.21271		
Total	6	915.2			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	
Intercept	-42.1939	66.24545	-0.63693	0.558796	
BOD	8.691737	5.332284	1.630021	0.17843	
DO	26.41153	12.53381	2.107223	0.102812	

Scatter is plotted between actual TDS and predicted TDS shown in **Fig. 5**. The R^2 value indicates the probability of existence of error. If the value of R^2 is approximately 1 then probability of existence of error is negligible that means the predicted model is valid.

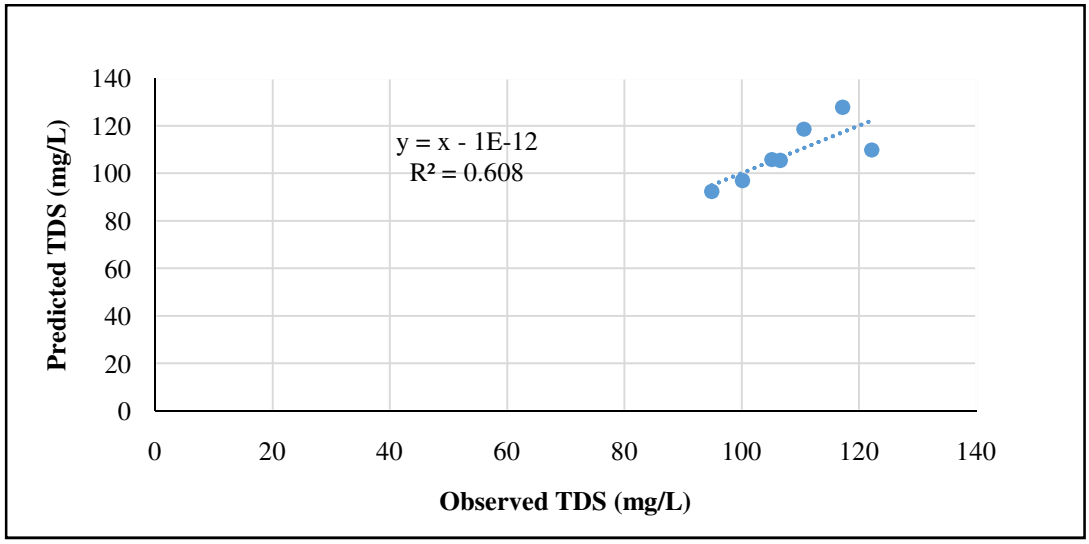

Fig. 5 : Actual vs predicted TDS values

CONCLUSION

The water quality is determined by various physico-chemical parameters. The values of parameters changes due to various natural as well as anthropogenic factors.The estimated water quality parameters were TDS,TH, BOD, COD, DO. Deterioration of Indian waterb-odies due to industrial effluent discharge and domestic waste discharge has been reported by many researchers in the past few decades. Variation in water temp-erature as important physical parameter has been studied. Multiple regression analysis was done by using MS Excel at 95 % confidence level and the regression equation relating TDS with its dependent water quality parameters has been obt-ained. The results obtained are useful to explain behaviour and impact of Hohka wetland water.

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