

RESPONSE OF PHYTOPLANKTON OF THANE LAKES, (MAHARASHTRA) TO PHYSICO-CHEMICAL PARAMETERS

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ABSTRACT

Phytoplankton samples were collected from four selected lakes (Ambeghosale, Rewale, Makhmal & Upavan) in the Thane City. Phytoplankton analysis was done throughout the year for these lakes. During the course of statistical analysis of phytoplankton. Partial Least Square regression (PLS) response (phytoplankton) to physico-chemical parameter was represented first time for Thane lakes. This study shows that calculated PLS response of phytoplankton is very near to actual response of phytoplankton in all four-study lakes.

Key words : Lakes, Phytoplankton, PLS (Partial Least Square Regression).

INTRODUCTION

Regression means change in the measurements of a variable character, on the positive or negative side, beyond the mean. Regression co-efficient is a measure of the change in dependent (y) character with one unit change in the independent character (x). Sharma and Sarang (2004) reported regression equation amongst different limnological parameters of Jaisamand lake, Udaipur (Rajasthan) and Saha (2004) obtained regression line for algal productivity in fresh waterbodies in Jharkhand. Davies *et al* (2005) represented relations between the variance of soil depth and exotic diversity, native diversity, native beta diversity for the largest spatial scale with the help of least square's regression. This work reports the response of phyto plankton of Thane lakes to physico-chemical parameters.

Partial Least Square Regression (PLS) reduces the number of predictors to a set of uncorrelated components and performs least square regression on these components.

MATERIALS AND METHODS

Water samples from the study lakes (Ambeghosale, Rewale, Upavan & Makhmal) were collected monthly. The samples for phytoplankton were collected monthly and preserved in 4% Lugol's iodine for further analysis. The physico chemical analysis of water samples was performed as per

the procedures described in the standard methods (APHA 1981) and Trivedi and Goel (1984) for the physico chemical parameters: Air temperature, water temperature, light penetration, total solids, dissolved solids, suspended solids, pH, conductivity, turbidity, salinity, dissolved oxygen, free Carbon dioxide, phenolphthale alkalinity, total alkalinity, total hardness, Calcium hardness, Calcium, Magnesium, Silicates, Phosphates, Nitrates and Biological Oxygen Demand.

One year data of the physico-chemical parameters and phytoplankton were subjected to statistical analysis, for which, software Mintab 14 was used. The (Partial Least Square Regression) PLS groups are drawn by using this statistical software.

RESULT AND DISCUSSION

In this study, the predictors (Physico-chemical parameters) were more than the number of observations and hence ordinary Regression Least Square fails. Hence, Partial Least Square (PLS) method was used. Similarly this study indicates that the response is correlated to phytoplankton. Response phytoplankton (y) depends on Physico-Chemical Parameters (x). Numbers of observations were 12 but with 10 components good results were obtained. Hence, 10 components were considered for least square. In PLS, standardized coefficient indicates the importance of each predictor in the model. The coefficients are used with the predictors to calculate the value of the response variable.

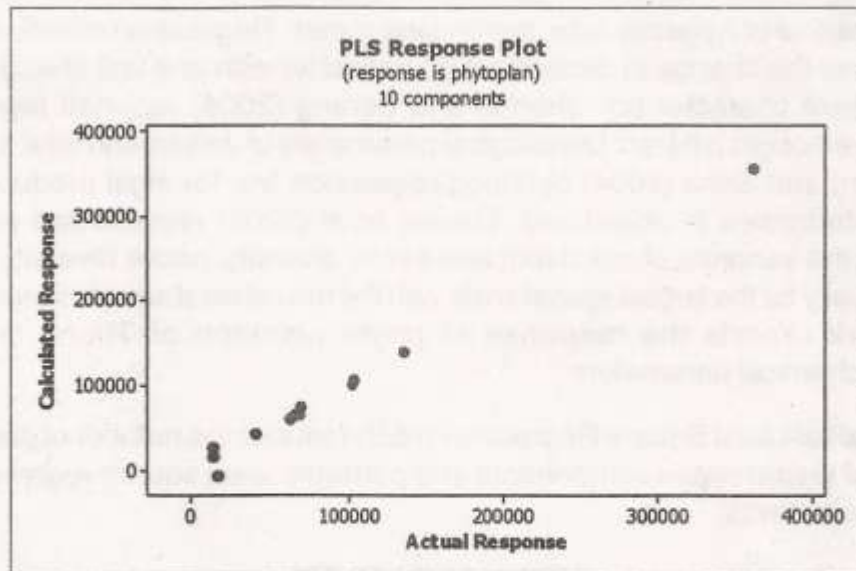


Fig. 1 PLS response (Phytoplankton) plot between calculated and actual response in the lake Ambeghosale

Using the equation we can obtain calculated values (expected value) of phytoplankton. The actual values and calculated values are given in the Table 2.

