V

RESULT AND DISCUSSIONS

TABLE 2 : SEASONAL VARIATION IN THE TEMPERATURE (Temp.) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	22.0 ± 0.55	24.0 ± 0.42	24.5 ± 0.12	25.5 ±1.17	26.0 ± 2.10	28.5 ± 1.10	25.0 ± 1.61	26.8 ± 0.60	27.6 ± 0.32	27.1 ± 0.28	28.2 ± 0.52
B	22.3 ± 0.60	24.0 ± 0.30	24.2 ± 0.10	25.2 ± 1.12	27.2 ± 0.20	28.0 ± 1.28	26.2 ± 1.20	26.7 ± 0.16	26.2 ± 0.30	27.2 ± 0.20	27.5 ± 0.82
C	22.4 ± 0.72	24.2 ± 0.26	24.3 ± 0.14	25.3 ± 1.09	26.0 ± 0	28.3 ± 2.07	25.6 ± 0.44	26.0 ± 0.18	27.3 ± 0.72	27.4 ± 0.70	28.1 ± 0.14
D	22.0 ± 0.22	23.5 ± 0.55	24.0 ± 0.14	25.2 ± 1.10	26.2 ± 1.17	27.1 ± 2.01	25.0 ± 0.24	26.0 ± 0.20	27.0 ± 0.62	27.6 ± 0.81	28.2 ± 0.10
KOTITIRTH											
A	22.2 ± 0.40	23.0 ± 1.09	25 ± 0.62	25.2 ± 0.30	25.1 ± 0.27	27.0 ± 0	26.2 ± 0.05	23.5 ± 0.44	25.2 ± 0.70	27.2 ± 0.14	28.0 ± 0.32
B	22.5 ± 0.27	23.2 ± 0.62	25.2 ± 0.70	26.0 ± 0.40	25.5 ± 0.32	27.6 ± 1.09	26.7 ± 0.14	25 ± 0.32	26.3 ± 0.12	27.8 ± 0.20	28.0 ± 0.27
C	22.0 ± 0	23.5 ± 2.21	25.6 ± 0.40	26.3 ± 0.14	25.1 ± 0.62	27.2 ± 2.21	26.0 ± 0.16	25.2 ± 0.72	25.2 ± 0.27	26.2 ± 0.32	28.0 ± 0.72
D	22.0 ± 0.62	23.7 ± 0.60	25.0 ± 0	26.0 ±0.10	25.2 ± 0.80	27.5 ± 1.16	26.0 ± 0.62	25.1 ± 0.12	25.0 ± 0	27.0 ± 0.12	28.0 ± 1.07
RANKALA											
A	22.5 ± 0.22	24.2 ± 0.84	25.2 ± 0.27	26.2 ± 1.09	25.2 ± 1.08	26.4 ± 0.22	26.2 ± 0.17	27.2 ± 1.10	27.2 ± 1.10	26.5 ± 0.12	28.1 ± 1.12
B	22.3 ± 0.27	24.1 ± 0.60	25.6 ± 0.20	26.3 ± 0.24	25.3 ± 1.27	25.2 ± 0.40	26.0 ± 2.12	26.0 ± 1.28	26.3 ± 0.60	27.2 ± 0.42	28.3 ± 1.10
C	22.0 ± 1.21	24.2 ± 0.17	26.2 ± 1.21	26.8 ± 1.21	26.2 ± 0. 22	26.0 ± 0.62	25.8 ± 1.10	28.1 ± 0.40	27.2 ±0.72	26.4 ± 0.72	28.0 ± 0.21
D	23.5 ± 1.09	24.0 ± 0	25.0 ± 1.70	25.5 ± 1.09	25.2 ± 1.07	26.2 ± 0.70	26.0 ±0.14	27.0 ± 0.32	26.2 ± 0.42	27.1 ± 0.10	27.0 ± 1.12

