RESULTS

Water Quality

Special emphasis was given for the water quality and the variations in water quality through different seasons of the study period in five stations of Lower Anaicut reservoir were studied viz station I, station II, station III, station IV and station V are presented in tables 4, 5, 6, 7 and 8 correspondingly.

Air temperature

Season dependent variations in air temperature of the five stations of the Lower Anaicut reservoir are presented in figure 9. It divulges that the patterns of deviation in all the five stations are alike throughout the phase of research. The air temperature varied between 28°C and 40°C during the period of investigation. The lowest temperature of 28°C was recorded in the month of December '02 in the stations I, II, IV, V and in station III during January'03, February'03 and July'03 and the highest temperature of 40°C was recorded in June'03 in station V. The air temperature showed no significant difference (p > 0.1) among the different stations during the experiment period (table 9).

Examination of the table 10 disclose that the air temperature has the best fit and significant relationship with water temperature (r=0.9309), conductivity (r=0.7623), DO (r=0.9433), TS (r=0.7157), TDS (r=0.7400), TSS (r=0.5553), nitrates (r=0.6814), silicates (r=0.6697), BOD (r=0.9281), iron (r=0.5082), GPP
The water temperature (figure 10), conductivity (figure 11), DO (figure 12), TS (figure 13), TDS (figure 14), TSS (figure 15), nitrates (figure 16), BOD (figure 18), GPP (figure 20) and NPP (figure 21) had the best fit with the air temperature in polynomial fit.

Water temperature = \(-477.55 + 45.647x - 1.391x^2 + 0.014x^3\)

Conductivity = \(212703.9 - 27276.3x + 3111.5x^2 - 27.914x^3 + 0.221x^4\)

DO = \(1460.6 - 175.71x + 7.978x^2 - 0.160x^3 + 0.0012x^4\)

TS = \(554920.8 - 69121x + 3222.7x^2 - 266.558x^3 + 0.513x^4\)

TDS = \(128420.2 - 16460.4x + 791.66x^2 - 16.858x^3 + 0.134x^4\)

TSS = \(426500.5 - 52660.5x + 2431.05x^2 - 49.699x^3 + 0.379x^4\)

Nitrates = \(-2650.6 + 327.50x - 15.079x^2 + 0.306dx^3 + 0.0023x^4\)

BOD = \(12872.7 - 1508.1x + 66.165x^2 - 1.285x^3 + 0.009x^4\)

GPP = \(1067396.2 - 123206.5x + 5334.62x^2 - 102.44x^3 + 0.735x^4\)

NPP = \(1000684.1 - 114659.1x + 4920.06x^2 - 93.548x^3 + 0.664x^4\)

Silicates (figure 17), Iron (figure 19), CR (figure 22), chlorophyll c (figure 23), had vapor pressure model, rational function, saturation growth-rate model and reciprocal quadratic model as the best-fit models respectively.
The associations can be expressed as follows.

Silicates = \( \exp(182.28-1441.65/x-39.278\ln(x)) \)

Iron = \( \frac{(2.267.0.035x)}{(1+0.156x-0.004x^2)} \)

CR = \( \frac{201.16x}{(-24.769+x)} \)

Chlorophyll c = \( \frac{1}{(86502.1-4437.7x+54.225x^2)} \)

**Water temperature**

Seasonal variations of the water temperature in the five stations of Lower Anaicut are presented in figure 24. The maximum water temperature of 36°C was documented during June’03 in station V and the lowest water temperature of 23°C during December ‘02 in station I, II, IV and V in January’03 in station III and November ’02 in station IV and V. The disparity in the water temperature among the different stations was insignificant (\( p > 0.01 \)) as shown in table 11. The high mean value of 27.84 ± 4.05 was recorded in station V and the low mean value of 25.76 ± 2.24 was recorded in station IV. The water temperature was found to have significant relationship with air temperature (\( r=0.9282 \)), conductivity (\( r=0.7824 \)), DO (\( r=0.9368 \)), TS (\( r=0.7230 \)), TDS (\( r=0.7532 \)), TSS (\( r=0.5520 \)), nitrates (\( r=0.7318 \)), silicates (\( r=0.6623 \)), BOD (\( r=0.9064 \)), iron (\( r=0.5227 \)), GPP (\( r=0.9186 \)), NPP (\( r=0.8777 \)), CR (\( r=0.8521 \)), chlorophyll b (\( r=0.5706 \)) and c (\( r=0.6304 \)) as presented in table 12.
Amongst these parameters, air temperature (figure 25), conductivity (figure 26), DO (figure 27), TDS (figure 29), nitrates (figure 31), silicates (figure 32) and chlorophyll c (figure 39) showed polynomial fit and the relationship can be expressed as

\[
\text{Air temperature} = 1106.8 - 158.60x + 8.547x^2 - 0.2x^3 + 0.0017x^4
\]

\[
\text{Conductivity} = -13690.3 + 1668.5x - 63.881x^2 + 0.819x^3
\]

\[
\text{DO} = -502.63 + 73.181x - 3.823x^2 + 0.086x^3 - 0.0007x^4
\]

\[
\text{TDS} = 7358.8 + 915.83x + 35.358x^2 + 0.457x^3
\]

\[
\text{Nitrates} = -1727.549 + 250.64x - 13.531x^2 + 0.322x^3 - 0.002x^4
\]

\[
\text{Silicates} = 1159.8 - 172.8x + 9.491x^2 - 0.227x^3 + 0.002x^4
\]

\[
\text{Chlorophyll c} = -136.75 + 20.244x - 1.114x^2 + 0.026x^3 - 0.0002x^4
\]

Total suspended solids, GPP and NPP had vapor pressure model as the best fit with water temperature (figures 30, 35 and 36) and the relationship can be expressed as

\[
\text{TSS} = \exp(-57.051 + 363.33/x + 15.060\ln(x))
\]

\[
\text{GPP} = \exp(-18.508 + 231.06/x + 5.268\ln(x))
\]

\[
\text{NPP} = \exp(-27.441 + 298.96/x + 7.086\ln(x))
\]

Rational function, modified exponential fit, Harris model, logistic model and reciprocal logarithm fit were found to be significant for expressing the
relationships of TS, BOD, iron, CR and chlorophyll b respectively (figures 28, 33, 34, 37 and 38) with water temperature. The relationships are expressed as

\[ TS = \frac{847.83 - 13.630x}{(1-0.009x-0.0004x^2)} \]

\[ BOD = 0.320e^{(102.23/x)} \]

\[ \text{Iron} = \frac{1}{(20.441-11.381x^{0.160})} \]

\[ CR = \frac{469.81}{(1-31.448*\exp(-0.161x))} \]

\[ \text{Chlorophyll b} = \frac{1}{(2359.68661.65*\ln(x))} \]

**pH**

Variations in the pH of five stations are presented in figure 40. The pH of the five stations were between 7.2 and 8.6. The lowest pH value was recorded in station I, III and IV in the months of January’03 and March’03, September’02, October’02 and January’03, and January and February’03 correspondingly and the uppermost in the month of June’03 in station IV. The pH has no significant difference (P>0.01) among the stations during the period of investigation (table 13). The pH is established to have significant relationship (table 14) with acidity (r=0.9530), alkalinity PA(r=0.7719), total alkalinity (r=0.9764), carbonates (r=0.7719), bicarbonates (r=0.9274), chlorides (r=0.5085), phosphates (r=0.7191), hardness (r=0.9766), calcium (r=0.9530), magnesium (r=0.9335), LCSI (r=0.5069), chlorophyll-a (r=0.8095), chlorophyll b (r=0.6446) and chlorophyll c (r = 0.7462).
Among these factors, total alkalinity (figure 43), bicarbonates (figure 45), chlorides (figure 46), hardness (figure 48), calcium (figure 49) and LCSI (figure 51) showed polynomial fit as the best fit model.

Total alkalinity = -522277.2 + 271493.2x - 52802x^2 + 4553.6x^3 - 146.84x^4

Bicarbonates = -588600.5 + 306161.3x - 59550.9x^2 + 5133.8x^3 - 165.46x^4

Chlorides = -966871 + 502326.6x - 97759.3x^2 + 8446.5x^3 - 273.34x^4

Hardness = -303871.5 + 149737.04x - 27638.3x^2 + 2264.6x^3 - 69.453x^4

Calcium = -299298.3 + 149597.3x - 28014.1x^2 + 2329.4x^3 - 72.551x^4

LCSI = -2660.8 + 1363.5x - 261.62x^2 + 22.276x^3 - 0.710x^4

Phosphates (figure 47), chlorophyll a (figure 52) and chlorophyll b (figure 53) had reciprocal logarithm fit as the best fit model and relationships can be expressed as

Phosphates = 1/(180.9084.718*ln(x))

Chlorophyll a = 1/(-3988294.9 + 1917978.8*ln(x))

Chlorophyll b = 1/(-11066878 + 5322055.6*ln(x))

Acidity (figure 41), alkalinity PA (figure 42), magnesium (figure 50) and chlorophyll c (figure 54) showed significant relationships with pH in terms of modified exponential fit, heat capacity model, logarithm fit and reciprocal models respectively and their relationship can be expressed as
Acidity = 2.76198853e-009*e^(155.19/x)

Alkalinity PA= 595.94-42.242x-14962.6/x^2

Magnesium = -258.17+140.04*ln(x)

Chlorophyll c = 1/(3330.3x-23956.4)

**Conductivity**

The electrical conductivity of the five stations ranged from 730 μSie - 1880 μSie (figure 55). The low electrical conductivity (730 μSie) was observed in the station III in September’02 and October’02 and the maximum in station V in July’03. The electrical conductivity showed no significant difference among the different stations during the study period (table 15). The minimum mean value is 911.5 ± 84.5 in station IV and the maximum mean value from the station V is 1069.2 ± 331.5.

The electrical conductivity was found to have significant relationship with pH (r=0.5581), transparency (r=0.5095), TS (r=0.7925), TDS (r=0.9829), TSS (r=0.6039), acidity (r=0.6281), chlorides (r=0.5303), silicate (r=0.5222), hardness (r=0.5594), calcium (r=0.5487), magnesium (r=0.5463), chlorophyll a (r=0.8383) and chlorophyll c (r=0.6548) (table 16).

Among these parameters pH (figure 56), transparency (figure 57), TS (figure58), TDS (figure 59), TSS (figure 60), acidity (figure 61), hardness (figure
64), calcium (figure 65) and magnesium (figure 66) showed polynomial fit and the relationship can be expressed as

\[
pH = 22.221 - 0.059x + 8.394x^2 - 4.8784717e-008x^3 + 1.002534e-011x^4
\]

\[
\text{Transparency} = -2864.9 + 9.886x - 0.011cx^2 + 6.2091022e-006x^3 - 1.1682143e-009
\]

\[
\text{TS} = 15564.58 - 48.012x + 0.056x^2 - 2.7646414e-005x^3 + 4.9774724e-009
\]

\[
\text{TDS} = 1693.7 - 5.037x + 0.006x^2 - 3.53911e-006x^3 + 6.4944247e-010x^4
\]

\[
\text{TSS} = 13870.7 - 42.974x + 0.049x^2 - 2.4107304e-005x^3 + 4.32803e-009x^4
\]

\[
\text{Acidity} = 593565 - 0.132x + 9.7470051e-005x^2 - 2.3190279e-008x^3
\]

\[
\text{Hardness} = 2269.6 - 8.449x + 0.01lx^2 - 6.8283937e-006x^3 + 1.4026405e-009x^4
\]

\[
\text{Calcium} = 732.53 - 2.887x + 0.004x^2 - 2.5515176e-006x^3 + 5.4231915e-010x^4
\]

\[
\text{Magnesium} = 350.39 - 1.275x + 0.001x^2 - 9.9321059e-007x^3 + 2.0055208e-010x^4
\]

Chlorides (figure 62), chlorophyll a (figure 67) and chlorophyll c (figure 68) showed Gaussian model, exponential association and reciprocal models respectively were found to be significant with electrical conductivity and their relationship can be expressed as

\[
\text{Chlorides} = 150.36\exp((-1523.9-x)^2)/(2*649.42^2))
\]

\[
\text{Chlorophyll a} = 0.0009\exp(-3.2858717e-008x)
\]

\[
\text{Chlorophyll c} = 1/(-0.898x + 1278.25)
\]
Sinusoidal fit is found to be a suitable model for comparing silicates (figure 63) with conductivity and it can be expressed as

\[ \text{Silicates} = 3.175 + 1.462 \times \cos(0.035x + 7.595) \]

**Transparency**

The minimum transparency of 25 cm was observed in station V in July’03 and the maximum of 132 cm in station III during December’02 and February’03 (figure 69). The difference in the transparency of the five stations (table 17) is insignificant (P>0.01). The maximum mean value observed is 87.81 ± 18.59 in station IV and the minimum mean value 68.42 ± 29.01 in station I.

The transparency was found to have significant correlation (table 18) with conductivity \((r=0.6493)\), TS \((r=0.8962)\), TDS \((r=0.6304)\), TSS \((r=0.9255)\), chlorophyll a \((r=0.6804)\), chlorophyll b \((r=0.6298)\) and chlorophyll c \((r=0.7494)\).

Among these parameters, conductivity (figure 70), TS (figure 71) and TDS (figure 72) showed polynomial fit and the relationships can be expressed as follows

\[ \text{Conductivity} = 4409.4 - 176.37x + 3.166x^2 - 0.024x^3 + 6.6674822e-005 \]

\[ \text{TS} = 5589.6 - 204.48x + 3.458x^2 - 0.025x^3 + 7.1594245e-005 \]

\[ \text{TDS} = 2718.4 - 106.78x + 1.913x^2 - 0.014x^3 + 4.0059754e-005 \]
Total suspended solids showed hyperbolic fit (figure 73) and the expression can be written as

\[ \text{TSS} = -16.238 + 31865.4 / x \]

Chlorophyll a (figure 74), chlorophyll b (figure 75) and chlorophyll c (figure 76) showed reciprocal quadratic, reciprocal logarithmic and reciprocal models respectively as the best fit and significant relationship with transparency and the relationship can be expressed as

\[ \text{Chlorophyll a} = \frac{1}{(-184.65 + 7.156x - 0.041x^2)} \]
\[ \text{Chlorophyll b} = \frac{1}{(-7227.3 + 2248.8 \ln(x))} \]
\[ \text{Chlorophyll c} = \frac{1}{(115.07x - 7702.54)} \]

**Dissolved oxygen**

The minimum amount of dissolved oxygen of 6.0 mg/l was recorded in June’03 in the stations I, IV and V. The maximum amount of dissolved oxygen was observed from station V (10.89 mg/l) during December’02 (figure 77). The dissolved oxygen showed insignificant difference among the different stations studied. The maximum mean value of 8.44 ± 1.31 in station IV and the minimum mean value of 7.4 ± 1.56 in station II were recorded (table 19).

The DO was found to have significant relationship (table 20) with TS (r=0.5213), nitrates (r=0.5889), phosphates (r=0.8131), silicates (r=0.6805), BOD
(r=0.9456), GPP (r=0.9580), NPP (r=0.9336), CR (r=0.7997), chlorophyll a (r=0.7133) and chlorophyll c (r= 0.7587).

Among these parameters having significant relationship, BOD (figure 82), GPP (figure 83) and NPP (figure 84) had polynomial fit and their relationship with dissolved oxygen is expressed as follows.

\[
\text{BOD} = -734.76 + 342.84x - 58.245x^2 + 4.317x^3 - 0.116x^4
\]

\[
\text{GPP} = -205637.1 + 103410.4x - 19150.4x^2 + 1555.7x^3 - 46.617x^4
\]

\[
\text{NPP} = -136572.9 + 67939.1x - 12408.1x^2 + 990.02x^3 - 28.982
\]

Silicates (figure 81) as well as chlorophyll a (figure 86) showed reciprocal quadratic as best fit model and the relationship can be written as

\[
\text{Silicates} = \frac{1}{3.708 - 1.004x + 0.071x^2}
\]

\[
\text{Chlorophyll b} = 0.04 + 0.023\cos(10.663x - 2.895)
\]

TS (figure 78), nitrates (figure 79), phosphates (figure 80), CR (figure 85) and chlorophyll c (figure 87) showed MMF model, rational function, reciprocal logarithm fit, vapor pressure model and saturation growth rate model as best fit respectively with DO and the relationship can be expressed as

\[
\text{TS} = \frac{971.3*0.0001 + 14192826*x^{-10.948}}{0.0001 + x^{-10.948}}
\]

\[
\text{Nitrates} = \frac{2420966.2 - 419401.4x}{1 + 339147.9x - 57417.08x^2}
\]

\[
\text{Phosphates} = \frac{1}{322.2 - 176.68\ln(x)}
\]
CR = \exp(-22.236+63.527/x+10.0951\ln(x))

\text{Chlorophyll c} = -0.0003x/(-6.599+x)

\textbf{Total solids}

The seasonal variations in the total solids (TS) present in the five stations are presented in figure 88. The minimum TS of 800 mg/l was recorded in station I (September and November’02), station II (August’02 and September’02), station III (December’02 and February’03) and station IV during November’02 and the maximum was found in station V (2300 mg/l) in the month of July’03. The difference in the total solids level of the five stations is not significant (P>0.01). The maximum mean value of 1189.2 ± 483.1 in station V and the minimum mean value of 958.5 ± 100.1 in station IV were recorded (table 21).