Table 1 Regression coefficient of phytoplankton in the lake Ambeghosale

	Regression coefficient	Standardized coefficient
Constant	12093	0.000000
AT	-4967	-0.200994
WT	-78	-0.001993
LP	389	0.06675
TS	26	0.045875
DS	-135	-0.165236
SS	133	0.194137
pH	-5565	-0.037691
Conductivity	3402	0.003253
Turbidity	730	0.14764
SALI	-3019986	-0.347431
DO	5706	0.13203
F CO ₂	1599	0.348482
PAlk	370	0.031146
TAlk	306	0.106659
T hard	-45	-0.019338
CA hard	2399	0.380447
CA hard	5990	0.380466
MG	-1433	-0.151111
SIL	-484	-0.075149
POSP	61009	0.153184
NIT	28711	0.030341
BOD	661	0.035139

Table 2 Observed and expected values of phytoplankton in the lake Ambeghosale

Row	Observed values	Expected values
1	103040	104836
2	68520	73341
3	135200	1395490
4	102000	99988
5	39440	43588
6	361440	357091
7	64600	65528
8	67140	65293
9	61360	60189
10	13260	26390
11	16800	-6614
12	13200	16881

Using PLS we got the final regression equation as : Phytoplankton = 12093 – 4967 AT – 78 WT + 389 LP + 26 TS – 135 DS + 133 SS – 5562 pH + 3402 COND + 730 TURB – 3019986 SALI + 5706 DO + 1599 FCO₂ + 370 PA + 306 TA – 45 T HARD + 2399 CA HARD + 5990 CA – 1433 MG – 484 SIL + 61009 POSP + 28711 NIT + 661 BOD.

By observing standardized regression coefficient, following conclusions are drawn: For phytoplankton in lake Ambeghosale we observed maximum positive coefficients (hence positive covariance) for free carbondioxide (0.348482). Calcium (0.380446) and Ca⁺⁺ hardness (0.380447), while salinity and air temperature has negative coefficient (hence negative covariance), whereas coefficient of water temp. (-0.001993) and conductivity (0.003253) are very close to 'zero'. Hence, free carbon-di-oxide, Ca⁺⁺ and Ca⁺⁺ hardness have positive impact on phytoplankton, whereas salinity and air temperature have negative impact.

Table 3 Regression coefficient of phytoplankton in the lake Rewale

	Regression coefficient	Standardized coefficient
Constant	2128007	0.000000
AT	-86284	65309
WT	86785	0.71730
LP	-18239	-0.39042
TS	-2244	-0.81448
DS	233	-1.06718
SS	-3584	-1.53089
pH	-1041347	-1.53089
Conductivity	309084	0.21461
Turbidity	5254	0.49125
Sali	48778847	1.52524
DO	-45235	-0.20140
F CO ₂	14760	0.45799
P Alk	67626	0.49187
T Alk	4003	0.27208
T Hard	1871	0.18100
CA Hard	-7306	-0.57563
CA Hard	-18314	-0.57782
MG	28814	0.63825
SIL	-8381	-0.50878
POSP	5542000	1.16002
NIT	3514435	0.37921
BOD	6795	0.07691

Table 4 Observed and expected values of phytoplankton in the lake Rewale

Row	Observed values	Expected values
1	1490400	1481938
2	71910	101181
3	284800	187439
4	229400	426149
5	699600	557382
6	271600	322781
7	198240	179596
8	64240	88195
9	67620	-4233
10	17600	50240
11	27560	79515
12	7140	-40174

Using PLS we got the final regression equation as : Phytoplankton = 2128007 - 86284 AT + 86785 WT - 18239 LP - 2244 TS + 233 DS - 3584 SS - 1041347 pH + 709084 COND + 5254 TURB + 48778847 SALI - 45235 DO + 14760 FCO₂ + 67626 PA + 4003 TA + 1871 T HARD - 7306 CA HARD - 18314 CA + 28814 MG - 8381 SIL + 5542000 POSP + 3514435 NIT + 6795 BOD.