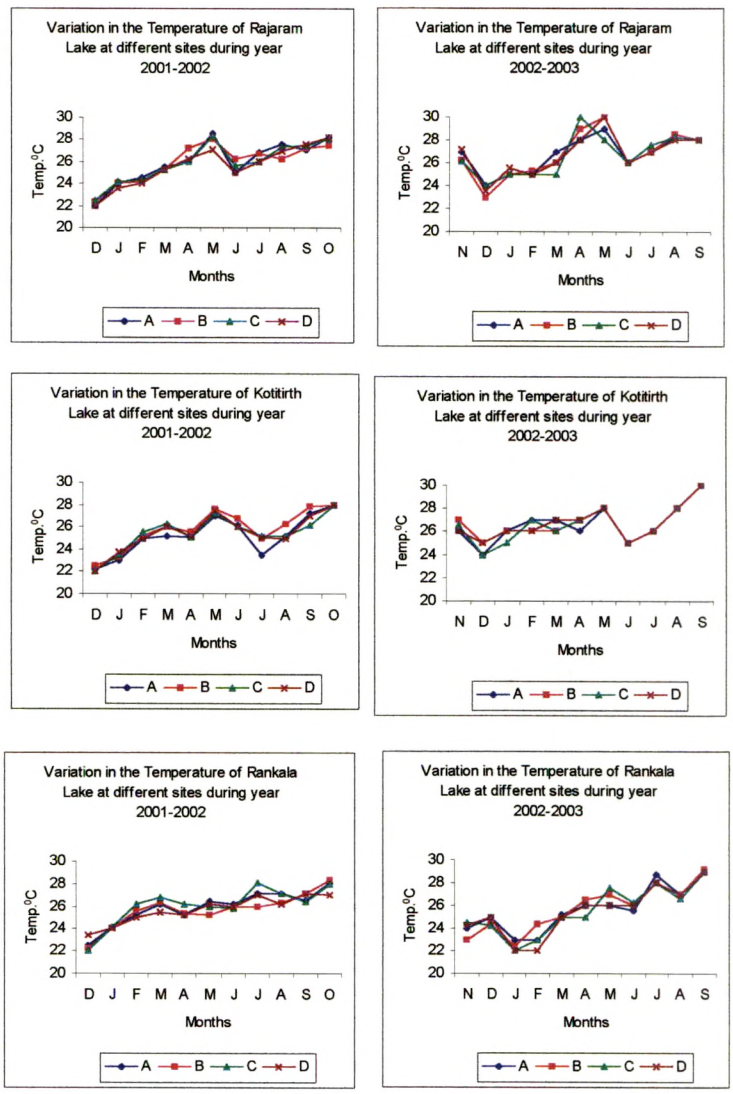
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in ^{0}C