The total solids in water is found to have significant relationship (table 22) with conductivity (r=0.8419), transparency (r=0.8512), total dissolved solids (r=0.8077), total suspended solids (r=0.9502), nitrates (r=0.5628) and chlorophyll c (r= 0.7329).

Polynomial fit was found to be the best fit model to correlate total solids with conductivity (figure 89), total dissolved solids (figure 91), total suspended solids (figure 92) and nitrates (figure 93). The polynomial fit relationships can be expressed as

Conductivity = 9762.8-27.067x+0.029x^2-1.386265e-005x^3+2.3614437e-009x^4
Reciprocal logarithm fit was found to be the best-fit to compare transparency (figure 90) with total solids.

Transparency = \frac{1}{(-0.142+0.022*\ln(x))}

The total solids were found to be correlated with chlorophyll c (figure 94) by reciprocal model.

Chlorophyll c = \frac{1}{(-233.33x+210023.8)}

**Total dissolved solids**

Variations in the total dissolved solids (TDS) of the five stations are presented in figure 95. The TDS of the five stations falls between 500 and 1150 mg/l. The least TDS value was recorded in station I (March’03), station II (November’02 and January’03), station III (September’02 and October’02) and station IV (December’02 and January’03) and the maximum in the month of July’03 in all the stations studied. The TDS has no significant difference (P>0.01) among the different stations during the study period. The maximum mean value of 696.9 ± 200.4 in station V and the minimum mean value of 590 ± 57.6 in station IV were recorded (table 23).
The TDS is found to have significant relationship with pH (r=0.5308), conductivity (r=0.9851), transparency (r=0.5198), TS (r=0.7998), TSS (r=0.5999), acidity (r=0.5898), chlorides (r=0.5081), hardness (r=0.5374), calcium (r=0.5069), magnesium (r=0.5395) and chlorophyll c (r=0.5352) (table 24).

Polynomial fit was the suitable model for conductivity (figure 97) and TS (figure 99) and the relationships are

\[
\text{Conductivity} = -3787.8 + 22.520x - 0.041x^2 + 3.5613013e-005x^3 - 1.0867482e-008x^4
\]

\[
\text{TS} = 19485.5 - 95.577x + 0.177x^2 - 0.0001x^3 + 4.1765148e-008x^4
\]

Both pH (figure 96) and chlorides (figure 102) showed Gaussian model relationship and the expression is as follows.

\[
\text{pH} = 8.032*\exp((-880.55-x)^2)/(2*887.03^2))
\]

\[
\text{Chlorides} = 145.51*\exp((-1003.08-x)^2)/(2*449.63^2))
\]

Total suspended solids (figure 100) and calcium (figure 104) showed heat capacity model and expressed as

\[
\text{TSS} = -2108.2 + 2.682x + 3.2302085e+008/x^2
\]

\[
\text{Calcium} = 181.47 - 0.098x - 23315737/x^2
\]

Quadratic fit is the best fit model to compare hardness (figure 103) and magnesium with TDS and the relationship can be written as

\[
\text{Hardness} = -258.45 + 1.073x - 0.0006x^2
\]
Magnesium = -37.735+0.160x-9.0025044e-005x^2

Transparency (figure 98), acidity (figure 101) and chlorophyll c (figure 106) had best fit models of sinusoidal fit, saturation growth-rate model and reciprocal model respectively. The relationship may be expressed as

Transparency = 70.246+20.336*cos(0.018x+1.321)

Acidity = 0.615x/(-443.61+x)

Chlorophyll c = 1/(-4.257x+2982.7)

**Total suspended solids**

Seasonal variations in the total suspended solids (TSS) of the five stations studied are presented in figure 107. The minimum value of 150 mg/l was recorded in the month of February’03 in station III and maximum of 1200 mg/l was recorded in July’02 in station I. The TSS showed no significant difference (P>0.01) among the different stations during the experiment period (table 25).

A perusal of table 26 reveals that TSS has the best fit and significant relationship with conductivity (r=0.6513), transparency (r=0.9049), total solids (r=0.9507), total dissolved solids (r=0.6372), chlorophyll a (r=0.7877), chlorophyll b (r=0.6375) and chlorophyll c (r=0.7468).

The conductivity (figure 108), total solids (figure 110) and total dissolved solids (figure 111) were found to have polynomial fit as best fit model. The relationships can be expressed as follows.
Conductivity = 561.99 + 4.337x - 0.015x^2 + 1.9500712e-005x'^3 - 7.8163986e-009xM

TS = 349.12 + 3.871x - 0.009x^2 + 1.2104496e-005x'^3 - 4.7648755e-009xM

TDS = 349.12 + 2.871x - 0.009x^2 + 1.2104496e-005x'^3 - 4.7648755e-009xM

Reciprocal logarithm fit was the best suitable model for chlorophyll a (figure 112) and chlorophyll b (figure 113). The expression is as follows.

Chlorophyll a = 1/(-2156889 + 3060511*ln(x))

Chlorophyll b = 1/(-2493971.3 + 353881*ln(x))

Hoerl model and Reciprocal model were the best suitable models to express the relationship with transparency (figure 109) and chlorophyll c (figure 114) respectively. The relationships can be expressed as

Transparency = 980.01*(0.999^x)*(x^-0.367)

Chlorophyll c = 1/(-2.905x + 1956.4)

Free carbon di oxide

Free carbon di oxide (CO₂) was completely absent in all the stations during the period of investigation.

Acidity

Seasonal variations in the acidity of the five stations studied are presented in figure 115. The minimum value of 0.5 mg/l was recorded in all the stations in most of the months during the study period. The maximum of 5 mg/l was recorded
in all stations in most of the months. The acidity showed no significant difference (P>0.01) among the different stations during the experiment period (table 27) also it revealed that station III had the higher mean value and station V had the lower value during the period of study.

The acidity value showed significant positive correlation (table 28) with pH (r=0.9548), alkalinity PA (r=0.7823), total alkalinity (r=0.9104), carbonates (r=0.7823), bicarbonates (r=0.8440), hardness (r=0.9316), calcium (r=0.9037), magnesium (r=0.9044) and chlorophyll c (r=0.7191).

Acidity showed MMF model relation with pH (figure 116), alkalinity PA (figure 117) and carbonates (figure 119) and the relationships can be expressed as follows.

$$\text{pH} = \frac{7.168 \times 0.220 + 8.180 \times x^{-2.31}}{0.220 + x^{-2.31}}$$

$$\text{Alkalinity PA} = \frac{5.877 \times 0.001 + 25.297 \times x^{-7.934}}{0.001 + x^{-7.934}}$$

$$\text{Carbonates} = \frac{11.755 \times 0.001 + 50.595 \times x^{-7.934}}{0.01 + x^{-7.934}}$$

Quadratic fit was the best fit to establish the relationship between hardness (figure 121), calcium (figure 122) and magnesium (figure 123) with acidity.

$$\text{Hardness} = 240.82 - 43.017x + 3.510x^2$$

$$\text{Calcium} = 81.044 - 12.548x + 0.749x^2$$

$$\text{Magnesium} = 38.951 - 7.402x + 0.671x^2$$
Saturation growth rate model was found to be the best fit to represent the relationship of bicarbonates (figure 120) and chlorophyll c (figure 124) with acidity.

\[
\text{Bicarbonates} = 176.95x/(-0.164+x)
\]

\[
\text{Chlorophyll c} = 0.010x/(-1.362+x)
\]

Hoerl model was found to be the best fit to represent the relationship of total alkalinity (figure 118) with acidity.

\[
\text{Total alkalinity} = 252.4*(1.043^x)*(x^{-0.289})
\]

**Phenolphthalein alkalinity (PA)**

The alkalinity (PA) was completely absent during most of the months in station I (October’02, January03 to March’03 and May’03), station II (September’02, October’02, December’02 and January’03 to March’03), station III (January’03), station IV (February’03) and station V (February’03, May’03 and June’03).

Phenolphthalein alkalinity showed insignificant difference in the different stations studied (table 29). The maximum mean value of 20 mg/l from the station IV, and the minimum mean value of 7.69 mg/l from the station I was observed.

The alkalinity PA showed significant relationship (table 30) with pH \(r=0.7696\), acidity \(r=0.7137\), total alkalinity \(r=0.7373\), carbonates \(r=1.000\), COD \(r=0.6359\), hardness \(r=0.7654\), calcium \(r=0.7699\), magnesium
(r=0.7237), LCSI (r=0.5198), chlorophyll b (r=0.5060) and chlorophyll c (r=0.5687).

Linear fit was found to be the best fit model to correlate alkalinity with carbonates (figure 129), hardness (figure 131) and magnesium (figure 133) and the relationships can be expressed as

Carbonates = 0+2x

Hardness = 115.97+3.137x

Magnesium = 19.225+0.475x

pH (figure 126) and calcium (figure 132) showed MMF model as the best fit model and the relationship can be written as

pH = (7.303*2197.7+8.349*x^2.520)/(2197.7+x^2.520)

Calcium = (36.923*896.66+77.412*x^2.519)/(896.66+x^2.519)

Reciprocal quadratic fit was found to be the best fit model to correlate acidity (figure 127) and chlorophyll c (figure 136) with phenolphthalein alkalinity. And it can be expressed as

Acidity = 1/(0.220-0.001x+0.001x^2)

Chlorophyll c = 1/(-1538.6+469.84x-13.944x^2)

Total alkalinity (figure 128), COD (figure 130), LCSI (figure 134) and chlorophyll b (figure 135) showed exponential fit, polynomial fit, exponential
association and reciprocal respectively as their best fit to phenolphthalein alkalinity. The relationships can be written as

Total alkalinity = 187.04e^^(0.015x)

\[ \text{COD} = 43.076 - 2.318x + 0.492x^2 - 0.029x^3 + 0.0005x^4 \]

\[ \text{LCSI} = -0.240(1 - \text{exp}(-0.123x)) \]

\[ \text{Chlorophyll b} = \frac{1}{(39884.7x - 797675.03)} \]

**Total alkalinity**

Total alkalinity ranged from 170 to 360 mg/l. The minimum total alkalinity was observed from the station I (March’03 and station II January’03) and the maximum from the station II in the month of July’02 (figure 137). The total alkalinity showed no significant difference (P>0.01) in the different stations studied (table 31). The mean total alkalinity showed the following gradation.

Station IV > station V > station II > station III > station I

The total alkalinity showed significant relationship with pH (r=0.9720), acidity (r=0.8598), alkalinity PA (r=0.7907), carbonates (r=0.7907), bicarbonates (r=0.9466), phosphates (r=0.9893), hardness (r=0.9532), calcium (r=0.8958), magnesium (r=0.9298), LCSI (r=0.5988), chlorophyll a (r=0.8068), chlorophyll b (r=0.6511) and chlorophyll c (r=0.7486) (table 32).
Polynomial fit is found to be the best-fit model for relating pH (figure 138), hardness (figure 144), calcium (figure 145) and magnesium (figure 146) with total alkalinity. The relationships can be expressed as:

\[ \text{pH} = 26.517 - 0.321x + 0.001x^2 - 4.7209613e-006x^3 + 4.2440938e-009x^4 \]

\[ \text{Hardness} = 750.92 - 14.721x + 0.104x^2 - 0.0002x^3 + 2.8394626e-007x^4 \]

\[ \text{Calcium} = -289.99 + 3.205x - 0.009x^2 + 1.035634e-005x^3 \]

\[ \text{Magnesium} = 187.99 - 3.356x + 0.022x^2 - 5.964187e-005x^3 + 5.689041e-008x^4 \]

Heat capacity model is found to be the best-fit model for relating alkalinity PA (figure 140) and carbonates (figure 141) with total alkalinity. The relationship can be expressed as:

\[ \text{Alkalinity PA} = 54.280 - 0.038x - 1517155.8/x^2 \]

\[ \text{Carbonates} = 108.56 - 0.076x - 3034327.7/x^2 \]

Reciprocal logarithm fit is the best model for relating phosphate (figure 143) and chlorophyll a (figure 148) with total alkalinity and the relationships can be expressed as:

\[ \text{Phosphates} = 1/(631.36 - 109.10*\ln(x)) \]

\[ \text{Chlorophyll a} = 1/(-29290.9 + 5140.43*\ln(x)) \]

Vapor pressure model, sinusoidal fit, rational function, reciprocal model and reciprocal quadratic fits are found to be the suitable models for representing
the relationship of acidity (figure 139), bicarbonates (figure 142), LCSI (figure 147), chlorophyll b (figure 149) and chlorophyll c (figure 150) with total alkalinity and the relationships can be expressed as

\[
\text{Acidity} = \exp(283.12-8295.81/x-45.3151\ln(x))
\]

\[
\text{Bicarbonates} = 274.69+96.207\cos(0.009x+1.507)
\]

\[
\text{LCSI} = (-288.01+0.731x)/(1+7.899x-0.021x^2)
\]

\[
\text{Chlorophyll b} = 1/(30.772x-5506.3)
\]

\[
\text{Chlorophyll c} = 1/(-50114.7+398.12x-0.737x^2)
\]

**Carbonates**

The carbonates was absent in station I (October’02, January03 to March’03 and May’03), station II (September’02, October’02, December’02 and January’03 to March’03), station III (January’03), station IV (February’03) and station V (February’03, May’03 and June’03).

The monthly variations in the carbonates level of the five stations are presented in figure 151. The minimum level of carbonates was 20 mg/l observed in station I (September’02, November’02, December’02, April’03, June and July’03), station II (September’02, October’02 and December’02), station III (September’02 to November’02, February’03 and June’03), station IV (December’02, January’03, March’03 and May’03) and station V (December’02 and March’03). The maximum of 80 mg/l in July’02 was observed in station III.
Level of carbonates showed significant difference (table 33) among the different stations studied (P<0.01). The highest mean of carbonates level of 40 ± 21.60 was found in station IV and the lowest mean level of 15.38 ± 14.5 in station I.

Carbonates were found to have significant correlation (table 34) with pH (r=0.7694), acidity (r=0.7137), alkalinity PA (r=1.0000), total alkalinity (r=0.7373), COD (r=0.6359), hardness (r=0.7654), calcium (r=0.7699), magnesium (r=0.7237), LCSI (r=0.5198), chlorophyll b (r=0.5060) and chlorophyll c (r=0.5687).

Linear fit is found to be the best-fit model for relating alkalinity PA (figure 154), hardness (figure 157) and magnesium (figure 159) with carbonates. The relationship can be expressed as

Alkalinity PA = 0 + 0.5x

Hardness = 115.97 + 1.568x

Magnesium = 19.225 + 0.237x

MMF model is found to be the best-fit model for relating pH (figure 152) and calcium (figure 158) with carbonates. The relationship can be expressed as

pH = (7.298*6782.57 + 8.431*x^2.314)/(6782.57 + x^2.314)

Calcium = (36.923*5142.09 + 77.412*x^2.519)/(5142.09 + x^2.519)
Reciprocal quadratic fit is the best model for relating acidity (figure 153) and chlorophyll c (figure 162) and the relationships can be expressed as

\[
\text{Acidity} = \frac{1}{(0.220-0.005x+0.0003x^2)}
\]

\[
\text{Chlorophyll c} = \frac{1}{(-1538.65+234.92x-3.486x^2)}
\]

Exponential fit, polynomial fit, exponential association and reciprocal model are found to be the suitable models for representing the relationship of total alkalinity (figure 155), COD (figure 156), LCSI (figure 160) and chlorophyll b (figure 161) and the relationships can be expressed as

\[
\text{Total alkalinity} = 187.04e^{0.007x}
\]

\[
\text{COD} = 43.076-1.159x+0.123x^2-0.003x^3+3.1887019e^{-0.005x^4}
\]

\[
\text{LCSI} = -0.240(1-\exp(-0.061x))
\]

\[
\text{Chlorophyll b} = \frac{1}{(19957.3x-798275.8)}
\]

**Bicarbonates**

The monthly variations in the bicarbonates level of the five stations are presented in figure 163. The minimum level of bicarbonates was 160 mg/l observed in station III (March’03 and May’03) and station IV (October’02 and November’02). The maximum was 340 mg/l in station IV (June’03). Bicarbonates showed no significant difference (table 35) among the five stations (P>0.01). The
highest mean bicarbonates level of 220.77 ± 32.26 was found in station V and the lowest mean level of 193.08 ± 31.99 in station III.

Bicarbonates were found to have significant correlation (table 36) with pH (r=0.8865), acidity (r=0.7121), alkalinity PA(r=0.6393), total alkalinity (r=0.9514), carbonates (r=0.6393), chlorides (r=0.5063), hardness (r=0.8375), calcium (r=0.7847), magnesium (r=0.8248), chlorophyll a (r=0.8383), chlorophyll b (r=0.6414) and chlorophyll c (r=0.7625).