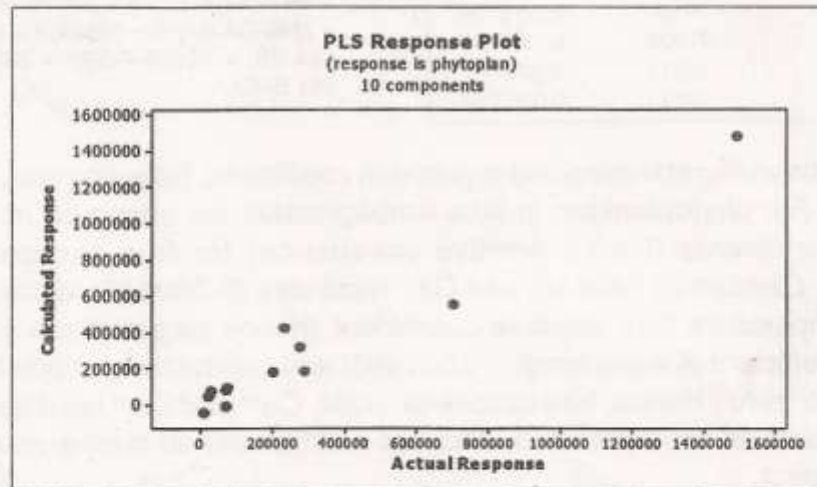


Fig. 2 PLS response (phytoplankton) plot between calculated and actual response to in the lake Rewale

Table 5 Regression coefficient of phytoplankton in the lake Makhamali

	Regression coefficient	Standardized coefficient
Constant	262466	0.000000
AT	-318	-0.033566
WT	-962	-0.120478
LP	-1607	-0.311229
TS	-22	-0.059119
DS	-28	-0.085825
SS	9	0.030971
pH	-32221	-0.661728
Conductivity	36228	0.102892
Turbidity	335	0.215377
Sali	-403747	-0.262495
DO	2607	0.199006
F CO ₂	-183	-0.053479
P Alk	-625	-0.298115
T Alk	155	0.311213
T Hard	235	0.120630
CA Hard	22	0.020553
CA Hard	57	0.020781
MG	204	0.047860
SIL	852	0.301151
POSP	-65723	-0.161516
NIT	-65723	-0.161516
BOD	4645	0.533200

Table 6 Observed and expected values of phytoplankton in the lake Makhamali

Row	Observed values	Expected values
1	21200	18233
2	28320	30053
3	27600	30289
4	32200	31539
5	24360	23139
6	158200	157789
7	31620	32008
8	11160	10877
9	24320	24079
10	12580	12918
11	25520	26777
12	13200	12537

Using PLS we got the final regression equation as : Phytoplankton = 262466 – 318 AT – 962 WT – 1607 LP – 22 TS – 28 DS + 9 SS – 32221 pH + 36228 COND + 335 TURB – 403747 SALI + 2607 DO – 183 FCO₂ – 625 PA + 155 TA + 235 T HARD + 22 CA HARD + 57 CA + 204 MG + 825 SIL – 65723 POSP – 65723 NIT + 4645 BOD.

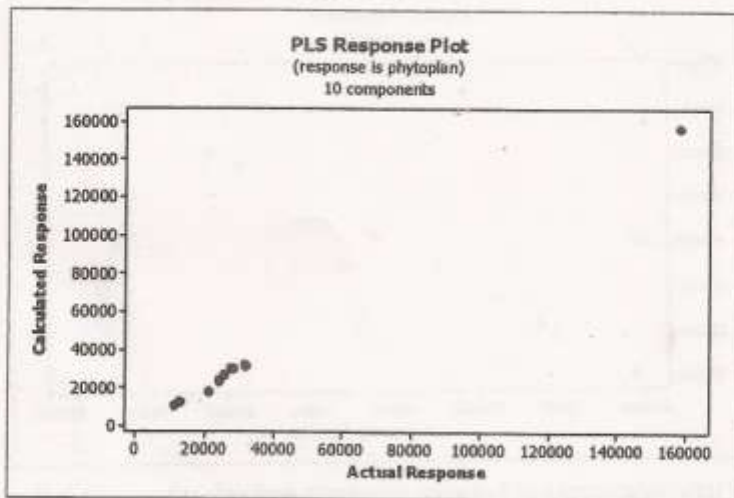


Fig. 3 PLS response (phytoplankton) plot between calculated an actual response in the lake Makhamali