TABLE 3 : SEASONAL VARIATION IN THE TEMPERATURE (Temp.) DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nove.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	27.0 ± 0.54	24.0 ± 1.12	25.0 ± 0.62	25.0 ± 0.64	27.0 ± 0.32	28.0 ± 1.20	29.0 ± 0.62	26.0 ± 0.14	27.0± 0.42	28.2 ± 0.37	28.0 ± 1.40	28.0 ± 0.42
B	26.2 ± 0.44	23.0 ± 2.00	25.0 ± 0.30	25.3 ± 0.25	26.0 ± 0.20	29.0 ± 0.25	30.0 ± 1.09	26.0 ± 1.17	27.0 ± 0.26	28.5 ± 0.20	28.0 ±1.72	28.0± 0.20
C	26 .1 ±0.22	24.0 ± 0.50	25.0 ±1.09	25.0 ± 1.61	25.0 ± 0.82	30.0 ±0.54	28.0 ± 1.17	26,0 ± 0.74	27.5 ±1.10	28.2 ± 0.25	28.0 ±0.74	28.0 ±0.04
D	27.2 ± 0.44	23.5 ± 1.12	25.5 ± 2.12	25.0 ± 2.10	26.0 ± 0.30	28.0 ±2.12	30.0 ± 0.62	26.0 ± 1.32	27.3 ± 1.17	28.0 ± 2.12	28.0 ± 1.22	28.5 ± 1.32
KOTITIRTH												
A	26.0 ± 0.32	24.0 ± 0.54	26.0 ±1.09	27.0 ± 0.32	27.0 ± 1.10	26.0 ± 0.62	28.0 ± 1.07	25.0 ±0.20	26.0 ±1.09	28.0 ± 2.12	30.0 ± 0.72	30.0 ± 0.2
B	27.0 ± 2.12	25.0 ± 0.30	26.0 ± 1.17	26.0 ± 0.15	26.0 ± 0.50	27.0 ±0.72	28.0 ± 2.12	25.0 ± 1.17	26.0 ± 2.12	28.0 ± 1.09	30.0 ± 0.80	29.0 ± 1.17
C	26.5± 1.10	24.0 ± 0.74	25.0 ± 0.64	27.0 ± 0.50	26.0 ± 0.25	27.0 ± 0.25	28.0 ±2.07	25.0 ±0.54	26.0 ± 0.64	28.0 ± 0.14	30.0 ± 0.54	30.0 ± 0.14
D	26.0 ± 2.12	25.0 ± 1.12	26.0 ± 0.55	26.0 ± 0.30	27.0 ± 1.09	27.0 ± 2.0	28.0 ± 1.10	25.0 ± 0.27	26.0 ± 0.45	28.0 ± 0.65	30.0 ±0.60	29.0 ± 1.09
RANKALA												
A	24.0 ± 1.09	25.0 ± 2.12	23.0 ± 1.15	23.0 ± 1.01	25.2 ±0.64	26.0 ±0.42	26.0 ±0.30	25.5 ± 0.25	28.7± 0.62	27.0 ± 1.42	29.0 ± 0	30.2 ± 0.44
B	23.0 ± 1.27	24.3 ± 0.54	22.4 ± 1.20	24.3 ±0.40	25.0 ±0.40	26.5 ± 0.64	27.0 ± 0.42	26 ± 1.18	28.0 ± 1.17	27.0 ± 1.09	29.2 ± 1.02	30.0 ± 0
C	24.5 ± 0.32	24.2 ±0.10	22.0 ± 1.0	23.0 ±1.15	25.0 ± 0.70	25.0 ± 1.26	27.5 ±0.65	26.2 ± 1.42	28.0 ± 0.32	26.6 ± 1.80	29.0 ± 0.32	30.0 ± 0.26
D	24.2 ±0.14	25.0 ± 1.30	22.0 ± 2.12	22.0 ± 2.10	25.0 ±0.70	26.0 ±0.30	26.0 ± 0.18	26.0 ± 0.80	28.0 ± 1.10	27.0 ± 0	29.0 ± 0.14	30.0 ± 0.37

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in ^{0}C

FIG. 6 : VARIATION IN THE TEMPERATURE DURING YEAR 2001-2003



The parameters analysed at different lakes i.e. Rankala, Rajaram and Kotitirth in different seasons are discussed into following points :

1. PHYSICAL PARAMETERS

- **Temperature** (Temp.)

Temperature of water depends on the season and on the temperature of the ground with which it is in contact. The observations for temperature during the year 2001-2003 are depicted in Table 2 and 3 respectively. It varies from 22^0C – 30^0C. In all the sampling sites, there is slight variation in different months in three lakes.

Lowest temperature (22^0C) is observed, during winter season in the month of January 2001 in Kotitirth lake at site A and D respectively. While in summer season highest temperature (30^0C) is recorded in the month of May, 2003, in Rajaram lake at Site B and D respectively. In the month of October, there is highest temperature (30^0C) in both the years in all three lakes (Fig. 6).