Polynomial fit is found to be the best-fit model for relating pH (figure 164), alkalinity PA (figure 166), total alkalinity (figure 167), carbonates (figure 168), chlorides (figure 169), hardness (figure 170), calcium (figure 171) and magnesium (figure 172) with bicarbonates. The relationships can be expressed as follows.

\[
pH = 50.715 - 0.745x + 0.004x^2 - 1.2519617e-005x^3 + 1.2349253e-008x^4
\]

\[
\text{Alkalinity PA} = 1878.71 - 30.284x + 0.179x^2 - 0.0004x^3 + 4.3446748e-007x^4
\]

\[
\text{Total alkalinity} = 3757.42 - 59.568x + 0.358x^2 - 0.0009x^3 + 8.6893495e-007x^4
\]

\[
\text{Carbonates} = 3757.42 - 60.568x + 0.358x^2 - 0.0009x^3 + 8.6893495e-007x^4
\]

\[
\text{Chlorides} = -1983.27 + 36.939x - 0.246x^2 + 0.0007x^3 - 8.0113417e-006x^4
\]

\[
\text{Hardness} = 5424.29 - 91.959x + 0.581x^2 - 0.001x^3 + 1.5800038e-006x^4
\]

\[
\text{Calcium} = 2171.4 - 35.793x + 0.219x^2 - 0.0005x^3 + 5.6531806e-007x^4
\]

\[
\text{Magnesium} = 781.69 - 13.504x + 0.087x^2 - 0.0002x^3 + 2.4444489e-007x^4
\]
Exponential association is the suitable model for chlorophyll a (figure 173) and chlorophyll c (figure 175) with bicarbonates. The relationship can be expressed as:

\[
\text{Chlorophyll a} = 0.0001(1-\exp(-1.6046704\times 10^{-6}x))
\]

\[
\text{Chlorophyll c} = 7.3109444\times 10^{-5}(1-\exp(-1.5606378\times 10^{-7}x))
\]

Vapor pressure model and reciprocal logarithm fit are the best fit models for relating acidity (figure 165) and chlorophyll b (figure 174) respectively with bicarbonate. The relationship can be expressed as follows.

\[
\text{Acidity} = \exp(400.43-11497.3/x-64.53\ln(x))
\]

\[
\text{Chlorophyll b} = 1/(-4455933.4+801334.1*\ln(x))
\]

**Residual chlorine**

During the study period there was no residual chlorine observed from the different stations studied.

**Chloride**

The chloride level in the five stations showed seasonal variations (figure 176) and the value ranged from 51.12 mg/l (station IV: October’02) to 73.24 mg/l (Station I: May’03, station II: July’02, station III: April’03 and station IV: May’03). The difference in the chloride levels was not significant (P>0.01) among the different stations (table 37).
A perusal of the table-38 points out the chloride level in water was having significant relationship with pH \( r=0.6532 \), conductivity \( r=0.5398 \), TDS \( r=0.5452 \), acidity \( r=0.6129 \), alkalinity PA \( r=0.5590 \), total alkalinity \( r=0.5830 \), carbonates \( r=0.5590 \), bicarbonates \( r=0.5266 \), hardness \( r=0.6098 \), calcium \( r=0.5628 \), magnesium \( r=0.6055 \), chlorophyll-a \( r=0.8259 \) and chlorophyll-c \( r=0.7173 \).

Sinusoidal fit is found to be the best model for relating pH (figure 177), acidity (figure 180), alkalinity PA (figure 181), total alkalinity (figure 182), carbonates (figure 183), bicarbonates (figure 184), hardness (figure 185), calcium (figure 186) and magnesium (figure 187). The relationships can be expressed as the following.

\[
pH = 7.796 + 0.389 \times \cos(0.053x - 0.820)
\]

\[
Acidity = 2.059 + 1.994 \times \cos(0.050x - 3.524)
\]

\[
Alkalinity PA = 18.480 + 8.909 \times \cos(0.073x - 2.589)
\]

\[
Total alkalinity = 260.19 + 51.647 \times \cos(0.052x - 0.815)
\]

\[
Carbonates = 36.961 + 17.818 \times \cos(0.073x - 2.589)
\]

\[
Bicarbonates = 222.25 + 34.721 \times \cos(0.047x - 0.350)
\]

\[
Hardness = 182.4 + 44.485 \times \cos(0.054x - 1.067)
\]

\[
Calcium = 61.653 + 15.35 \times \cos(0.055x - 1.080)
\]
Magnesium = 29.53+7.163*cos(0.054x-1.124)

Polynomial fit is found to be the best fit model for expressing the interaction of conductivity (figure 178) and TDS (figure 179) with chlorides. The relationships can be expressed as

Conductivity = 6273.26-218.35x+3.099x^2-0.018x^3+3.8619788e-005x^4

TDS = 3715.54-124.7x+1.735x^2-0.010x^3+2.0758402e-005x^4

Saturation growth rate model and reciprocal model are found to be the best fit models for expressing the interaction of chlorophyll a (figure 188) and chlorophyll c (figure 189) respectively with chlorides. The relationships can be expressed as

Chlorophyll a = -0.0006x/(-144.44+x)

Chlorophyll c = l/(16.777x-1181.48)

**Ammonia**

A seasonal variation in the ammonia levels during the period of investigation is presented in figure 190. The minimum level of 0.012 mg/l was recorded from station V in July’02. The maximum level of 2.4 mg/l was from station I in the month of June’03. There was significant difference (P>0.01) in the ammonia levels among the stations studied (table 39).
Ammonia was found to have significant relationship (table 40) with alkalinity PA (r=0.5429), carbonates (r=0.5429), bicarbonates (r=0.5026), phosphates (r=0.5199), COD (r=0.6056), iron (r= 0.6899), chlorophyll b (r=0.5006) and chlorophyll c (r=0.6206).

Rational function was found to be the best fit model in draw the relationship of phosphates (figure 194), COD (figure 195) and iron (figure 196) with ammonia. The relationships can be expressed as

Phosphates = (0.479+6.080x)/(1+27.419x-9.857x^2)
COD = (37.831-1517.85x)/(1-41.402x+11.831x^2)
Iron = (0.671-0.19x)/(1-0.97x+0.239x^2)

Sinusoidal fit is the suitable model for alkalinity PA (figure 191), and carbonates (figure 192). The relationships can be expressed as follows

Alkalinity PA = 13.798+9.039*cos(9.708x-0.180)
Carbonates = 27.597+18.078*cos(9.708x-0.180)

Reciprocal model is the best fit for relating ammonia with chlorophyll b (figure 197) and chlorophyll c (figure 198). The relationships can be expressed as follows

Chlorophyll b = 1/(-98.762x+91.604)
Chlorophyll c = 1/(-2921.2x+2485.22)
Logistic model is the best suitable model for bicarbonates (figure 193) to relate with ammonia. The relationship can be expressed as follows

\[ \text{Bicarbonates} = \frac{203.73}{(1-0.411 \times \exp(-46.722x))} \]

**Nitrate**

Figure 199 reveals the seasonal variations in the nitrate level in five stations studied. The minimum value of 0.1 mg/l was observed in station IV (July’02) and maximum level of nitrate was recorded in station II during July’03 (5.23 mg/l). The difference in nitrate levels in the different stations is insignificant (P>0.01) (table 41). However, the comparison of means reveal that the station I has the highest levels of nitrate and the station II has the least levels.

Nitrate levels have significant relationship (table 42) with conductivity \((r=0.6697)\), TS \((r=0.5811)\), silicates \((r=0.5631)\), BOD \((r=0.5115)\), COD \((r=0.5470)\), chlorophyll a \((r=0.7239)\) and chlorophyll c \((r=0.7407)\).

Conductivity (figure 200), TS (figure 201) and BOD (figure 203) showed rational function as best fit model to compare with nitrates. The relationships can be expressed as

\[ \text{Conductivity} = \frac{(858.36-840.04x)}{(1-1.047x+0.066x^2)} \]

\[ TS = \frac{(973.87-955.28x)}{(1-1.049x+0.067x^2)} \]

\[ \text{BOD} = \frac{(12.292+31.675x)}{(1+0.572x+0.961x^2)} \]
MMF model and sinusoidal fit are found to be the suitable models to correlate nitrates with silicates (figure 202) and COD (figure 204) respectively. The relationships can be expressed as follows

Silicates = \( \frac{2.191 \times 6.879 + 4.707 \times x^{10.417}}{6.879 + x^{10.417}} \)

COD = 48.648 + 22.274 \times \cos(4.971 \times x + 1.302)

Reciprocal model was found to be the best fit model for correlating chlorophyll a (figure 205) and chlorophyll c (figure 206) with nitrates and the relationships can be written as:

Chlorophyll a = \( \frac{1}{-78.218 \times x + 283.989} \)

Chlorophyll c = \( \frac{1}{-1737.2 \times x + 3028.19} \)

**Phosphate**

Seasonal variations in the occurrence of phosphate in the water samples of the five stations during the present investigations are presented in figure 207. The phosphate concentration was low in station V in July'03 (0.12 mg/l). The maximum of 1.6 mg/l was also recorded in the same station during July’02. Phosphate was completely absent during the month of June’03 in station IV.

Analysis of variance reveals that the phosphate levels (table 43) in stations studied during the present investigation no significant difference (P<0.05). The comparison of the mean values reveals that the phosphate level of station V is
higher than that of the other stations. The phosphate levels in the different stations vary as follows.

Station V > station I > station III > station II > station IV

Significant correlation was found (table 44) with total alkalinity \((r=0.5231)\), bicarbonates \((r=0.5377)\), nitrates \((r=0.5192)\), COD \((r=0.5418)\), magnesium \((r=0.5096)\), chlorophyll a \((r=0.6678)\) and chlorophyll c \((r=0.6850)\).

Polynomial fit is found to be the suitable model to correlate total alkalinity (figure 208), bicarbonates (figure 209), nitrates (figure 210) and magnesium (figure 212) with phosphates. The relationships can be expressed as follows

- **Total alkalinity**: \(396.33 - 1483.19x + 3933.45x^2 - 3686.86x^3 + 1118.91x^4\)
- **Bicarbonates**: \(328.97 - 1139.08x + 3030.30x^2 - 2853.09x^3 + 870.36x^4\)
- **Nitrates**: \(2.893 - 17.474x + 47.323x^2 - 36.72x^3 + 8.386x^4\)
- **Magnesium**: \(44.256 - 176.14x + 474.20x^2 - 436.70x^3 + 129.72x^4\)

Reciprocal quadratic fit is found to be the best model for chlorophyll a (figure 213) and chlorophyll c (figure 214). The relationships can be expressed as follows

- **Chlorophyll a**: \(1/(220.05 - 471.91x + 230.23x^2)\)
- **Chlorophyll c**: \(1/(-6110.77 + 3888.53x + 124.80x^2)\)
Sinusoidal fit is the suitable model for relating COD (figure 211) with phosphate. The relationships can be expressed as follows

\[ \text{COD} = 60.027 + 275.752 \times \cos(8.284x + 1.086) \]

**Sulphate**

The minimum sulphate level of 2.15 mg/l was observed in station V during September’02 and the maximum level of 83.0 mg/l was in station IV in January’03 (figure 215). The analysis of variance reveals that the levels of sulphate differ significantly (P<0.05) in the different stations studied (table 45). Comparison of the mean values reveals that the sulphate level in station V was lower than that of the other stations, station IV had the highest sulphate level.

Sulphate was found to have significant correlation (table 46) with chlorophyll a (r=0.5859), chlorophyll b (r=0.6058) and chlorophyll c (r=0.6731) with sulphate.

Reciprocal logarithm fit is found to be the best fit for establishing relationship with chlorophyll a (figure 216) and chlorophyll b (figure 217) the relationship can be represented as

\[ \text{Chlorophyll a} = \frac{1}{(853.05 - 303.78 \times \ln(x))} \]

\[ \text{Chlorophyll b} = \frac{1}{(851.20 - 301.08 \times \ln(x))} \]

Chlorophyll c had reciprocal quadratic fit as the best fit model (figure 218) and the expression is
Chlorophyll c = 1/(-92.409+18.270x-0.211x^2)

Silicates

Seasonal variations in the silicates of the different stations during the experimental period are presented in figure 219. Results of the present study reveal that the silicate level in five stations do not differ significantly. However, the comparison of means reveals that the station III have higher levels of silicates than the others stations (table 47).

Silicates show significant correlation (table 48) with DO (r=0.6758), BOD (r=0.6836), GPP (r=0.7147), NPP (r=0.6477), CR (r=0.7469), chlorophyll a (r=0.5065), chlorophyll b (r=0.5819) and chlorophyll c (r=0.6840).

MMF model is found to be the best fit model for BOD (figure 221) and CR (figure 224). The relationships can be expressed as follows

BOD = (11.653*0.323+24.925*x^-2.995)/(0.323+x^-2.995)
CR = (685.33*0.464+1772.66*x^-3.436)/(0.464+x^-3.436)

Reciprocal quadratic, Weibull model, modified Hoerl model, rational function reciprocal logarithm fit and reciprocal model were found to be the best-fit model for DO (figure 220), GPP (figure 222), NPP (figure 223), chlorophyll a (figure 225), chlorophyll b (figure 226) and chlorophyll c (figure 227). The relationships can be expressed as follows

DO = 1/(0.094+0.015x-0.001x^2)
GPP = 2832.21-1598.15*exp(-1.5437*x^-1.596)

NPP = 2119.05*0.813^(1/x)*x^-0.519

Chlorophyll a = (1.229+58.038x)/(1-29.187x+498.32x^2)

Chlorophyll b = 1/(645.87-405.27*ln(x))

Chlorophyll c = 1/(-8327.7x+16741.5)

**Biological oxygen demand (BOD)**

The results of the present study reveal that there is a wide fluctuation in the biological oxygen demand of station II that showed a maximum of 35.56 mg/l (December’02) and a minimum of 4.94 mg/l in station V during June’03 (figure 228). Analysis of variance reveals that there is no significant difference (P>0.01) in the BOD level of the five stations studied. However, the comparison of means reveals that the station I had significantly lesser value than other stations (table 49).

BOD (table 50) showed significant relation with conductivity (r=0.6235), DO (r=0.9651), TS (r= 0.6174), TDS (r=0.6144), TSS (r=0.5551), nitrates (r=0.6606), silicates (r=0.6032), iron (r=0.5585), GPP (r=0.9378), NPP (r=0.9324), CR (r=0.7860), chlorophyll b (r=0.6088) and chlorophyll c (r= 0.7564).
Polynomial fit is found to be the fit model for correlating BOD with GPP (figure 237), NPP (figure 238) and CR (figure 239). The relationships can be expressed as follows

\[
GPP = 573.31 + 93.920x - 7.091x^2 + 0.563x^3 - 0.010x^4
\]

\[
NPP = -1736.68 + 672.96x - 65.182x^2 + 2.780x^3 - 0.039x^4
\]

\[
CR = -521.55 + 319.04x - 32.567x^2 + 1.474x^3 - 0.021x^4
\]

Logistic model is found to be the fit model for correlating BOD with conductivity (figure 229), TDS (figure 232) and iron (figure 236). The relationships can be written as follows

\[
\text{Conductivity} = \frac{893.89}{1 - 2.333 \times \exp(-0.327x)}
\]

\[
\text{TDS} = \frac{587.67}{1 - 2.524 \times \exp(-0.348x)}
\]

\[
\text{Iron} = \frac{0.819}{1 - 2.883 \times \exp(-0.244x)}
\]

Saturation growth rate model is the best-fit model for correlating TS (figure 231) and TSS (figure 233) with BOD. The relationships can be expressed as follows

\[
\text{TS} = \frac{816.43x}{-3.001 + x}
\]

\[
\text{TSS} = \frac{316.94x}{-3.538 + x}
\]

Silicates (figure 235) and chlorophyll c (figure 241) showed reciprocal quadratic fit as best fit model and the expressions are
Silicates = 1/(0.525-0.060x+0.003x^2)

Chlorophyll c = 1/(-8352.8+1155.9x-27.743x^2)

Weibull model, rational function and reciprocal models are found to be suitable for correlating DO (figure 230), nitrates (figure 234) and chlorophyll b (figure 240) respectively with BOD. The expressions can be written as follows

DO = 10.129-4.536*exp(-0.0001*x^3.220)

Nitrates = (-0.899+0.200x)/(1-0.306x+0.026x^2)

Chlorophyll b = 1/(-7.794x+263.48)

Chemical oxygen demand (COD)

Seasonal variations in COD reveal a peak in station III during July’02 (figure 242). The results of the analysis of variance show no significant difference in the COD of different stations studied (table 51). COD (table 52) has significant correlation with bicarbonates (r=0.5137), ammonia (r=0.7606), silicates (r=0.5034), iron (r=0.5508), chlorophyll a (r=0.8354), chlorophyll b (r=0.6392) and chlorophyll c (0.7262).

Chlorophyll a, b, c (figures 247 to 249) showed reciprocal logarithm fit as best fit model to compare with COD. The relationships can be expressed as

Chlorophyll a = 1/(2268937.6-633140.8*ln(x))

Chlorophyll b = 1/(813135.1-234613.4*ln(x))
Chlorophyll \( c = \frac{1}{(4938.65 - 1422.32 \ln(x))} \)

Polynomial fit found to be the best fit model to correlate ammonia (figure 244) and iron (figure 246) with COD and the expression can be written as

Ammonia \( = -1.027 + 0.117x - 0.003x^2 + 3.3196157e^{-005}x^3 - 1.0586606e^{-007}x^4 \)

Iron \( = -1.191 + 0.170x - 0.004x^2 + 5.0960101e^{-005}x^3 - 1.6893564e^{-007}x^4 \)

Bicarbonates (figure 243) and silicates (figure 245) had heat capacity model and sinusoidal fit relationships with COD. The relationships can be expressed as

Bicarbonates \( = 161.43 + 0.544x + 22534.2/x^2 \)

Silicates \( = 4.318 + 2.065 \cos(0.062x + 0.893) \)

**Hardness**

Seasonal variations (figure 250) as well as variations among the five stations are well marked. Least hardness of 72 mg/l was recorded from the station I (March’03) and IV (January’03) and the maximum from station IV (280 mg/l) in June’03. The results of the analysis of variance (table 53) revealed that, hardness of the five stations has no significance (\( P > 0.01 \)) difference among the stations. Comparison of mean values reveals that the hardness of the five stations is in the following order.