Table 7 Regression coefficient of phytoplankton in the lake Upavan

	Regression coefficient	Standardized coefficient
Constant	-4768	0.000000
AT	1477	0.247079
WT	51	0.022748
LP	-154	-0.214009
TS	0	-0.000086
DS	7	-0.030918
SS	-14	-0.044657
pH	-6758	-0.116180
Conductivity	28160	0.119902
Turbidity	7	0.003301
Sali	15141	0.011320
DO	930	0.060669
F CO ₂	-727	-0.212837
P Alk	277	0.065738
T Alk	206	0.192473
T Hard	19	0.0366563
CA Hard	25	0.043818
CA Hard	62	0.04687
MG	-60	-0.033594
SIL	-26	-0.019875
POSP	113615	0.282204
NIT	29598	0.077760
BOD	2025	0.278645

Table 8 Observed and expected values of phytoplankton in the lake Upavan

Row	Observed values	Expected values
1	42800	41746.2
2	48000	47958.5
3	34410	34866.6
4	20640	20235.6
5	22370	22062.0
6	42680	42682.1
7	58400	58540.7
8	61800	61760.2
9	72000	71929.8
10	11200	11183.2
11	10740	11071.0
12	27600	27640.0

Using PLS we got the final regression equation as : Phytoplankton = - 4768 + 1477 AT + 51 WT - 154 LP - 0 TS + 7 DS - 14 SS - 6758 pH + 28160 COND + 7 TURB + 15141 SALI + 930 DO - 727 FCO₂ + 277 PA + 206 TA + 19 T HARD + 25 CA HARD + 62 CA - 60 MG - 26 SIL + 113615 POSP + 29598 NIT + 2025 BOD.

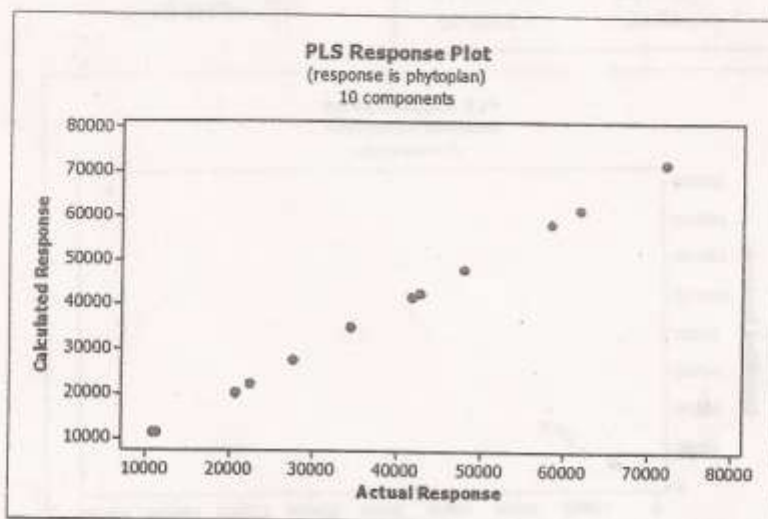


Fig. 4 PLS response (phytoplankton) plot between calculated and actual response in the lake Upavan.

In lake Rewale highly significant positive coefficient was observed with salinity (1.52524) and phosphate (1.16002), while highly significant negative coefficient was observed with suspended solids (-1.06718) and pH (-1.53089) some other parameters like temperature (0.7173), penolpthaline alkalinity (0.49187), free carbon dioxide (0.45799), turbidity (0.49125), magnesium (0.63825) showed significant positive response with phytoplankton and Ca^{++} (-0.57782), Ca^{++} hardness (-0.7563), air temperature (-0.65309), silicates (-0.50878), total solids (-0.81448) showed significant negative response with phytoplankton.

In lake Makhamali BOD (0.5332) was maximum positive coefficient, while total alkalinity (0.311213) and silicates (0.301151) showed positive response with phytoplankton, while pH (-0.661728) was maximum negative coefficient and light penetration (-0.311299) is showing negative response with phytoplankton.

However, in lake Upavan (non infested) maximum standardized coefficient was very low as compared to all other macrophyte-infested lakes (i.e. near 0.2). In this lake phosphate (0.282204), BOD (0.278645), air temperature (0.247079), total alkalinity (0.192473), conductivity (0.119902) were the parameters, which are showing positive coefficient to phytoplankton, while light penetration (-0.2140098), free CO_2 (-0.212837) are the parameters showing maximum negative coefficient. In this lake total solids (-0.000086) and turbidity (0.003301) are the parameters, which are near the 'zero'.

From this study, it is clear that calculated response is very near to actual response in all four study lakes. However, in lake Upavan calculated responses were nearly equal to actual values, which might be due to non infested Upavan lake.

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