Variations in the temp. values indicate that it is not influenced by the interference, but changes with the changing environmental climate. The temperature of lake water vary with season. Higher temperature is observed during summer, because of clear atmosphere,

TABLE 4 : SEASONAL VARIATION IN THE pH DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	7.20 ± 0.02	7.60 ± 0.01	7.71 ± 0.04	8.00 ± 0.02	8.10 ± 0.03	8.00 ± 0.02	7.90 ± 0.01	8.20 ± 0.01	7.80 ± 0.09	8.2 ± 0.03	8.2 ± 0.02
B	7.42 ± 0.06	7.62 ± 0.02	7.80 ± 0.01	7.90 ± 0.02	8.00 ± 0.07	7.80 ± 0.06	7.90 ± 0.02	8.20 ± 0.03	7.80 ± 0.02	8 ± 0.01	8 ± 0.02
C	7.22 ± 0.04	7.60 ± 0.05	7.70 ± 0.07	7.80 ± 0.02	7.90 ± 0.02	7.80 ± 0.04	7.90 ± 0.01	8.00 ± 0.01	7.80 ± 0.02	8 ± 0.01	8 ± 0.02
D	7.32 ± 0.02	7.60 ± 0.02	7.80 ± 0.03	7.90 ± 0.01	8.20 ± 0.05	7.90 ± 0.06	7.90 ± 0.02	8.10 ± 0.01	7.80 ± 0.01	8 ± 0.01	7.9 ± 0.02
KOTITIRTH											
A	7.90 ± 0.02	7.5 ± 0.03	7.52 ± 0.01	8.10 ± 0.02	7.60 ± 0.06	7.80 ± 0.03	7.60 ± 0.02	7.70 ± 0.07	8.00 ± 0	8.4 ± 0.04	8.2 ± 0.01
B	7.62 ± 0.01	7.72 ± 0.02	7.54 ± 0.01	7.90 ±0.01	7.70 ±0.02	7.70 ±0.02	7.70 ±0.01	7.80 ± 0.06	8.10 ± 0.02	8.3 ± 0. 03	7.9 ± 0.02
C	7.72 ± 0.01	7.61 ± 0.02	7.42 ± 0.02	8.00 ± 0.02	7.50 ± 0.06	7.80 ± 0.03	7.60 ± 0.01	7.90 ± 0.06	7.90 ± 0.02	8.2 ±0.03	7.9 ± 0.02
D	7.81 ± 0.01	7.72 ± 0.02	7.40 ± 0.01	8.20 ± 0.01	7.60 ± 0.04	7.80 ± 0.03	7.60 ± 0.01	7.80 ± 0.06	8.00 ± 0.01	8.3 ± 0.03	7.9 ± 0.02
RANKALA											
A	7.60 ± 0.02	7.60 ± 0.01	7.70 ± 0.04	7.60 ± 0.02	7.40 ± 0.06	7.60 ± 0.04	7.60 ± 0.04	7.70 ± 0.04	8.10 ± 0.04	8.4 ± 0.02	8.2 ± 0.02
B	7.70 ± 0.02	7.70 ± 0.02	7.60 ±0.03	7.70 ± 0.02	8.20 ± 0.05	7.50 ± 0.02	7.70 ± 0.04	7.80 ± 0.02	8.00 ± 0.04	8.3 ± 0.01	7.9 ± 0.02
C	7.60 ± 0.01	7.40 ± 0.01	7.50 ± 0.04	7.60 ± 0.01	8.00 ±0.04	7.60 ± 0.02	7.60 ±0.06	7.90 ± 0.02	8.00± 0.03	8.2 ± 0.01	7.9 ± 0.07
D	7.60 ± 0.01	7.50 ± 0.01	7.60 ± 0.04	7.60 ± 0.02	8.00 ± 0.04	7.60 ± 0.02	7.60 ± 0.06	7.80 ± 0.02	8.00 ± 0.04	8.3 ±0.01	7.9 ± 0.06