Station V > station IV > station II > station I > station III.
Hardness showed (table 54) significant correlation with pH ($r=0.9923$), acidity ($r=0.8979$), alkalinity PA ($r=0.7866$), alkalinity TA ($r=0.9749$), carbonates ($r=0.7866$), bicarbonates ($r=0.9274$), chlorides ($r=0.5446$), phosphates ($r=0.6808$), calcium ($r=0.9366$), magnesium ($r=0.9793$), LCSI ($r=0.5125$), chlorophyll a ($r=0.7647$) and chlorophyll c ($r=0.7622$).

Polynomial fit is found to be the most suitable model to relate hardness with alkalinity PA (figure 253), alkalinity TA (figure 254), carbonates (figure 255), bicarbonates (figure 256), chlorides (figure 257), calcium (figure 259), magnesium (figure 260) and LCSI (figure 261). The relationships can be expressed as

\[
\text{Alkalinity PA} = 100.42 - 2.790x + 0.026x^2 - 9.7371802e-005x^3 + 1.2591174e-007x^4
\]

\[
\text{Alkalinity TA} = -90.664 + 8.404x - 0.091x^2 + 0.0004x^3 - 6.3744444e-007x^4
\]

\[
\text{Carbonates} = 200.84 - 5.581x + 0.052x^2 - 0.0001x^3 + 2.5182347e-007x^4
\]

\[
\text{Bicarbonates} = -291.5 + 13.986x - 0.144x^2 + 0.0006x^3 - 8.8926791e-007x^4
\]

\[
\text{Chlorides} = -334.07 + 12.880x - 0.137x^2 + 0.0006x^3 - 9.5811016e-007x^4
\]

\[
\text{Calcium} = 97.810 - 2.266x + 0.023x^2 - 8.9720561e-005x^3 + 1.2012508e-007x^4
\]

\[
\text{Magnesium} = -26.264 + 0.858x - 0.006x^2 + 2.3887197e-005x^3 - 3.193449e-008x^4
\]

\[
\text{LCSI} = -1.305 + 0.032x - 0.0003x^2 + 1.1807427e-006x^3 - 1.6134635e-009x^4
\]
Reciprocal logarithm fit is the best model to derive the relationships with phosphates (figure 258), chlorophyll a (figure 262) and chlorophyll c (figure 263). The relationships can be expressed as

Phosphates = \(1/(97.98917.634*\ln(x))\)

Chlorophyll a = \(1/(-31117.4+587621*\ln(x))\)

Chlorophyll c = \(1/(-139204.4+26181.8*\ln(x))\)

The pH (figure 251) and acidity (figure 252) are found to have sinusoidal and Gaussian model relationships with hardness. The relationships can be expressed as

\[ \text{pH} = 7.905+0.711*\cos(0.014x+1.850) \]

\[ \text{Acidity} = 5.734*\exp((-99.699-x)^2)/(2*47.471^2) \]

GPP = \(1033.36x/(-21.579+x)\)

**Calcium**

Seasonal variation in calcium levels in the five stations are well documented (figure 264). The calcium level varied from 24.04 mg/l (station IV: January and February’03) to 89.33 mg/l (station IV: April’03). The analysis of variance reveals no significant difference in the calcium levels of these different stations (table 55). However, the mean value reveals a higher calcium level in station VI during the study period than the other stations studied.
Among the different parameters analyzed, the following parameters showed significant relationship with calcium levels (table 56). viz pH (r=0.9602), acidity (r=0.9032), alkalinity PA (r=0.7923), alkalinity TA (r=0.9408), carbonates (r=0.7923), bicarbonates (r=0.8869), hardness (r=0.9426), magnesium (r=0.8614), chlorophyll a (r=0.7717), chlorophyll b (r=0.5776) and chlorophyll c (r=0.7608).

Polynomial fit is found to be the most suitable model for expressing relationship of calcium with pH (figure 265), alkalinity TA (figure 268), bicarbonates (figure 270), hardness (figure 271) and magnesium (figure 272). The relationships can be expressed as

\[
pH = 6.123+0.109x-0.003x^2+6.1039896e-005x^3-3.037276e-007x^4
\]

\[
\text{Alkalinity TA} = -312.33+45.630x-1.460x^2+0.019x^3-8.8944315e-005x^4
\]

\[
\text{Bicarbonates} = -304.75+43.483x-1.350x^2+0.017x^3-7.556793e-005x^4
\]

\[
\text{Hardness} = -90.082+15.702x-0.468x^2+0.006x^3-3.0406114e-005x^4
\]

\[
\text{Magnesium} = -21.931+3.562x-0.112x^2+0.001x^3-7.2995881e-006x^4
\]

Sinusoidal fit is the most suitable fit to compare alkalinity PA (figure 267) and carbonates (figure 269) with calcium. The relationships can be expressed as

\[
\text{Alkalinity PA} = 15.771+12.436\times\cos(0.063x+1.109)
\]

\[
\text{Carbonates} = 31.543+24.873\times\cos(0.063x+1.109)
\]
Reciprocal logarithm fit is found to be suitable for chlorophyll a (figure 273) and chlorophyll c (figure 275). The relationships can be expressed as

\[
\text{Chlorophyll a} = \frac{1}{-1003206.2 + 239686.2 \ln(x)}
\]

\[
\text{Chlorophyll c} = \frac{1}{-4473832.2 + 1056875.6 \ln(x)}
\]

Guassian model and reciprocals models are the best fit models for comparing acidity (figure 266) and chlorophyll b (figure 274) respectively with calcium levels. The relationships can be expressed as

\[
\text{Acidity} = 5.816 \times \exp\left(\frac{-(25.747-x)^2}{2 \times 22.780^2}\right)
\]

\[
\text{Chlorophyll b} = \frac{1}{7.706x - 221.38}
\]

**Magnesium**

The occurrence of magnesium showed seasonal variation (figure 276) and the maximum value of 45.83 mg/l was recorded from station IV in June’03. The minimum level was recorded in station I (9.61 mg/l) in March’03. Analysis of variance reveals (table 57) that the difference in the magnesium level of the different stations is not significant (P>0.01). The analysis of the mean value and the comparison of 95% class intervals reveal that the occurrence of magnesium is in the following order.

Station V > station IV > station II > station III > station I
Magnesium showed significant correlation (table 58) with pH ($r=0.9647$), acidity ($r=0.7999$), alkalinity PA ($r=0.7336$), alkalinity TA ($r=0.9607$), carbonates ($r=0.7336$), bicarbonates ($r=0.9046$), phosphates ($r=0.5116$), hardness ($r=0.9787$), calcium ($r=0.8419$), chlorophyll b ($r=0.6529$) and chlorophyll c ($r=0.7084$).

Guassian model is found to be the best-fit model for representing acidity (figure 278), and hardness (figure 284) and can be expressed as

Acidity = $5.358*exp((-15.098-x)^2)/(2*9.434^2))$

Hardness = $312.72*exp((-59.837-x)^2)/(2*29.182^2))$

Chlorophyll b (figure 286) and chlorophyll c (figure 287) showed reciprocal logarithm fit as the best fit to compare with magnesium and the relationship can expressed as follows

Chlorophyll b = $1/(-20554.3+5904.23*ln(x))$

Chlorophyll c = $1/(-2761.04+793.36*ln(x))$

Logistic model is found to be suitable for alkalinity PA (figure 279), carbonates (figure – 281) and phosphates (figure 283). The expressions are

Alkalinity PA = $34.459/(1+93.446*exp(-0.160x))$

Carbonates = $68.919/(1+93.446*exp(-0.160x))$

Phosphates = $-0.012/(1-1.213*exp(-0.004x))$
Sinusoidal fit, polynomial fit and heat capacity model are highly suitable for pH (figure 277), alkalinity TA (figure 280), bicarbonates (figure 282) and calcium (figure 285) respectively. The relationships can be expressed as:

\[ \text{pH} = 7.925 + 0.724 \cos(0.088x + 1.870) \]

\[ \text{Alkalinity TA} = -74.396 + 51.314x - 3.542x^2 + 0.102x^3 - 0.0009x^4 \]

\[ \text{Bicarbonates} = -100.75 + 55.366x - 3.750x^2 + 0.103x^3 - 0.0009x^4 \]

\[ \text{Calcium} = -7.101 + 2.255x + 1486.84/x^2 \]

**Iron**

Seasonal variations in the dynamics of iron in the water of five stations are presented in figure 288. There was a wide fluctuation in the iron content of the five stations studied, from 0 mg/l (in all the stations) to 6.13 mg/l (station III in June'03). The results of the analysis of variance reveal that there is no significant difference (P > 0.01) in iron concentration among the different stations studied during the present investigation (table 59). However, comparison of the means reveals that the station III has higher iron level and lesser iron level in the station IV.

Among the different parameters analyzed, (table 60) pH (r = 0.5373), alkalinity PA (r = 0.5565), alkalinity TA (r = 0.5002), carbonates (r = 0.5565), chlorides (r = 0.5407), ammonia (r = 0.7506), phosphates (r = 0.6418), hardness (r = 0.5004), magnesium (r = 0.5076), NPP (r = 0.5909), LCSI (r = 0.8384), chlorophyll
a (r=0.6357) chlorophyll b (r=0.5844) and chlorophyll c (r=0.5200) have significant correlation with iron.

Sinusoidal fit is found to be the most suitable model for relating pH (figure 289), alkalinity PA (figure 290), carbonates (figure 292), chlorides (figure 293) and hardness (figure 296) with iron. The relationship can be expressed as follows

\[
\text{pH} = 7.650 + 0.278 \times \cos(4.518x + 0.631)
\]

\[
\text{Alkalinity PA} = 15.402 + 8.445 \times \cos(4.592x + 0.803)
\]

\[
\text{Carbonates} = 30.805 + 16.890 \times \cos(4.591x + 0.803)
\]

\[
\text{Chlorides} = 116.92 + 31.061 \times \cos(1.826x + 1.783)
\]

\[
\text{Hardness} = 164.64 + 30.941 \times \cos(4.557x + 0.488)
\]

Ammonia (figure 294), magnesium (figure 297) and NPP (figure 298) showed rational function as the best and suitable model for expressing relationship with iron. The relationship can be expressed as follows

\[
\text{Ammonia} = (0.277 - 0.041x)/ (1 - 0.367x + 0.034x^2)
\]

\[
\text{Magnesium} = (35.589 + 3315.28x)/ (1 + 139.86x - 7.772x^2)
\]

\[
\text{NPP} = (1358.36 - 824.35x)/ (1 - 0.449x - 0.092x^2)
\]

Harris model, exponential association, reciprocal model, reciprocal quadratic and Gompertz relation are the best fit models to compare alkalinity TA (figure 291), LCSII (figure 299), chlorophyll a (figure 300), chlorophyll b (figure...
301) and chlorophyll c (figure 302) with iron. The relationships can be expressed as follows:

Alkalinity TA = $1/(0.003+0.001x^{0.141})$

LCSI = $-0.188(1-\exp(-21.710x))$

Chlorophyll a = $1/(-21.033x+101.38)$

Chlorophyll b = $1/(30.451+256.78x-187.37x^2)$

Chlorophyll c = $0.267\exp(-\exp(0.997-1.063x))$

Polynomial fit is found to be the best to correlate phosphate (figure 295) with iron. The relationship can be written as:

Phosphates = $0.459-0.446x+0.164x^2+0.024x^3-0.006x^4$

**Gross primary productivity (GPP)**

The minimum GPP of 921.25 mg C/m$^3$/hr was recorded in the month of July’03 in station V and the maximum of 3698.75 mg C/m$^3$/hr was recorded in the station III during January’03 (figure 303).

The results of the analysis of variance reveal that there is no significant difference ($P>0.01$). However, comparison of means reveals that the productivity was higher in station III than the other stations and the station II has least value (table 61).
GPP showed correlation (table 62) with conductivity (r=0.6786), transparency (r=0.5105), DO (r=0.9653), TS (r=0.6784), TDS (r=0.6606), TSS (r=0.5366), nitrates (r=0.5951), silicates (r=0.6530), BOD (r=0.9325), NPP (r=0.9541), CR(r=0.7883) and chlorophyll c (r=0.7520).

Polynomial fit is found to be the most suitable for correlating GPP with DO (figure 306), BOD (figure 312), NPP (figure 313) and CR (figure 314) and the relationships can be expressed as follows

\[
DO = 13.551 - 0.020x + 1.8397188 e^{-0.009x^2} - 5.8008554 e^{-0.009x^3} + 6.1853955 e^{-0.013x^4}
\]

\[
BOD = -42.376 + 0.094x - 6.336685e^{-0.005x^2} + 2.0212242 e^{-0.008x^3} - 2.3427071 e^{-0.012x^4}
\]

\[
NPP = -440.63 + 1.376x - 0.0004x^2 + 8.0106703 e^{-0.008x^3}
\]

\[
CR = 1313.46 - 1.657x + 0.001x^2 - 1.6421762 e^{-0.007x^3}
\]

Conductivity (figure 304), TS (figure 307), TDS (figure 308) and silicates (figure 311) showed vapor pressure model as the best fit model to correlating GPP. The relationships can be written as

Conductivity = \(\exp(-2.097 + 2223.2/x + 1.017 \ln(x))\)

TS = \(\exp(-4.108 + 2805.85/x + 1.2551 \ln(x))\)

TDS = \(\exp(-2.160 + 2118.01/x + 0.9771 \ln(x))\)

Silicates = \(\exp(47.726 - 6915.57/x - 5.7021 \ln(x))\)
Hoerl model, saturation growth-rate model, modified geometric fit and reciprocal models were found to be the best models for correlating GPP with transparency (figure 305), TSS (figure – 309), nitrates (figure 310) and chlorophyll c (figure 315) respectively. The relationships can be expressed as

\[
\text{Transparency} = 6.3906463 \times 10^{-5} \times (0.999^x) \times (x^{2.083})
\]

\[
\text{TSS} = \frac{250.84x}{-669.14+x}
\]

\[
\text{Nitrates} = 0.221 \times x^{(363.76/x)}
\]

\[
\text{Chlorophyll c} = \frac{1}{99.388x-134166.8}
\]

**Net primary productivity (NPP)**

Seasonal variations of NPP (figure 316) showed the minimum recorded data (453.75 mg C/m³/hr) in station V during June’03. The maximum level was recorded in station III (3183.75 mgC/m³/hr) in the month of February’03. The analysis of variance reveals that there is no significant difference (P>0.01). However, comparison of the means reveals that the NPP was higher in station V and lesser in station II (table 63).

NPP showed correlations with (table 64) conductivity (r=0.7327), transparency (r=0.5027), DO (r=0.9546), TS (r=0.6968), TDS (r=0.7112), TSS (r=0.5521), nitrates (r=0.6192), silicates (r=0.6497), BOD (r=0.9162), iron (r=0.5271), GPP (r=0.9134), CR (r=0.8697) and chlorophyll c (r=0.6502).
Polynomial fit is found as the most suitable model for correlating NPP with transparency (figure 318), DO (figure 319), nitrates (figure 323), GPP (figure 327) and CR (figure 328).

Transparency = 21.978 + 0.006x + 0.0001x^2 - 8.2938231e-008x^3 + 1.5094084e-011x^4

DO = 7.820 - 0.010x + 1.6012303e-005x^2 - 7.0205644e-009x^3 + 9.7533346e-013x^4

Nitrates = 6.450 - 0.008x + 3.8212238e-006x^2 - 5.4145939e-010x^3

GPP = 1946.37 - 4.655x + 0.006x^2 - 2.9443459e-006x^3 + 4.1899413e-010x^4

CR = -806.972 + 4.428x - 0.004x^2 + 2.5426597e-006x^3 - 4.2982715e-010x^4

Conductivity (figure 317), TS (figure 320), TDS (figure 321) and silicates (figure 324) showed vapor pressure model as the best fit model to correlate with NPP and the expression is

Conductivity = \exp(2.581 + 785.41/x + 0.500\ln(x))

TS = \exp(2.561 + 883.22/x + 0.506\ln(x))

TDS = \exp(2.249 + 754.71/x + 0.491\ln(x))

Silicates = \exp(31.414 - 2681.75/x - 3.966\ln(x))

Saturation growth-rate model is found to be suitable model to correlate TSS (figure 322) chlorophyll c (figure 329) with NPP. The expression can be written as follows

TSS = 300.05x/(-324.75 + x)
Chlorophyll \( c = \frac{0.005x}{-704.93+x} \)

Richard’s model and heat capacity model are the best models for correlating BOD (figure 325) and iron (figure 326) with NPP respectively. The relationships can be expressed as

\[
\text{BOD} = \frac{27.048}{1+\exp(2.692-0.002x)\left(\frac{1}{1.084}\right)}
\]

\[
\text{Iron} = -0.333+0.0004x+710376.2/x^2
\]

**Community respiration**

The community respiration in the five stations showed seasonal variations (figure 330). The highest community respiration was recorded in station III (2757.5 mgC/m3/hr) during January’03 and the lowest level was recorded station V (453.75 mgC/m3/hr) during June and July’03. The results of the analysis of variance (table 65) reveal that the community respiration of five stations do not differ significantly (\( P>0.01 \)). Comparison of mean the values reveals that station V had the maximum rate of community respiration and station II, the least. The gradation in community respiration is as follows

Station V > station IV > station III > station I > station II.

A perusal of the table 66 reveals that community respiration has significant correlation with DO (\( r=0.8515 \)), nitrates (\( r=0.5000 \)), silicates (\( r=0.6646 \)), BOD (\( r=0.7981 \)), GPP (\( r=0.8903 \)), and NPP (\( r=0.9031 \)).
Polynomial fit is found to be the suitable model to compare DO (figure 331), BOD (figure 334) and GPP (figure 335) with community respiration and the relationships are as follows

\[
\begin{align*}
\text{DO} & = 12.296-0.024x+3.3963355e^{-005}x^2-1.6232572e^{-008}x^3+2.5516616e^{-012}x^4 \\
\text{BOD} & = 29.757-0.078x+0.0001x^2-4.6214306e^{-008}x^3+6.7733918e^{-012}x^4 \\
\text{GPP} & = 5717.16-16.949x+0.021x^2-9.9209484e^{-006}x^3+1.5541074e^{-009}x^4
\end{align*}
\]

Silicates (figure 333) and NPP (figure 336) showed vapor pressure model as best fit to correlate community respiration. The relationships can be written as

\[
\begin{align*}
\text{Silicates} & = \exp(21.046-1276.05/x-2.7231n(x)) \\
\text{NPP} & = \exp(-5.985+1036.36/x+1.7351n(x))
\end{align*}
\]

Rational function is found to have significant relationship with nitrates (figure 332). The relationship can be expressed as follows

\[
\text{Nitrates} = (-5.7147718e+010+2.2052846e+008x)/(1-97874769x+282175.8dx^2)
\]

**Langlier’s Calcium Saturation Index (LCSI)**

A perusal of the seasonal variations in LCSI of the different stations (figure 337) reveals that LCSI has a higher value of -0.1 in all the stations during most of the months and a lower value of -0.4 in station III and station V during the months July’02 and November’02 to January’03 respectively. The analysis of variance
(table 67) reveals that the variation in the LCSI of different stations are significant (P<0.01). However, the mean values are present in the order

Station I > station II > station IV > station III > station V.

LCSI was found to have significant correlation (table 68) with magnesium (figure 338) and chlorophyll c (figure 339) in sinusoidal fit (r=0.5049) and reciprocal model (r=0.5655) respectively. The relationship can be expressed as

Magnesium = 28.109 + 5.309 * cos(76.978x - 1597)

Chlorophyll c = 1/(1577863.5x + 315582.4)

Chlorophyll a

Seasonal variations in the chlorophyll-a content of the different stations investigated are presented in figure 340. The maximum level of chlorophyll-a was observed from station III (0.1836 mg/l) in the month of July’03 and the minimum level of 0.0003 mg/l was also recorded from station III in the month of November’02. The analysis of variance reveals that there is no significant difference (P>0.01) in the content of chlorophyll-a in the different stations studied. However, higher chlorophyll-a content was recorded in station III (table 69). The gradation in the content of chlorophyll a is in the order

Station III > station IV > station II > station I > station V

The chlorophyll a (table 70) has significant correlation with DO (r=0.5592), TDS (r=0.5081), nitrates (r=0.6430), phosphates (r=0.5715), silicates (r=0.5065),
BOD \( (r=0.5119) \), GPP \( (r=0.5214) \), chlorophyll b \( (r=0.6611) \) and chlorophyll c \( (r=0.8429) \).

Nitrates \( (\text{figure 343}) \), BOD \( (\text{figure 346}) \) and GPP \( (\text{figure 347}) \) showed quadratic fit as the best fit model to correlate with chlorophyll a. The relationships can be expressed as

\[
\text{Nitrates} = 0.266 + 53.121x - 265.46x^2
\]

\[
\text{BOD} = 20.343 - 271.72x + 1555.17x^2
\]

\[
\text{GPP} = 2309.28 - 28819.1x + 169810.3x^2
\]

Rational function is found to be the suitable model for relating TDS \( (\text{figure 342}) \), phosphates \( (\text{figure 344}) \), silicates \( (\text{figure 345}) \) and chlorophyll b \( (\text{figure 348}) \) with chlorophyll a. The relationships are as below

\[
\text{TDS} = \frac{(595.13 - 5832.05x)}{(1 - 11.030x + 9.124x^2)}
\]

\[
\text{Phosphates} = \frac{(0.176 - 1.806x)}{(1 - 26.825x + 186.89x^2)}
\]

\[
\text{Silicates} = \frac{(1.229 + 58.038x)}{(1 - 29.187x + 498.324x^2)}
\]

\[
\text{Chlorophyll b} = \frac{(0.021 - 0.143x)}{(1 - 15.507x + 60.566x^2)}
\]

Reciprocal quadratic fit and saturation growth-rate models are the suitable models for relating DO \( (\text{figure 341}) \) and chlorophyll c \( (\text{figure 349}) \) with chlorophyll a respectively and the relationships can be expressed as

\[
\text{DO} = \frac{1}{(0.107 + 1.170x - 6.656x^2)}
\]
Chlorophyll c = $2.095x/(0.594+x)$

**Chlorophyll b**

A perusal of the figure 350 reveals that the maximum level of chlorophyll b was recorded in station I (0.0895 mg/l) during May’03 and the minimum of 0.0003 was observed in station III during the month of July’02.

The results of analysis of variance show that there is no significant difference (P>0.01) in the chlorophyll b level of the different stations (table 71). However, the mean values reveal that the station II had higher chlorophyll b content and station V has the lower value. The gradation is as follows:

Station II > station IV > station I > station III > station V

Chlorophyll-b (table 71) is significantly correlated with conductivity ($r=0.5067$), TDS ($r=0.5691$), nitrates ($r=0.5253$), phosphates ($r=0.8791$), COD ($r=0.6528$), chlorophyll a ($r=0.5893$) and chlorophyll c ($r=0.7128$).

Polynomial fit is found to be the best model for correlating conductivity (figure 351), TDS (figure 352), nitrates (figure 353) and chlorophyll a (figure 356) with chlorophyll b. The relationships can be expressed as follows:

Conductivity = $1020.37-11567.9x+253913.9x^2-1181259.5x^3+1556970.3x^4$

TDS = $646.62-6262.44x+145350.7x^2-683513.8x^3+902915.9x^4$

Nitrates = $0.900-9.571x+645.68x^2-4049.08x^3+6440.03x^4$
Chlorophyll a = 0.015-0.163x+19.87x^2-136.34x^3+228.95x^4

Phosphates (figure 354), COD (figure 355) and chlorophyll c (figure 357) showed reciprocal logarithm fit, modified Hoerl model and rational function respectively as the best fit models to compare with chlorophyll b. The relationships are as follows:

Phosphates = 1/(28.199+4.554*ln(x))

COD = 64.064*1.0^(1/x)*x^0.122

Chlorophyll c = (0.008+0.485x)/(1-26.886x+208.95x^2)

**Chlorophyll c**

Seasonal variations in the chlorophyll c are well documented in the five stations during the period of study (figure 358). The maximum value of 0.57 mg/l was observed in June’03 from station IV and the minimum of 0.00009 was obtained from station II during August’02.

The results of the analysis of variance (table 73) show that the variation among the different stations is insignificant (P>0.01). However, comparison of the mean values reveals that the station III had higher and station V had the lower chlorophyll c content and the gradation is as follows:

Station III > station I > station II > station IV > station V
Chlorophyll c had significant correlation (table 75) with ammonia $(r=0.5092)$, nitrates $(r=0.6587)$, silicates $(r=0.5153)$, iron $(r=0.5846)$, chlorophyll a $(r=0.8718)$ and chlorophyll b $(r=0.6144)$.

Rational function is found to be the suitable model for correlating ammonia (figure 359), iron (figure 362) and chlorophyll a (figure 363) with chlorophyll c. The relationships can be written as follows:

\[
\text{Ammonia} = \frac{(0.322-0.566x)}{(1-3.257x+2.643x^2)}
\]
\[
\text{Iron} = \frac{(0.662-1.204x)}{(1-4.161x+4.42x^2)}
\]
\[
\text{Chlorophyll a} = \frac{(0.016-0.007x)}{(1-3.611x+3.526x^2)}
\]

Nitrates (figure 360) and chlorophyll b (figure 364) showed reciprocal quadratic fit as the best fit model to correlate with chlorophyll c and the relationships can be expressed as:

\[
\text{Nitrates} = \frac{1}{(1.297-5.947x+8.698x^2)}
\]
\[
\text{Chlorophyll b} = \frac{1}{(698.52-4413.86x+6080.81x^2)}
\]

Sinusoidal is found to be suitable to compare silicates (figure 361) with chlorophyll c and the expression is as follows:

\[
\text{Silicates} = 3.736+2.080\cos(12.719x-2.505)
\]
Sediment Characteristics

The sediment characteristics of the station I, station II, station III, station IV and station V during the investigational period are presented in tables 75, 76, 77, 78 and 79 respectively. The results reveal a seasonal variation as well as variation among different stations.

pH

The comparison of seasonal variation of sediment pH of the different aquatic ecosystems during the period of investigation is presented in figure 365. The minimum sediment pH of 7.4 was observed in station IV (July-03) and station V (June-03). The maximum sediment pH of 8.8 was recorded from station IV in the month of June-03. Analysis of variance comparing the sediment pH reveals no significant difference (table 80) in the five stations during the period of investigation. The comparison of the mean pH values reveals that the station IV had the higher pH values than the other stations studied. The gradation in pH is as follows

Station IV > station I > station III = station V > station II

The sediment pH is established to have significant relationship (table 81) with water parameters, pH \( r=0.8689: \) polynomial fit, conductivity \( r=0.5640: \) polynomial fit, TDS \( r=0.5308: \) polynomial fit, acidity \( r=0.7246: \) reciprocal quadratic fit, alkalinity \( PA(r=0.6249: \) sinusoidal fit, total
alkalinity ($r=0.8857$: polynomial fit), carbonates ($r=0.6249$: sinusoidal fit),
bicarbonates ($r=0.8540$: polynomial fit), chlorides ($r=0.5061$: polynomial fit),
phosphates ($r=0.6337$: reciprocal logarithm fit), hardness ($r=0.8333$: polynomial fit),
calcium ($r=0.7895$: heat capacity model), magnesium ($r=0.8095$: polynomial fit),
chlorophyll a ($r=0.7920$: reciprocal logarithm fit), chlorophyll b ($r=0.6413$: reciprocal model) and chlorophyll c ($r=0.7355$: reciprocal model).

The relationships can be expressed as followed as follows

\[
\text{pH} = 508.39 - 187.40x + 24.024x^2 - 1.150x^3 + 0.012xM \quad \text{(figure 366)}
\]

\[
\text{Conductivity} = 10855645 - 5276045.6x + 960411.1x^2 - 77600.8x^3 + 2348.37xM \quad \text{(figure 367)}
\]

\[
\text{TDS} = 6322781.2 - 3075629.4x + 560394.1x^2 - 45326.2x^3 + 1373.21x^4 \quad \text{(figure 368)}
\]

\[
\text{Acidity} = \frac{1}{(87.864 - 22.770x + 1.478x^2)} \quad \text{(figure 369)}
\]

\[
\text{Alkalinity PA} = 19.331 + 11.419\cos(2.074x - 5.028) \quad \text{(figure 370)}
\]

\[
\text{Alkalinity TA} = -1032428.8 + 516799.5x - 96747.04x^2 + 8027.72x^3 - 249.05xM \quad \text{(figure 371)}
\]

\[
\text{Carbonates} = 38.662 + 22.839\cos(2.704x - 5.028) \quad \text{(figure 372)}
\]

\[
\text{Bicarbonates} = -924974.6 + 459738.4x - 85460.9x^2 + 7041.99x^3 - 216.97x^4 \quad \text{(figure 373)}
\]

\[
\text{Chlorides} = 130356.2 - 48430.01x + 5990.55x^2 - 246.52x^3 \quad \text{(figure 374)}
\]

\[
\text{Phosphates} = \frac{1}{(223.95 - 103.57\ln(x))} \quad \text{(figure 375)}
\]

\[
\text{Hardness} = 52289.6 - 18788.1x + 2238.45x^2 - 88.082x^3 \quad \text{(figure 376)}
\]

\[
\text{Calcium} = -2139.03 + 195.26x + 40158.16/x^2 \quad \text{(figure 377)}
\]
Magnesium = 8275.38 - 2954.3x + 349.62x^2 - 13.658x^3 (figure 378)

Chlorophyll a = 1/(-3249843.3 + 1535666.9*ln(x)) (figure 379)

Chlorophyll b = 1/(417.46x - 3195.77) (figure 380)

Chlorophyll c = 1/(2281.85x - 18238.4) (figure 381)

Conductivity

The monthly variations in the conductivity of the sediments are presented in figure 382. The minimum conductivity level of 400 μSi was observed in station I in December 02. The maximum level was also obtained from station I (1080 μSi) in July 02. Analysis of variance reveals that there is significant variation (table 82) in the conductivity of the five stations (P<0.01). Comparison of the mean values reveals that the conductivity of station IV sediments is far higher than that of other stations. The variation in the conductivity of the sediments is in the order of

Station IV > station V > station II > station III > station I

The sediment conductivity is found to have significant relationship (table 83) with water parameters conductivity (r=0.6924: polynomial fit), TS (r=0.6944: polynomial fit), TDS (r=0.6773: polynomial fit), TSS (r=0.5970: polynomial fit), chlorophyll a (r=0.7878: reciprocal logarithm fit), chlorophyll b (r=0.6375: reciprocal logarithm fit) and chlorophyll c (r=0.6250: reciprocal model).

Following is the representation of the relationships.
Conductivity = -21858.9 + 146.94x - 0.343x^2 + 0.0003x^3 - 1.2400919e-007xM (figure 383)

TS = -36373.9 + 231.58x - 0.521x^2 + 0.0005x^3 - 1.7607482e-007xM (figure 384)

TDS = -14048.4 + 93.990x - 0.218x^2 + 0.0002x^3 - 7.8144575e-008x^4 (figure 385)

TSS = -22325.5 + 137.59x - 0.303x^2 + 0.0002x^3 - 9.7930244e-008x^4 (figure 386)

Chlorophyll a = 1/(-2200635.4 + 324582.8*ln(x)) (figure 387)

Chlorophyll b = 1/(-3488991.3 + 514608.09*ln(x)) (figure 388)

Chlorophyll c = 1/(11.242x - 5842.7) (figure 389)

**Sediment Water Content**

The perusal of the tables 75 - 79 reveals the minimum sedicent content of 20.9% in station IV in October-02 and the maximum of 41.8% in station I during May-03 (figure 390). Analysis of variance reveals that the difference in sediment moisture (table 84) of the different stations is highly significant (P<0.001). Comparison of the mean values of reveals that the station II had the highest levels of moisture content in the sediments and station IV had the lowest moisture content levels of the five stations studied. The gradation is in the following order

Station II > station I > station V > station III > station IV

**Alkalinity**

A read-through on the tables 75 - 79 and figure 391 reveals that a minimum of 1.0 mg/100g were observed in station V (February-03 and June-03) and a
maximum of 2.4 mg/100g in station I, station II and station III (July-02 in all the three stations). It reveals that a difference in alkalinity among the different stations (table 85) is not significant (P>0.01). An examination of the mean values reveals that the station I and V had the highest range of alkalinity in the sediments of the five stations. The gradation in alkalinity is as follows

Station I = station V > station III = station IV > station II

The sediment alkalinity is found to have significant relationship (table 86) with water parameters pH (r=0.8082:sinusoidal fit), acidity (r=0.7130:vapor pressure model), alkalinity PA(r=0.5990:MMF model), total alkalinity (r=0.7975:MMF model), carbonates (r=0.5990:MMF model), bicarbonates (r=0.7360:MMF model), hardness (r=0.7828: sinusoidal fit), calcium (r=0.7525:sinusoidal fit), magnesium (r=0.7571:sinusoidal fit), chlorophyll a (r=0.5620:reciprocal logarithm fit), chlorophyll b (r=0.6089:saturation growth rate model) and chlorophyll c (r=0.7054:reciprocal model).