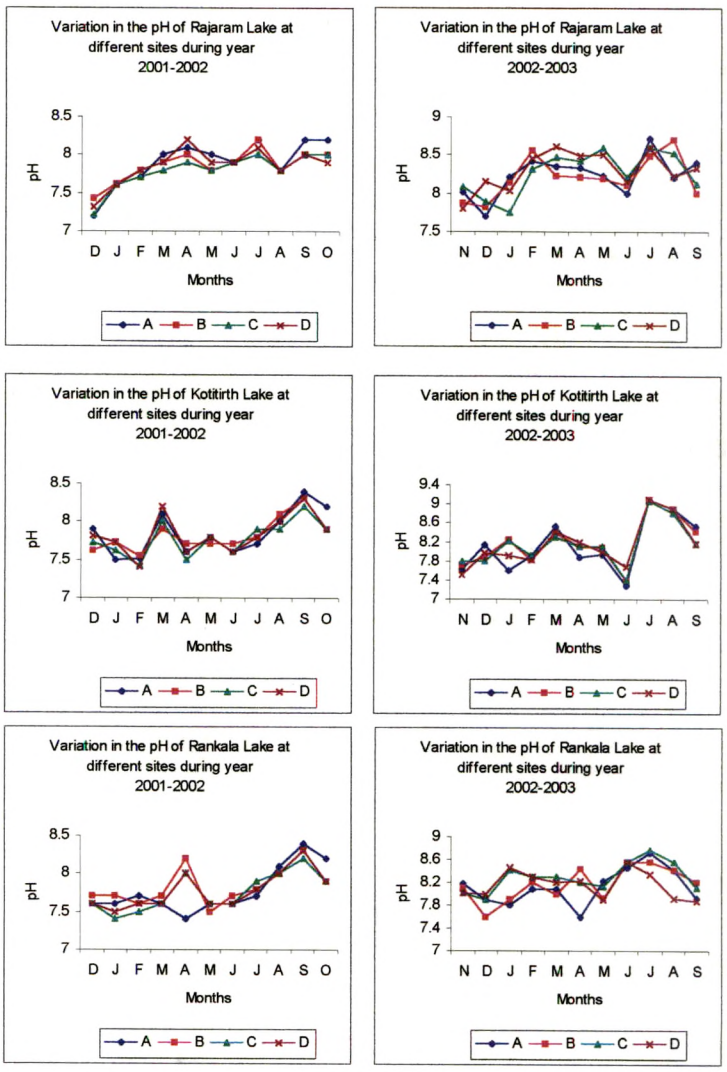
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation

TABLE 5 : SEASONAL VARIATION IN THE pH DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nove.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
RAJARAM												
A	8.01 ± 0.09	7.70 ±0.05	8.20 ± 0	8.42 ± 0.04	8.34 ±0.11	8.33 ±0.06	8.22 ±0.04	8.00 ± 0.01	8.71 ± 0.03	8.20 ±0.01	8.40 ± 0	8.38 ± 0.03
B	7.87 ± 0.05	7.82 ± 0.04	8.13 ±0.02	8.56 ± 0.02	8.22 ±0.04	8.21 ± 0.07	8.19 ±0.61	8.10 ±0.03	8.49 ± 0.03	8.70 ± 0.002	8.00 ± 0.04	8.22± 0.04
C	8.08 ± 0.06	7.89 ±0.03	7.75 ± 0.30	8.31 ± 0.07	8.47 ±0.04	8.42 ± 0.05	8.6 ± 0.40	8.20 ±0.01	8.60 ± 0.01	8.53 ±0.05	8.11 ± 0.03	8.10 ±0.01
D	7.80 ± 1.12	8.16 ±0.08	8.03 ±0.06	8.45 ± 0.02	8.62 ±0.04	8.49 ± 0.03	8.51 ± 0.03	8.15 ± 0.02	8.60 ± 0.01	8.23 ±0.05	8.33 ± 0.03	8.00 ± 0
KOTITIRTH												
A	7.62 ± 0.05	8.12 ±0.09	7.60 ±0.02	7.89 ±0.03	8.53 ± 0.03	7.87 ± 0.06	7.92 ± 0.06	7.27 ±0.09	9.09 ±0.03	8.90 ± 0.06	8.53 ± 0.01	8.30 ± 0.03
B	7.71 ± 0.02	7.87 ± 0.06	8.23 ±0.04	7.81 ± 0.03	8.39 ±0.03	8.10 ± 0.01	8.08 ±0.06	7.40 ± 0.01	9.09 ±0.01	8.90 ± 0.03	8.40 ± 0.02	8.30 ± 0.02
C	7.80 ±0.02	7.80 ± 0.02	8.21 ± 0.03	7.89 ±0.03	8.30 ±0.01	8.11 ±0.03	8.09 ± 0.03	7.40 ± 0.01	9.05 ±0.01	8.80 ± 0.01	8.15 ± 0.03	8.20 ± 0.03
D	7.51 ± 0.03	7.97 ± 0.06	7.91 ±0.03	7.81 ± 0.03	8.40 ± 0.01	8.19 ± 0.03	7.990 ±0.03	7.69 ± 0.03	9.10 ± 0	8.90 ±0.02	8.15 ± 0.02	8.30 ±0.02
RANKALA												
A	8.18 ±0.03	7.89 ± 0.02	7.81 ± 0.03	8.09 ±0.03	8.09 ±0.03	7.60 ± 0.03	8.22 ± 0.04	8.45 ±0.02	8.71 ± 0.02	8.40 ± 0.01	7.92 ± 0.02	8.17 ±0.01
B	8.11 ± 0.03	7.60 ±0.03	7.89 ±0.01	8.21 ± 0.03	7.99 ± 0.03	8.44 ± 0.01	7.92 ± 0.06	8.55 ± 0.01	8.56 ± 0.03	8.42 ± 0.03	8.21 ±0.01	7.81 ±0.02
C	8.01 ± 0.03	7.90 ± 0.02	8.40 ±0.01	8.29 ± 0.03	8.29 ± 0.01	8.20 ±0.06	8.13 ± 0.02	8.55 ±0.02	8.76 ± 0.02	8.55 ± 0.01	8.11 ±0.02	7.90 ±0.01
D	8.02 ±0.06	8.00 ±0.02	8.45 ±0.01	8.29 ±0.03	8.20 ± 0.02	8.23 ± 0.04	7.89 ±0.03	8.56 ±0.01	8.35 ± 0.02	7.91 ±0.02	7.87 ± 0.03	8.11 ±0.01