The relationships can be expressed as follows

\[ \text{pH} = 7.789 + 0.475 \cos(2.840x - 0.491) \] (figure 392)

\[ \text{Acidity} = \exp(20.692 - 19.511/x - 15.700\ln(x)) \] (figure 393)

\[ \text{Alkalinity PA} = \frac{(8.533 \times 2013.7 + 28.712 \times x^{12.625})}{(2013.7 + x^{12.625})} \] (figure 394)

\[ \text{Alkalinity TA} = \frac{(203.96 \times 153219.8 + 331.54 \times x^{19.001})}{(153219.8 + x^{19.001})} \] (figure 395)

\[ \text{Carbonates} = \frac{(17.067 \times 2013.23 + 57.425 \times x^{12.624})}{(2013.23 + x^{12.624})} \] (figure 396)
Bicarbonates = \( \frac{(182.49 \times 4123.58 + 288.89 \times x^{12.598})}{(4123.58 + x^{12.598})} \) (figure 397)

Hardness = \( 178.73 + 54.055 \times \cos(3.082x - 0.870) \) (figure 398)

Calcium = \( 60.958 + 20.308 \times \cos(2.659x - 0.094) \) (figure 399)

Magnesium = \( 28.729 + 8.351 \times \cos(3.286x - 1.240) \) (figure 400)

Chlorophyll a = \( \frac{1}{(-13266.4 + 22606.9 \times \ln(x))} \) (figure 401)

Chlorophyll b = \( \frac{0.002x}{(-1.131 + x)} \) (figure 402)

Chlorophyll c = \( \frac{1}{(265.80x - 413.49)} \) (figure 403)

**Acidity**

The perusal of the tables 75 – 79 reveals the minimum acidity level of 0.025 mg/100g in station I to IV in July-02 and the maximum of 0.214 mg/100g in station V during June-03 (figure 404). Analysis of variance reveals that the difference in sediment acidity (table 87) of the different stations is not significant (P>0.01). Comparison of the mean values reveals that the station IV had the highest acidity levels in the sediments and station I had the lowest acidity levels of the five stations studied. The gradation is in the following order

Station IV > station II > station III > station V > station I

The sediment acidity is found to have significant relationship (table 88) with water pH (r=0.8224: polynomial fit), conductivity (r=0.5510: polynomial fit), DO (r=0.5775: sinusoidal fit), TS (r=0.5163: polynomial fit), TDS (r=0.5368:...
The relationships can be expressed as follows

\[ \text{pH} = 9.928 - 76.694x + 770.78x^2 - 3215.96x^3 + 4781.1x^4 \] (figure 405)

\[ \text{Conductivity} = 1567.9 - 24329.6x + 351062.4x^2 - 2402231.1x^3 + 6002565.1x^4 \] (figure 406)

\[ \text{DO} = 7.797 + 1.427\cos(67.150x + 1.449) \] (figure 407)

\[ \text{TS} = 2541.1 - 65106.6x + 990549.3x^2 - 6380169.2x^3 + 14553510x^4 \] (figure 408)

\[ \text{TDS} = 1029.28 + 16268.5x + 233918.3x^2 - 1569379.7x^3 + 3844810.8x^4 \] (figure 409)

\[ \text{Acidity} = 0.488 \times 0.804^{1/x} \times 1.981 \] (figure 410)

\[ \text{Alkalinity PA} = 43.192 - 363.28x - 8171.1x^2 + 106080x^3 - 303917.8x^4 \] (figure 411)

\[ \text{Alkalinity TA} = 560.81 - 9939.4x + 79219.7x^2 - 192661.8x^3 \] (figure 412)

\[ \text{Carbonates} = 86.685 - 726.56x - 16342.2x^2 + 212160.1x^3 - 607835.7x^4 \] (figure 413)

\[ \text{Bicarbonates} = 521.56 - 11863.2x + 143166.1x^2 - 722301.1x^3 + 1307255.8x^4 \] (figure 414)
BOD = 15.185 + 6.021 * cos(67.722x + 1.396) (figure 415)

Hardness = 394.41 - 6849.2x + 51590.7x^2 - 119722.6x^3 (figure 416)

Calcium = 134.48 - 2322.4x + 17552.1x^2 - 41698.2x^3 (figure 417)

Magnesium = 63.316 - 1099.2x + 8249.9x^2 - 18878.1x^3 (figure 418)

Iron = (1.407 - 6.688x) / (1 + 2.127x - 32.700x^2) (figure 419)

GPP = 1865.4 + 617.79 * cos(69.019x + 1.146) (figure 420)

Chlorophyll a = 1 / (-1041710.2 - 329843.7 * ln(x)) (figure 421)

Chlorophyll b = 1 / (-345657.8 - 1094469.4 * ln(x)) (figure 422)

Chlorophyll c = 1 / (-1448153.9 - 458532.6 * ln(x)) (figure 423)

**Carbonates**

The sediment carbonates was absent in all the five stations throughout the period of investigation.

**Bicarbonates**

The perusal of the tables 75 - 79 reveals the minimum bicarbonate level of 18.8 mg/100g in station II in December-02 and the maximum of 170.8 mg/100g in the station I, II and III during July-02 (figure 424). Analysis of variance reveals that the difference in sediment bicarbonates (table 89) of the five stations is not significant (P>0.01). Comparison of the mean values reveal that the station III is
having the highest bicarbonates level in the sediments of the different stations studied.

Station III > station I > station V > station IV > station II

The sediment bicarbonates is found to have significant relationship (table 90) with water pH \((r=0.7987:\text{polynomial fit})\), acidity \((r=0.7414:\text{polynomial fit})\), alkalinity PA \((r=0.6041:\text{polynomial fit})\), total alkalinity \((r=0.7643:\text{polynomial fit})\), carbonates \((r=0.6044:\text{polynomial fit})\), bicarbonates \((r=0.6940:\text{polynomial fit})\), hardness \((r=0.7720:\text{polynomial fit})\), calcium \((r=0.7637:\text{polynomial fit})\), magnesium \((r=0.7374:\text{polynomial fit})\), chlorophyll a \((r=0.8031:\text{reciprocal logarithm fit})\), chlorophyll b \((r=0.6424:\text{reciprocal logarithm fit})\) and chlorophyll c \((r=0.7138:\text{reciprocal model})\).

The relationships are presented as follows

\[
\begin{align*}
\text{pH} & = 8.197 - 0.040x + 0.0005x^2 - 2.3751666e-006x^3 + 2.8322996e-009x^4 \quad (\text{figure } 425) \\
\text{Acidity} & = -1.767 + 0.292x - 0.004x^2 + 1.9045416e-005x^3 - 2.3881648e-008x^4 \quad (\text{figure } 426) \\
\text{Alkalinity PA} & = 34.433 - 1.184x + 0.015x^2 - 6.7967207e-005x^3 + 8.2211116e-008x^4 \quad (\text{figure } 427) \\
\text{Alkalinity TA} & = 313.86 - 5.268x + 0.069x^2 - 0.0002x^3 + 3.1646089e-007x^4 \quad (\text{figure } 428) \\
\text{Carbonates} & = 68.866 - 2.369x + 0.031x^2 - 0.0001x^3 + 1.6442223e-007x^4 \quad (\text{figure } 429) \\
\text{Bicarbonates} & = 244.99 - 2.899x + 0.037x^2 - 0.0001x^3 + 1.5203866e-007x^4 \quad (\text{figure } 430) \\
\text{Hardness} & = 248.43 - 5.662x + 0.077x^2 - 0.0003x^3 + 4.0278806e-007x^4 \quad (\text{figure } 431) \\
\text{Calcium} & = 86.408 - 2.098x + 0.029x^2 - 0.0001x^3 + 1.5279419e-007x^4 \quad (\text{figure } 432)
\end{align*}
\]
Magnesium = 39.336 - 0.861x + 0.011x^2 - 5.015x^3 + 6.0608014e-008x^4 (figure 433)

Chlorophyll a = 1/(-4740.05 + 1043.28*ln(x)) (figure 434)

Chlorophyll b = 1/(-10238.3 + 2208.5*ln(x)) (figure 435)

Chlorophyll c = 1/(-2.460x + 311.24) (figure 436)

**Available phosphorus**

Monthly variations in the available phosphorus levels of the sediments are presented in figure 437. The minimum available phosphorus level of 0.0012 g/100g was observed in station II in April-03. The maximum level was observed in station V (0.108 g/100g) during April-03. Analysis of variance reveals that there is no significant variation in the available phosphorus of the five different stations (P>0.01). Comparison of the mean values reveals that the available phosphorus of station I sediments are far higher than that of the other stations (table 91).

The available phosphorus of sediment is found to have significant relationship (table 92) with water ammonia (r=0.8823: reciprocal logarithm fit), phosphates (r=0.6997: rational function), chlorophyll a (r=0.8383: exponential association fit), chlorophyll b (r=0.5988: exponential association fit) and chlorophyll c (r=0.7625: exponential association fit).

The relationships can be expressed as

Ammonia = 1/(56.982 + 10.370*ln(x)) (figure 438)
Phosphates = \( (0.078+7.966x)/(1-59.923x+1112.35x^2) \) (figure 439)

Chlorophyll a = \(-8.2315052e-005(1-\exp(-0.034x))\) (figure 440)

Chlorophyll b = \(-3.141(1-\exp(0.218x))\) (figure 441)

Chlorophyll c = \(-5.1564441e-005(1-\exp(-0.090x))\) (figure 442)

**Sulphate**

A perusal on the tables 75 - 79 and figure 443 reveal that a minimum 0.1492 g/100g in station IV (July-03) and a maximum of 0.926 g/100g in station II and III (July-02) were observed. Analysis of variance reveals that the difference in sulphate among the different stations (table 93) is not significant (P>0.01). An examination of the mean values reveals that the station II has higher range of sulphate in the sediments in all months of study than the other stations. The gradation in sulphate is as follows

Station II > station III > station I > station V > station IV

The sediment sulphate is found to have significant relationship (table 94) with water pH (r=0.5985:geometric fit), acidity (r=0.5551:geometric fit), alkalinity PA (r=0.5776: sinusoidal fit), total alkalinity (r=0.5406:geometric fit), carbonates (r=0.5776: sinusoidal fit), sulphate (r=0.5153:MMF model), COD (r=0.5100: polynomial fit), hardness (r=0.5998:modified Hoerl model), calcium (r=0.5966: heat capacity model), magnesium (r=0.5929:rational function), chlorophyll a
(r=0.8142: reciprocal logarithm fit), chlorophyll b (r=0.6707:rational function) and chlorophyll c (r=0.7569:reciprocal model).

The relationships can be represented as follows

\[
pH = 8.556x^{(0.397x)} \text{ (figure 444)}
\]

\[
Acidity = 0.293x^{(-7.409x)} \text{ (figure 445)}
\]

\[
\text{Alkalinity PA} = 20.264 + 11.617* \cos(5.566x + 0.698) \text{ (figure 446)}
\]

\[
\text{Alkalinity TA} = 376.96x^{(1.614x)} \text{ (figure 447)}
\]

\[
\text{Carbonates} = 40.528 + 23.235* \cos(5.566x + 0.697) \text{ (figure 448)}
\]

\[
\text{Sulphate} = 9.876*3.4710815e+008 + 34.850*x^{(-21.845)}/(3.4710815e+008 + x^{(-24.845)}) \text{ (figure 449)}
\]

\[
\text{COD} = 158.88 - 1178.97x + 4231.3x^{2} - 6301.69x^{3} + 3297.3x^{4} \text{ (figure 450)}
\]

\[
\text{Hardness} = 170.62 * 1.468^{(1/x)} * x^{1.383} \text{ (figure 451)}
\]

\[
\text{Calcium} = 0.503 + 84.905x + 0.944/x^{2} \text{ (figure 452)}
\]

\[
\text{Magnesium} = (16.315 - 20.275x)/(1 - 1.853x + 0.759x^{2}) \text{ (figure 453)}
\]

\[
\text{Chlorophyll a} = 1/(1799.34 + 3423.09* \ln(x)) \text{ (figure 454)}
\]

\[
\text{Chlorophyll b} = (-4.6561195e+008 + 1.7641e+009x)/(1 - 1.3513e+010x + 6.6848e+010x^{2})(\text{figure 455})
\]

\[
\text{Chlorophyll c} = 1/(15178.9x - 7856.4) \text{ (figure 456)}
\]
Chlorides

Monthly variations in the chlorides of the sediments are presented in figure 457. The minimum chlorides level of 7.1 mg/100g was observed in station IV in July-03. The maximum level was observed in station II and III (21.3 mg/100g) during July-02. Analysis of variance reveals that there is no significant variation in the chlorides of the five stations (P>0.01). Comparison of the mean values reveals that the chlorides of the station V sediments are far higher than that of the other stations (table 95). The gradation in the chlorides of the sediments is

Station V > station I > station IV > station III > station II

The sediment chlorides is found to have significant relationship (table 96) with water parameters pH (r=0.8493:polynomial fit), acidity (r=0.6968:vapor pressure model), alkalinity PA (r=0.5964:polynomial fit), total alkalinity (r=0.8513: sinusoidal fit), carbonates (r=0.5964: sinusoidal fit), bicarbonates (r=0.8244: sinusoidal fit), chlorides (r=0.6119: polynomial fit), ammonia (r=0.8543:reciprocal logarithm fit), hardness (r=0.8246: polynomial fit), calcium (r=0.7790: polynomial fit), magnesium (r=0.7998: sinusoidal fit), chlorophyll a (r=0.7153:reciprocal logarithm fit), chlorophyll b (r=0.6922: rational function) and chlorophyll c (r=0.6046:reciprocal logarithm fit).

The relationships can be represented as follows

pH = 11.006-0.869x+0.063x^2-0.001x^3 (figure 458)
Acidity = \exp(36.658 - 104.22/x - 10.717\ln(x)) \text{(figure 459)}

Alkalinity PA = 410.67 - 118.14x + 12.461x^2 - 0.561x^3 + 0.009x^4 \text{(figure 460)}

Aalkalinity TA = 276.75 + 80.565\cos(0.262x + 0.325) \text{(figure 461)}

Carbonates = 821.34 - 236.29x + 24.923x^2 - 1.122x^3 + 0.018x^4 \text{(figure 462)}

Bicarbonates = 239.61 + 61.686\cos(0.252x + 0.406) \text{(figure 463)}

Chlorides = 453.50 - 95.688x + 7.619x^2 - 0.184x^3 \text{(figure 464)}

Ammonia = \frac{1}{(-662997.3 + 241217.5\ln(x))} \text{(figure 465)}

Hardness = 659.86 - 124.42x + 9.010x^2 - 0.192x^3 \text{(figure 466)}

Calcium = 222.86 - 43.034x + 3.168x^2 - 0.068x^3 \text{(figure 467)}

Magnesium = 29.330 + 8.793\cos(0.311x - 0.163) \text{(figure 468)}

Chlorophyll a = \frac{1}{(-787751.6 + 286614.1\ln(x))} \text{(figure 469)}

Chlorophyll b = \frac{(144926.1 - 17513.8x)}{(1 + 187564.1x - 25350.7x^2)} \text{(figure 470)}

Chlorophyll c = \frac{1}{(-625914.4 + 227727.3\ln(x))} \text{(figure 471)}

**Calcium**

The results presented in the tables 75 - 79 and figure 472 reveal the minimum calcium of 30.16 mg/100g (July-03) and the maximum of 217.22 mg/100g were recorded in station IV (June-03). Analysis of variance reveals that the difference in calcium among the different stations (table 97) is not significant.
(P>0.01). An examination of the mean values reveals that the station IV has high range of calcium in the sediments during the study. The gradation in the calcium distribution in sediments is as follows

Station IV > station I > station V > station III > station II

The sediment calcium is found to have significant relationship (table 98) with water parameters pH (r=0.8479:polynomial fit), acidity (r=0.7015:vaport pressure model), alkalinity PA(r=0.5937:heat capacity model), total alkalinity (r=0.8469: sinusoidal fit), carbonates (r=0.5937:heat capacity model), bicarbonates (r=0.8068: sinusoidal fit), hardness (r=0.8178:polynomial fit), calcium (r=0.7771: polynomial fit), magnesium (r=0.7926:polynomial fit), chlorophyll a (r=0.7575: reciprocal logarithm fit), chlorophyll b (r=0.6624:exponential association) and chlorophyll c (r=0.6296:reciprocal model).

The relationships are expressed as follows

\[ \text{pH} = 8.784-0.060x+0.0008x^2-4.0667545e-006x^3+6.9499451e-009x^4 \] (figure 473)

\[ \text{Acidity} = \exp(21.582-203.26/x-4.0771\ln(x)) \] (figure 474)

\[ \text{Alkalinity PA} = -7.229+0.206x+16089.7/x^2 \] (figure 475)

\[ \text{Alkalinity TA} = 285.99+84.042*\cos(0.023x+1.689) \] (figure 476)

\[ \text{Carbonates} = -14.599+0.412x+32179.5/x^2 \] (figure 477)

\[ \text{Bicarbonates} = 245.11+62.329*\cos(0.022x+1.690) \] (figure 478)
Hardness = 317.93-8.024x+0.111x^2-0.00056985165x^3+1.0176571e-006x^4 (figure 479)

Calcium = 96.368-2.385x+0.033x^2-0.0001x^3+2.8872842e-007x^4 (figure 480)

Magnesium = 53.474-1.353x+0.018x'^2-9.666434e-005x'^3+1.7580972e-007x^M (figure 481)

Chlorophyll a = 1/(-1962.9+426.06*ln(x)) (figure 482)

Chlorophyll b = -110.71(-0.0003-exp(-0.191x)) (figure 483)

Chlorophyll c = 1/(0.665x-26.673) (figure 484)

**Magnesium**

A perusal of the tables 75 to 79 reveal a minimum magnesium level of 24.5 mg/100g in station IV during July-03 and a maximum of 164.45 mg/100g in station II and III during July-02 (figure 485). Analysis of variance reveals that the difference in the sediment magnesium (table 99) of the five stations is not significant (P>0.01). Comparison of the mean values reveals that the station V is having the highest magnesium levels in the sediments of the different stations studied. The gradation in distribution of sediment magnesium is as follows

Station V > station IV > station I > station III > station II

The sediment magnesium is found to have significant relationship (table 100) with water parameters like pH \(r=0.8402:\text{heat capacity model}\), acidity \(r=0.7183:\text{vapor pressure model}\), alkalinity PA\(r=0.6147:\text{heat capacity model}\), total alkalinity \(r=0.8511:\text{Hoerl model}\), carbonates \(r=0.6147:\text{heat capacity model}\), bicarbonates \(r=0.8071:\text{quadratic fit}\), hardness \(r=0.8067:\text{vapor pressure model}\).
model), calcium ($r=0.7732$: vapor pressure model), magnesium ($r=0.7769$: vapor pressure model), iron ($r=0.5048$: logistic model), LCSI ($r=0.5057$: polynomial fit), chlorophyll a ($r=0.7568$: reciprocal logarithm fit), chlorophyll b ($r=0.6756$: rational function) and chlorophyll c ($r=0.7573$: reciprocal logarithm fit).