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation

FIG. 7 : VARIATION IN THE pH DURING YEAR 2001-2003



greater solar radiation and due to low water level (Swaranlatha and Narsing Rai (1998). Yogesh, Shastri and Pendse (2001) observed that during winter, water temperature was low due to frequent clouds, high humidity and high current velocity and high water level.

Kumar (1996) has reported, the range of pond water temperature from 24^0C to 29^0C in monsoon and 28^0C to 31^0C in summer season of Lakhikudi pond (Bihar). Agarkar (1998) has also reported 26.20^0C temperature in monsoon and 33^0C temperature in summer season of the Chandai Reservoir.

pH :

The pH is an important chemical factor in the fresh water bodies. pH maintains the acidity or alkalinity of water which is determined by concentration of hydrogen ions (H^+) and hydroxyl ions (OH^-). The pH depends on the biological processes in the aquatic bodies.

The analytical data during the year 2001-2003 is presented in Table 4 and 5 reveals that the pH is constantly remained above 7 and always found to be alkaline. The values ranges from 7.2 to 9.1 and seasonal variation in pH has shown in Fig. 7. In winter season minimum values are recorded in Rankala (7.4) at site C in Jan. 2002, Rajaram (7.3) at site A in December 2001. Kotitirth (7.4) at site D Jan. 2002 respectively. In monsoon season highest (9.1) values of pH

TABLE 6 : SEASONAL VARIATION IN ELECTRICAL CONDUCTIVITY (EC) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	0.30 ± 0.01	0.40 ± 0.12	0.32 ± 0.27	0.45 ± 0.30	0.42 ± 0.62	0.27 ± 0.12	0.50 ± 0.16	0.52 ± 1.09	0.62 ± 0.10	0.58 ± 1.08	0.42 ± 0.20
B	0.28 ± 0.22	0.36 ± 0.14	0.30 ± 0.60	0.46 ± 0.52	0.44 ± 0.06	0.28 ± 0.04	0.45 ± 0.62	0.50 ± 0.02	0.63 ± 0.25	0.59 ± 0.44	0.42 ± 0.17
C	0.30 ± 0.60	0.38 ± 0.14	0.32 ± 0.54	0.45 ± 0.32	0.40 ± 0.04	0.30 ± 0.23	0.50 ± 0.27	0.52 ± 0.23	0.60 ± 0.42	0.60 ± 0.22	0.42 ± 0.12
D	0.30 ±0.080	0.40 ± 0.10	0.30 ± 0.40	0.45 ± 0.14	0.42 ± 0.52	0.30 ± 0.16	0.50 ± 0.16	0.52 ± 0.20	0.60 ± 0.14	0.60 ± 0.30	0.42 ± 0.23
KOTITIRTH											
A	0.60 ±0.010	0.50 ± 0.46	0.72 ±0.12	0.53 ±0.002	0.70 ± 0.04	0.72 ±0.070	0.70 ± 0.03	0.80 ± 0.02	0.72 ± 0.02	0.68 ± 0.07	0.80 ± 0.10
B	0.62 ±0.003	0.52 ±0.006	0.70 ± 0.14	0.52 ± 0.06	0.72 ±0.02	0.75 ± 0.04	0.70 ±0.02	0.82 ± 0.06	0.70 ± 0.04	0.70 ± 0.04	0.78 ±0.006
C	0.59 ±0.004	0.50 ±0.002	0.73 ± 0.12	0.50 ± 0.04	0.70 ± 0.04	0.75 ± 0	0.72 ± 0.03	0.80 ± 0.02	0.70 ± 0.01	0.69 ± 0.04	0.78 ± 0.12
D	0.60 ± 0	0.53 ±0.14	0.72 ±0.12	0.52 ± 0.06	0.72 ± 0.06	0.75 ± 0	0.73 ± 0.03	0.81 ± 0.02	0.71 ± 0.04	0.69 ± 0.04	0.78 ±0.12
RANKALA											
A	0.28 ± 0.02	0.45 ± 0.01	0.36 ± 0.06	0.32 ± 0.16	0.37 ± 0.12	0.34 ± 0.12	0.42 ± 0.40	0.42 ± 0.21	0.30 ± 0.12	0.32 ± 0.12	0.42 ±0.10
B	0.30 ± 0.20	0.46 ± 0.10	0.35 ± 0.10	0.30 ± 0.18	0.36 ± 0.10	0.36 ± 0.10	0.40 ± 0.50	0.44 ± 0.20	0.32 ± 0.14	0.30 ± 0.14	0.40 ± 0.12
C	0.32 ± 0.20	0.48 ± 0.12	0.36 ± 0.14	0.32 ± 0.22	0.37 ±0.12	0.30 ± 0.17	0.39 ± 0.15	0.40 ± 1.09	0.30 ± 0.12	0.34 ± 0.12	0.43 ± 0.12
D	0.30 ±0.12	0.46 ± 0.62	0.34 ±0.14	0.30 ± 0.20	0.38 ± 0.12	0.33 ± 0.32	0.39 ± 0.16	0.42 ± 0.70	0.33 ± 0.14	0.32 ± 0.10	0.42 ±0.12

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mMhos/cm

are found in all the four sites in the month of July 2003 in Kotitirth lake, than Rajaram and Rankala lake. The higher range of pH indicates higher productivity of water (Khan and Khan 1985, Nishi Narayani, 1999).

For the best nature of water which can protect the flora and fauna, requires the pH range between 6.5 – 7.5, but the pH values from our observations fluctuate from time to time and season to season. This change may be mainly because of increase in load of alkaline salts, due to mixing of sewage, industrial effluents and degradation of organic and inorganic matter in the water body. Highly alkaline condition of water is too harm to aquatic life and sometimes this situation becomes very serious for their survival. The water of Kotitirth was smelling in the month of July 2003, showed highest pH (9.1), Rao, et al. (1999) have reported 7.12 pH of water from Mehadrigedda reservoir of Visakhapatnam in post monsoon season. These all above changes in pH level indicates that the maximum human activities are the main cause of it.