The relationships are as presented as follows

\[
\text{pH} = 6.632 + 0.010x + 450.60/x^2 \text{ (figure 486)}
\]

\[
\text{Acidity} = \exp(20.739 - 183.16/x - 3.971\ln(x)) \text{ (figure 487)}
\]

\[
\text{Alkalinity PA} = -7.912 + 0.232x + 12267.09/x^2 \text{ (figure 488)}
\]

\[
\text{Alkalinity TA} = 916.87*(1.010^x)*(x^{-0.010}) \text{ (figure 489)}
\]

\[
\text{Carbonates} = -15.824 + 0.464x + 24534.1/x^2 \text{ (figure 490)}
\]

\[
\text{Bicarbonates} = 208.10 - 0.948x + 0.009x^2 \text{ (figure 491)}
\]

\[
\text{Hardness} = \exp(-0.672 + 51.177/x + 1.151\ln(x)) \text{ (figure 492)}
\]

\[
\text{Calcium} = \exp(-1.638 + 48.864/x + 1.137\ln(x)) \text{ (figure 493)}
\]

\[
\text{Magnesium} = \exp(-2.470 + 52.268/x + 1.142\ln(x)) \text{ (figure 494)}
\]

\[
\text{Iron} = 1.007/(1-46563.1*\exp(-0.299x)) \text{ (figure 495)}
\]

\[
\text{LCSI} = -0.211 + 0.008x - 0.0002x^2 + 2.0170137e-0.006x^3 - 5.6719828e-0.009x^4 \text{ (figure 496)}
\]

\[
\text{Chlorophyll a} = 1/(-4189.2 + 899.23*\ln(x)) \text{ (figure 497)}
\]

\[
\text{Chlorophyll b} = (-4622129 + 124409.07x)/(1-980296.8x + 33190.7x^2) \text{ (figure 498)}
\]
Chlorophyll c = $1/(-2121814.7 + 449089.3 \ln(x))$ (figure 499)

**Nitrogen**

A perusal of the tables 75 to 79 and figure 500 reveal that a minimum soil nitrogen of 0.05 % in station IV (April-03) and a maximum of 4.97 % (July-02 and July-03) were recorded in station I. Analysis of variance reveals that the difference in nitrogen among the different stations (table 101) is not significant ($P>0.01$) at 10% levels. An examination of the mean values reveals that the station III has high range of nitrogen in the sediments in all the months of study of the five stations. The gradation in nitrogen is as follows

Station III > station I > station V > station IV > station II

The sediment nitrogen is found to have significant relationship (table 100) with water parameters like nitrates ($r=0.7546$: quadratic fit), iron ($r=0.5456$: MMF model), chlorophyll a ($r=0.5051$: reciprocal quadratic), chlorophyll b ($r=0.6458$: reciprocal quadratic) and chlorophyll c ($r=0.7398$: reciprocal logarithm fit).

The relationships can be expressed as follows

\[
\text{Nitrates} = 1.991 - 1.165x + 0.353x^2 \quad \text{(figure 501)}
\]

\[
\text{Iron} = \frac{(0.782\times183873.6 + 3.351\times^8.546)/(183873.6 + x^8.546)}{(183873.6 + x^8.546)} \quad \text{(figure 502)}
\]

\[
\text{Chlorophyll a} = 1/(-17.832 + 83.710x - 15.179x^2) \quad \text{(figure 503)}
\]
Chlorophyll b = 1/(-1509.9+2507.1x-667.66x^2) (figure 504)

Chlorophyll c = 1/(-12.216+209.62*ln(x)) (figure 505)

**Organic carbon**

Variations in the carbon of the sediments are presented in figure 506. The minimum carbon level of 0.071 % was observed in station I in September-02. The maximum level was observed in station V (7.22 %) during May-03. Analysis of variance reveals that there is variation in the carbon content of the five stations is not significant (P>0.01). Comparison of the mean values reveals that the carbon of station V sediments is far higher than that of the other stations (table 103). The variation in the carbon content of the sediments is

Station V > station II > station I > station III > station IV

The sediment organic carbon is found to have significant relationship (table 100) with water parameters phosphates (r=0.5169:MMF model), GPP (r=0.7381:quadratic fit), NPP (r=0.7025:rational function), CR (r=0.7662:MMF model), chlorophyll b (r=0.5591: rational function) and chlorophyll c (r=0.7058:reciprocal model).

The relationship is represented as follows

\[ \text{Phosphates} = \frac{(0.255*-2.9479416e+010+0.547*x^{2.257})}{(-2.9479416e+010+x^{2.257})} \] (figure 507)

\[ \text{GPP} = 2048.5-430.06x+173.84x^2 \] (figure 508)

\[ \text{NPP} = \frac{(1172.7-565.16x)}{(1-0.572x+0.049x^2)} \] (figure 509)
CR = \((924.51*5.8818e+008+53332.7*x'^{23.496})/(5.8818e+008+x'^{23.496})\) (figure 510)

Chlorophyll b = \((-0.004+0.077x)/(1-4.391x+5.555x^2)\) (figure 511)

Chlorophyll c = \(1/(-1248.7x+1554.5)\) (figure 512)

**Organic matter**

Variations in the organic matter of the sediments are presented in figure 513. The minimum organic matter of 0.369% was recorded in August-02 and maximum level was observed (12.44%) during May-03 in station V. Analysis of variance reveals that there is no significant variation in the organic matter of the five stations (P>0.01). Comparison of the mean values reveals that the organic matter of the station V sediments (3.027 %) is far higher than that of the other stations studied (table 105). The variation in organic matter of the sediments is

Station V > station II > station I > station III > station IV

The sediment organic matter is found to have significant relationship (table 100) with water parameters ammonia \((r=0.5875:\text{reciprocal logarithm fit})\), phosphates \((r=0.5155:\text{reciprocal logarithm fit})\), GPP \((r=0.8254:\text{polynomial fit})\), NPP \((r=0.8630: \text{rational function})\), CR \((r=0.9018:\text{polynomial fit})\), chlorophyll a \((r=0.7770: \text{saturation growth rate model})\), chlorophyll b \((r=0.5940: \text{reciprocal logarithm fit})\) and chlorophyll c \((r=0.6660: \text{reciprocal model})\).

The relationships can be expressed as

Ammonia = \(1/(2.663+25.252*\ln(x))\) (figure 514)
Phosphates = $1/(6.633 - 3.376 \ln(x))$ (figure 515)

GPP = $1829.04 - 302.97x + 306.28x^2 - 80.246x^3 + 4.963x^4$ (figure 516)

NPP = $(1032.6 - 266.53x)/(1 - 0.329x + 0.018x^2)$ (figure 517)

CR = $714.11 + 299.95x - 105.55x^2 + 10.962x^3$ (figure 518)

Chlorophyll a = $0.004x/(-0.208 + x)$ (figure 519)

Chlorophyll b = $1/(37.416 + 317.51 \ln(x))$ (figure 520)

Chlorophyll c = $1/(-24.997x + 102.08)$ (figure 521)

**Influence of various factors on NPP**

General model relating all of the water quality and sediment characteristics is proposed to find a general pattern for reservoir habitats and the contribution of various factor to net primary productivity. This relationship is found to have highly significant correlation ($r = 0.9813$). The relationships can be expressed as

$$NPP = 3793 + 38.8 \ X1 - 56.5 \ X2 - 1013 \ X3 - 1.21 \ X4 + 1.17 \ X5 + 40 \ X6 - 0.013 \ X7 + 2.82 \ X8 + 9.9 \ X10 + 4.05 \ X11 + 1.78 \ X12 - 1.91 \ X15 + 144 \ X16 + 42.0 \ X17 + 268 \ X18 + 0.23 \ X19 - 9.0 \ X20 - 8.0 \ X21 - 2.97 \ X22 + 7.9 \ X23 - 4.5 \ X24 - 29 \ X25 - 45.3 \ X26 + 0.828 \ X27 - 0.065 \ X29 - 729 \ X30 - 1132 \ X31 - 131 \ X32 - 83 \ X33 + 91 \ X34 + 0.452 \ X35 + 18.4 \ X36 - 110 \ X37 + 1137 \ X38 - 1.04 \ X40 - 2540 \ X41 - 106 \ X42 + 111 \ X43 + 1.81 \ X44 - 6.03 \ X45 - 29.6 \ X46 - 94 \ X47 + 41.9 \ X48$
Where

\[ X_1 = \text{Air temperature} \]
\[ X_2 = \text{Water temperature} \]
\[ X_3 = \text{pH} \]
\[ X_4 = \text{Conductivity} \]
\[ X_5 = \text{Transparency} \]
\[ X_6 = \text{Dissolved oxygen} \]
\[ X_7 = \text{Total solids} \]
\[ X_8 = \text{Total dissolved solids} \]
\[ X_9 = \text{Total suspended solids} \]
\[ X_{10} = \text{Free carbon di oxide} \]
\[ X_{11} = \text{Acidity} \]
\[ X_{12} = \text{Alkalinity PA} \]
\[ X_{13} = \text{Alkalinity TA} \]
\[ X_{14} = \text{Carbonates} \]
\[ X_{15} = \text{Bicarbonates} \]
\[ X_{16} = \text{Chlorides} \]
\[ X_{17} = \text{Ammonia} \]
\[ X_{18} = \text{Nitrates} \]
\[ X_{19} = \text{Phosphate} \]
\[ X_{20} = \text{Sulphate} \]
\[ X_{21} = \text{Silicate} \]
\[ X_{22} = \text{COD} \]
\[ X_{23} = \text{Hardness} \]
\[ X_{24} = \text{Calcium} \]
\[ X_{25} = \text{Magnesium} \]
\[ X_{26} = \text{Iron} \]
\[ X_{27} = \text{GPP} \]
\[ X_{28} = \text{NPP} \]
\[ X_{29} = \text{CR} \]
\[ X_{30} = \text{LCSI} \]
\[ X_{31} = \text{Chlorophyll a} \]
\[ X_{32} = \text{Chlorophyll b} \]
\[ X_{33} = \text{Chlorophyll c} \]
\[ X_{34} = \text{Sediment pH} \]
\[ X_{35} = \text{Sediment conductivity} \]
\[ X_{36} = \text{Sediment alkalinity} \]
\[ X_{37} = \text{Sediment acidity} \]
\[ X_{38} = \text{Sediment bicarbonates} \]
\[ X_{39} = \text{Sediment available phosphorus} \]
\[ X_{40} = \text{Sediment sulphate} \]
\[ X_{41} = \text{Sediment chloride} \]
\[ X_{42} = \text{Sediment calcium} \]
\[ X_{43} = \text{Sediment magnesium} \]
\[ X_{44} = \text{Sediment nitrogen} \]
\[ X_{45} = \text{Sediment organic carbon} \]
\[ X_{46} = \text{Sediment organic matter} \]
Plankton Studies

Phytoplankton

Station I

Seasonal variation of plankton diversity of Lower Anaicut reservoir station-I is given in table 107. The total count of plankton showed monthly variation during the present investigation. In general, July 02-Sheptember 02 and February 03 to July 03 were the periods of higher counts. A decrease in the total plankton population during October 02 to January 03 can be discerned from the data.

In station I the minimum plankton population was recorded in December 02 and it was high in June 03. The percent composition of the various groups of phytoplankton revealed that the station I was mainly represented by Chlorophyceae (46.27%) followed by Bacillariophyceae (38.88%), Myxophyceae (12.22%) and Xanthophyceae (2.62%) (figure 532). The Chlorophyceae dominated in the samples 72 nos/l during July-03 Chlorophyceae comprised chiefly of Spirogyra formed the major component. The other species that represented the group were Chlorella sp., Pandorina morum, Ankistrodesmus sp., Desmidium sp., Eudorina sp., Chlorococcum sp., Volvox sp., Microspora sp., Chlamydomonas sp., Ulothrix sp., Antinastrum sp., and Pediastrum sp. in the order of their abundance (table 112).
Bacillariophyceae was second order of dominance with a maximum number of 62 nos./l was observed in June 03 (figure 523) and a minimum number of 20 nos./l was observed in October 02. The most common algae were *Navicula rodiosa*, *Pinnularia sp.*, *Amphohora sp.*, *Euglena sp.*, *Tribonema* and *Flagillaria sp.* in the order of their abundance (table 112).

Myxophyceae was the third in the order of dominance with a maximum of 17 nos./l was observed in April 03 (figure 524). The minimum of 9 nos./l was observed in November 02 and December 02 contributed were *Spirulina sp.*, *Nostoc sp.*, *Anabeaena sp.*, *Oscillatoria* and *Phormodium uncinatum* (table 112).

Xanthophyceae was least represented (3%) with only one species (figure 525). *Tribonema sp.* was the sole representative of this group and was not found in most of the months at station I. Peak of occurrence was observed during April 03 to July 03.

Station II

The monthly variation of phytoplankton of Lower Anaicut reservoir station II is presented in table 108. The total count of plankton showed a significant monthly variation during the present investigation. In general, July 02 September 02 and February 03 to July 03 were the periods of higher counts. A decrease in the counts during October 02 to January 03 can be discerned from the data.
In station II phytoplankton population was least in December 02. The maximum value was recorded June 03. The percent composition of the various groups of phytoplankton revealed that the station II was mainly represented by Chlorophyceae (52.06%) followed by Bacillariophyceae (34.07%), Myxophyceae (12.73%) and Xanthophyceae (1.14%) (figure 533). The Chlorophyceae dominated in the samples 75 nos/l during April 03 (figure 522) Chlorophyceae comprised chiefly of Spirogyra formed the major component in very all the samples. The other species that represented the group were Chlorella sp., Pandorina morum, Ankistrodesmus sp., Desmidium sp., Eudorina sp., Chlorococcum sp., Volvox sp., Microspora sp., Chlamydomonas sp., Ulothrix sp., Antinastrum sp., and Pediastrum sp. in the order of their abundance (table 112).

Bacillariophyceae was second in order of dominance with a maximum number of 60 nos/l was observed in June 03 and a minimum number of 12 nos/l was observed in December 02 (figure 523). The most common algae were Navicula rodiosa, Pinnularia sp., Amphohora sp., Euglena sp., Tribonema and Flagillaria sp. in the order of their abundance (table 112).

Myxophyceae was the third in the order of dominance with a maximum of 19 nos/l was observed in June 03 (figure 524). The minimum of 8 nos/l was observed in October 02 and November 02 contributed mainly by Spirulina sp., Nostoc sp., Anabeaena sp., Oscillatoria and Phormodium uncinatum.
Only one species of Xanthophyceae was found (1.14%) in the total number of phytoplankton. *Tribonema sp.* was the sole representative of this group and was not found in most of the months at station I (figure 525) and peaks were observed during April 03 to July 03 (table 112).

**Station III**

The monthly variation of plankton collected from station III of Lower Anaicut reservoir is given in table 109. The total count of phytoplankton showed a significant monthly variation during the present investigation. In general, July 02 September 02 and February 03 to July 03 were the periods of higher counts. A decrease in the counts during October 02 to January 03 can be discerned from the data.

In station III the total number of phytoplankton was recorded low in December 02. The maximum value was recorded in September 02. The percent composition of the various groups of phytoplankton (table 109) revealed that the station III was mainly represented by Chlorophyceae (51.26%) followed by Bacillariophyceae (33.80%), Myxophyceae (13.82%) and Xanthophyceae (1.12%) (figure 534). The Chlorophyceae dominated in the samples 85 nos/l during September 02 (figure 522). Chlorophyceae comprised chiefly of *Spirogyra* which formed the major component in all the samples. The other species that represented the group were *Chlorella sp.*, *Pandorina morum*, *Ankistrodesmus sp.*, *Desmidium sp.*, *Eudorina sp.*, *Chlorococcum sp.*, *Volvox sp.*, *Microspora sp.*, *Chlamydomonas*
sp., Ulothrix sp., Antinastrum sp., and Pediastrum sp. in the order of their abundance (table 112).

Bacillariophyceae was second in order of dominance with a maximum number of 71 nos/l was observed in June 03 and a minimum number of 18 nos/l was observed in December 02 (figure 523). The most common algae found were Navicula rodiosa, Pinnularia sp., Amphohora sp., Euglena sp., Tribonema and Flagillaria sp. in the order of their abundance (table 112).

Myxophyceae was the third in the order of dominance with a maximum of 26 nos/l was observed in June 03 (figure 524). The minimum of 8 nos/l was observed in December 02 contributed mainly by Spirulina sp., Nostoc sp., Anabaeana sp., Oscillatoria and Phormodium uncinatum.

Xanthophyceae was represented by only one species (1.12%) of the total number of phytoplankton. Tribonema sp. was the sole representative of this group and was not found in most of the months at station III. Peak of occurrence was observed during April 03 to July 03 (figure 525).

Station IV

The monthly variation of phytoplankton collected from Lower Anaicut reservoir station IV is given in table 110. The total count of phytoplankton showed a significant monthly variation during the present investigation. In general, July 02 to September 02 and February 03 to July 03 were the periods of higher counts. A
decrease in the counts during October 02 to January 03 can be discerned from the data.

In station IV the total number of plankton minimum value was recorded in November 02. The maximum value was recorded June 03. The percent composition of the various groups of phytoplankton revealed that the station IV was mainly represented by Chlorophyceae (52.45%) followed by Bacillariophyceae (29.56%), Myxophyceae (16.63%) and Xanthophyceae (1.27%) (figure 535). The Chlorophyceae dominated in the samples (70 nos/l) during June 03 (figure 522). Chlorophyceae comprised chiefly of Spirogyra and formed the major component. The other species that represented the group were Chlorella sp., Pandorina morum, Ankistrodesmus sp., Desmidium sp., Eudorina sp., Chlorococcum sp., Volvox sp., Microspora sp., Chlamydomonas sp., Ulothrix sp., Antinastrum sp., and Pediastrum sp. in the order of their abundance (table 112).

Bacillariophyceae was second in the order of dominance with a maximum number of 36 nos/l was observed in June 03 and a minimum number of 14 nos./l was observed in November 02 (figure 523). The most common algae were Navicula radios, Pinnularia sp., Amphohora sp., Euglena sp., Tribonema and Flagillaria sp. in the order of their abundance (table 112).

Myxophyceae was the third in the order of dominance with a maximum of 30 nos/l was observed in June 03 (figure 524). The minimum of 5 nos./l was
observed in October 02 which include *Spirulina sp.*, *Nostoc sp.*, *Anabeaena sp.*, *Oscillatoria* and *Phormodium uncinatum*.

Xanthophyceae formed only one species (1.27%) of the total number of phytoplankton. *Tribonema sp.* was the sole representative of this group and was not found in most of the months at station IV. Peaks were observed during April 03 to July 03 (figure 525).

**Station V**

The monthly variation of phytoplankton collected from Lower Anaicut reservoir station V is given in table 111. The total count of phytoplankton showed a significant monthly variation during the present investigation. In general, July 02 September 02 and February 03 to July 03 were the periods of higher counts. A decrease in the counts during October 02 to January 03 can be discerned from the data.

In station V the total number of phytoplankton minimum value was low in November 02. The maximum value was recorded June 03. The percentage composition of the various groups of phytoplankton revealed that the station V was mainly represented by Chlorophyceae (48.82%) followed by Bacillariophyceae (33.45%), Myxophyceae (16.27%) and Xanthophyceae (1.45%) (figure 536). The Chlorophyceae dominated in the samples (72 nos/l) during June 03 (figure 522). Chlorophyceae comprised chiefly of *Spirogyra* that formed the
major component in almost all the samples. The other species that represented the group were *Chlorella sp.*, *Pandorina morum*, *Ankistrodesmus sp.*, *Desmidium sp.*, *Eudorina sp.*, *Chlorococcum sp.*, *Volvox sp.*, *Microspora sp.*, *Chlamydomonas sp.*, *Ulothrix sp.*, *Antinastrum sp.*, and *Pediastrum sp.* in the order of their abundance (table 112).

Bacillariophyceae was second in order of dominance with a maximum number of 62 nos./l in June 03 and a minimum number of 25 nos./l in October 02 (figure 523). The most common algae were *Navicula radiosa*, *Pinnularia sp.*, *Amphohora sp.*, *Euglena sp.*, *Tribonema* and *Flagillaria sp.* in the order of their abundance (table 112).

Myxophyceae was the third in the order of dominance with a maximum of 34 nos./l was observed in June 03 (524). The minimum of 10 nos./l was observed in October 02 contributed mainly by *Spirulina sp.*, *Nostoc sp.*, *Anabeaena sp.*, *Oscillatoria* and *Phormodium uncinatum*.

Xanthophyceae formed only one species (1.45%) of the total number of phytoplankton. *Tribonema sp.* was the sole representative of this group and was not found in most of the months at station V was observed during April 03 to July 03 (figure 525).
Zooplankton

Distinct monthly variations in the abundance and distribution of various zooplanktonic forms observed in the station 1 to 5 during the present investigation is shown in the tables 107 to 111. Six groups of zooplankton viz copepods, cladocerans, rotifers, insect larvae, molluscan larvae and protozoans constituted zooplankton population of the reservoir during the present investigation.

Station I

The overall composition of zooplankton in station I is presented in figure 537. The diversity of zooplankton and species composition of station I is presented in table 113. The percentage composition of different groups of zooplankton is presented in table 107. Rotifers were the most dominant forms in the station I forming 29.47% of the total zooplanktonic fauna. Rotifers were found in maximum numbers during the months of June 03 (24 nos/l) and in minimum numbers during the month of October 02 (5 nos/l) (figure 527). The main genera were Brachionus and Lepadella and they were seen throughout the study (table 107).

Cladocerans ranked second in the order of dominance (28.18%). They constituted the peak in the month of June 03 and August 02 (22 nos/l) (figure 528), and found in minimum numbers during the months of December 02 (4 nos/l).
Major species under this group were *Daphnia, Monia, Chydorus, Cypris, Calanus, Mysis* and *Nauplius* in the order of their abundance (figure 107).

Copepods ranked third in the order of dominance 22.75% among the planktonic fauna (table 107). Copepods were found in maximum numbers (18 nos/l) during the month of April 03 and in minimum numbers (5 nos/l) (figure 529) during the months of November 02 and December 02. The main genera were *Cyclops* and *Diaptomus* and they were seen throughout the study. They were mainly represented by *Mesocyclops* followed by *Heliodiaptomus viduus* and *Neodiaptomus physalipus*.

Protozoan ranked fourth in the order of dominance and constituted 9.30% of the total planktonic fauna (table 107). Protozoans were found maximum numbers (9 nos/l) during September 02 and minimum numbers in the months of December 02 (figure 526). The main species found were *Amoeba, Vorticella* and *Paramecium*.

Insects larva comprised of *Culex* sp., and *Anopheles* sp. which showed its occurrence during September 02 to December 02 but in all the other months they were completely absent (figure 530). Nymphs of May fly and Stone fly larva showed its occurrence during July 02 to September 02 and January 03 to July 03. The total annual contribution was 7.3%.
Molluscan larva comprised of Glochidium and Veliger showed its occurrence during the months of July 02, August 02, September 02 and February 03 to July 03 (figure 531). The total annual contribution was 3.00%.

Station II

The overall composition of zooplankton in station II is presented in figure 538. The diversity of zooplankton and species composition of station II is presented in table 113. The percentage composition of different groups of zooplankton is presented in table 108. Rotifers were the most dominant forms in the station II forming 27.70% of the total zooplankton. Rotifers were found in maximum numbers during the month of July 02 (20 nos/l) and the minimum numbers during the month of November 02 (7 nos/l) (figure 527). The main genera were *Brachionus* and *Lepadella* and they were seen throughout the study.

Cladocerans ranked second in the order of dominance (27.11%). They constituted the peak in the month of June 03 and August 02 (24 nos/l) and found in minimum numbers during the months of October 02 and December 02 (6 nos/l). Major species under this group were *Daphnia, Monia, Chydorus, Cypris, Calanus, Mysis* and Nauplius in the order of their abundance.

Copepods ranked third in the order of dominance and constituted 23.18% of the total zooplankton (table 108). Copepods were found in maximum numbers (18 nos/l) during the month of June 03 and the minimum numbers (1 nos/l) (figure
529) during the month of July 02. The main genera were *Cyclops* and *Diaptomus* and they were seen throughout the study. They were mainly represented by *Mesocyclops* followed by *Heliodiaptomus vidius* and *Neodiaptomus physalipus* (table 113).

Protozoan ranked fourth in the order of dominance and constituted 9.68 % of the total zooplankton. Protozoans were found maximum numbers (6 nos/l) during September 02 and minimum numbers in the month of January 03, February 03 and May 03. The main species found were *Amoeba, Vorticella* and *Paramecium*.

Insects larva comprised of *Culex sp., Anopheles* sp. showed its occurrence during September 02 to December 02 but in all the other months they were completely absent (figure 530). Nymphs of May fly and Stone fly larva showed its occurrence during July 02 to September 02 and January 03 to July 03. The total annual contribution was 9.68 %.

Molluscan larva comprised of Glochidium and Veliger showed its occurrence during the months of July 02, August 02, September 02 and February 03 to July 03 (figure 531). The total annual contribution was 3.79 %.

**Station III**

The overall composition of zooplankton in station III is presented in figure 539. The diversity of zooplankton and species composition of station III is
presented in table 113. The percentage composition of different groups of zooplankton is presented in table 109. Rotifers were the most dominant forms in station III forming 29.97% of the total zooplankton (table 109). Rotifers were found in maximum numbers during the month of September 02 (17 nos/l) and in minimum numbers during the month of November 02 and December 02 (10 nos/l). The main genera were *Brachionus* and *Lepadella* and they were seen throughout the study.

Cladocerans ranked second in the order of dominance (26.12%). They constituted the peak in the month of June 03 (17 nos/l) (figure 528), minimum numbers during the month of November 02 (7 nos/l). Major species under this group were *Daphnia*, *Monia*, *Chydorus*, *Cypris*, *Calanus*, *Mysis* and *Nauplius* in the order of their abundance.

Copepods ranked third in the order of dominance 23.92% of the total zooplankton (table 109). Copepods were found in maximum numbers (17 nos/l) during the month of June 03 and the minimum numbers (4 nos/l) (figure 529) during the month of December 02. The main genera were *Cyclops* and *Diaptomus* which were seen throughout the study. They were mainly represented by *Mesocyclops* followed by *Heliodiaptomus viduus* and *Neodiaptomus physalis*.

Protozoan ranked fourth in the order of dominance and constituted 9.94% of the total zooplankton. Protozoans were found maximum numbers (8 nos/l) during June 03 and minimum numbers (2 nos/l) in the months of October 02 and
November 02 (figure 526). The main species found were *Amoeba*, *Vorticella* and *Paramecium*.

Insects larva comprised of *Culex* sp., *Anopheles* sp. showed its occurrence during September 02 to December 02 but in all the other months they were completely absent. Nymphs of May fly and Stone fly larva showed its occurrence during July 02 to September 02 and January 03 to July 03 (figure 530). The total annual contribution was 8.01%.

Molluscan larva comprised of Glochidium and Veliger showed its occurrence during the months of July 02, August 02, September 02 and February 03 to July 03 (figure 531). The total annual contribution was 2.24%.

**Station IV**

The overall composition of zooplankton in station IV is presented in figure 540. The diversity of zooplankton and species composition of station IV is presented in table 113. The percentage composition of different groups of zooplankton is presented in table 110. Cladocerans were the most dominant in the station IV (34.90%). They constituted the peak in the month of June 03 and August 02 (22 nos/l) (figure 528), the minimum numbers during the months of December 02 (4 nos/l), major species under this group were *Daphnia, Monia, Chydorus, Cypris, Calanus, Mysis* and *Nauplius* in the order of their abundance.
Rotifers ranked second in the order of dominance forming 25.78% of the total zooplankton (table 110). Rotifers were found in maximum numbers during the months of June 03 (24 nos/l) and in minimum numbers during the month of October 02 (5 nos/l) (figure 527). The main genera were *Brachionus* and *Lepadella* and they were seen throughout the study.

Copepods ranked third in the order of dominance (23.70%) of the total zooplankton (table 110). Copepods were found in maximum numbers (18 nos/l) during the month of April 03 and the minimum numbers (5 nos/l) (figure 529) during the months of November 02 and December 02. The main genera were *Cyclops* and *Diaptomus* and they were seen throughout the study. They were mainly represented by *Mesocyclops* followed by *Heliodiaptomus viduus* and *Neodiaptomus physalisus*.

Molluscan larva comprised of Glochidium and Veliger showed its occurrence during the months of July 02, August 02, September 02 and February 03 to July 03 (figure 531). The total annual contribution was 5.31%.

Protozoan ranked fourth in the order of dominance constituted about 5.21% of the total zooplankton (table 110). Protozoans were found maximum numbers 9 nos/l September 02 and minimum numbers in the months of December 02 (figure 526). The main species were found *Amoeba, Vorticella* and *Paramecium*.
Insects larva comprised of *Culex* sp., *Anopheles* sp. showed its occurrence during September 02 to December 02 but in all the other months they were completely absent. Nymphs of May fly and Stone fly larva had its occurrence during July 02 to September 02 and January 03 to July 03 (figure 530). The total annual contribution was 4.69%.

**Station V**

The overall composition of zooplankton in station V is presented in figure 541. The diversity of zooplankton and species composition of station V is presented in table 113. The percentage composition of different groups of zooplankton is presented in table 111. Cladocerans were most dominant in station V (28.24%). They constituted the peak in the month of June 03 and August 02 (22 nos/l), the minimum numbers during the months of December 02 (4 nos/l) (figure 528), major species under this group were *Daphnia, Monia, Chydorus, Cypris, Calanus, Mysis* and *Nauplius* in the order of their abundance.

Copepods ranked second in the order of dominance 25.90% among the total planktonic fauna (table 111). Copepods were found in maximum numbers (18 nos/l) during the month of April 03 and the minimum numbers (5 nos/l) during the months of November 02 and December 02 (figure 529). The main genera were *Cyclops* and *Diaptomus* and they were seen throughout the study. They were mainly represented by *Mesocyclops* followed by *Heliodiaptomus viduus* and *Neodiaiptomus physalipus*. 
Rotifers ranked third in the order of dominance forming 21.76% of the total zooplankton (table 111). Rotifers were found in maximum numbers during the months of June 03 (24 nos/l) and the minimum numbers during the month of October 02 (5 nos/l) (figure 527). The main genera were Brachionus and Lepadella and they were seen throughout the study.

Protozoan ranked fourth in the order of dominance and 12.23% of the total planktonic fauna (table 111). Protozoans were found maximum numbers 9 nos/l September 02 and minimum numbers in the months of December 02 (figures 526). The main species were found Amoeba, Vorticella and Paramecium.

Insects larva comprised of Culex sp., Anopheles sp. showed its occurrence during September 02 to December 02 but in all the other months they were completely absent. Nymphs of May fly and Stone fly larva showed its occurrence during July 02 to September 02 and January 03 to July 03 (figure 530). The total annual contribution was 7.37%.

Molluscan larva comprised of Glochidium and Veliger showed its occurrence during the months of July 02, August 02, September 02 and February 03 to July 03 (figure 531). The total annual contribution was 4.50%.

Floral and Faunal Diversity

Lower Anaicut reservoir's all stations had four types of hydrophytes that includes 5 species of floating plants, 5 species of emergent weed, 4 species of
submerged plants and 4 species of marginal plants were found to cover most of selected station during most of the times of the study period is presented in table 114. Other fauna results were presented in table 115.

**Fish Faunal Diversity**

**Fish production**

Monthly fish production from the Lower Anaicut reservoir during the study period is presented in table 117. The total yield 2652 kg/year with a monthly harvesting ranging from 91 kg in September 02 and 505 kg in July 02. Five types of fishes such as prawn, murrels, carp I, carp II and carp III were harvested as yield.

Fish fauna of the Lower Anaicut reservoir was comprised of indigenous and exotic species (table 116). The species of *Catla catla*, *Labeo* spp. *Cirrhinus* spp. and *Ctenopharyngodon idella* among the transplanted carps appeared in all the catches at all stations. The genus *Labeo* and *Cirrhinus* had the maximum species diversity. *Labeo calbasu, Labeo fimbriatus* and *Cirrhinus reba* maintained a dominant position in most of the collections but it dwindled to very negligible numbers during December'02 and January’03. *Puntius sarana, Tinca tinca, Carassius carassius, Hypophthalmichthys molitrix* although common was found only in very low numbers when compared with the other species. A stable population was not established in the case of *Osteoichilus chomassi, Thynnichthys*
sankhol which was brought into the catches during most of the months in low numbers. *Channa striatus* *C. maurilius* and *C. punctatus* were caught in July’02 and September’02. *Anabas testudineus* was commonly caught in the nets and it has become so obliquitious from September’02 to November’02 and in February’03 to May’03. The occurrence of cat fishes of *Notopterus chitala*, *N. notopterus* and *Wallgu attu*, *Mystus seenghala*, *Pangarius pangarius* seemed to be erotic. The occurrence of fresh water prawn *Macrobrachionum rosenbergii* *M. malcomsonii* more numbers were caught in November’02 to July’03, its representation being very low in the other months. *Clarias batrachus* and *Heteropneustes fossilis* and *Osphronemus gourami* were commonly seen in the samples in very low numbers. The only exotic fish *Oreochromis mossambicus* represented the major component in all the catches by virtue of their prolific breeding have dominated the whole reservoir. During January’03 to May’03 few specimens of the predatory fish *Rita rita*, *Pama pama*, *Silonia silondia*, *Clupisoma garua* also appeared in the samples. A large population of weed fishes of *Xenentodon cancila*, *Rasbora daniconius*, *Puntius titco*, *Oxygaster bacaila*, *Chela cochins*, *Barilius barila*, *Ambassis ranga* were caught during July’02 to October’02 its representation being very low in the other months.