- **Electrical Conductivity (EC)**

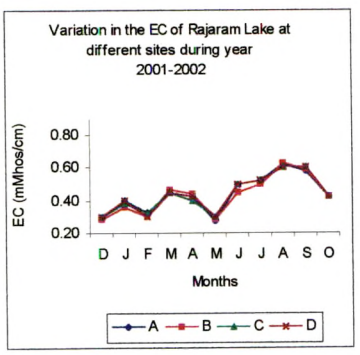
The measurement of electrical conductivity is found to be helpful to measure the various forms of the salts and also helpful for rapid measure of the total dissolved solids. Electrical conductivity is a parameter for dissolved ionic substances but it does not give any idea about the type of ions being present.

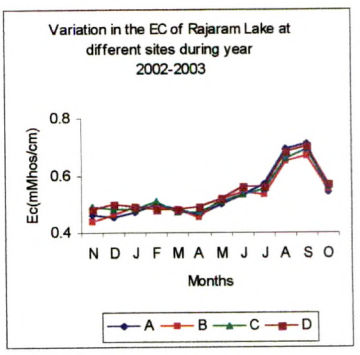
TABLE 7 : SEASONAL VARIATION IN THE ELECTRICAL CONDUCTIVITY (EC) DURING YEAR 2002-2003

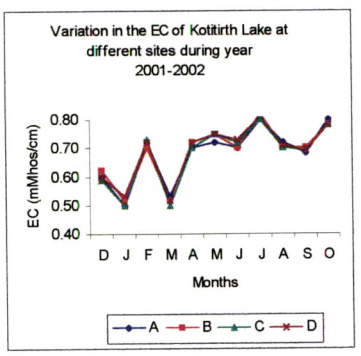
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	0.46 ± 0.01	0.45 ±0.008	0.47 ± 0.013	0.50 ± 0.01	0.48 ± 0.089	0.46± 0.013	0.50± 0.008	0.53 ±0.004	0.57 ±0.004	0.69 ± 0.004	0.71 ± 0.013	0.54 ± 0.008
B	0.44 ± 0.01	0.46 ± 0.004	0.49 ± 0.017	0.49 ± 0.01	0.48 ±0.006	0.45 ±0.012	0.52 ± 0.008	0.54 ±0.005	0.53± 0.006	0.65 ±0.006	0.67 ±0.01	0.55 ± 0.006
C	0.49 ± 0.007	0.48 ±0.008	0.48 ± 0.012	0.51 ±0.02	0.47 ± 0.008	0.47 ± 0.008	0.51 ± 0.006	0.53 ±0.003	0.55 ±0.004	0.66 ±0.008	0.69 ±0.014	0.56 ±0.01
D	0.48 ± 0	0.50 ±0.008	0.49 ± 0.016	0.48 ±0.03	0.48 ± 0.004	0.49 ±0.010	0.52 ±0.004	0.56 ±0.007	0.56 ±0.006	0.68 ±0.004	0.70 ±0.012	0.57 ±0.01
KOTITIRTH												
A	0.91 ± 0.017	0.87 ± 0.004	0.92 ± 0.014	0.78 ±0.010	0.98 ±0.004	1.10 ± 0	0.92 ± 0.46	1.70 ±0.004	1.54 ± 0.08	1.54 ±0.44	1.42 ±0.04	3.08 ± 0.08
B	0.93 ± 0.019	0.88 ±0.006	0.90 ± 0.012	0.82 ±0.014	0.95 ±0.006	0.98 ± 0	1.20 ±0.070	1.60 ±0.04	1.44 ±0.06	1.44 ± 0.42	1.33 ± 0.06	3.10 ± 0.006
C	0.94 ± 0.014	0.86± 0.003	0.91 ± 0.016	0.71 ± 0.012	0.94 ± 0.004	0.99 ± 0.002	1.30 ±0.070	1.70 ±0.06	1.42 ± 0.04	1.50 ± 0.040	1.30 ±0.04	3.10 ± 0
D	0.92 ± 0.015	0.88 ± 0.006	0.93 ± 0.012	0.80 ±0.010	0.93 ± 0.004	0.97 ± 0.004	1.20 ± 0.060	1.80 ± 0.04	1.62 ±0.06	1.42 ±0.40	1.32 ± 0.06	3.10 ± 0
RANKALA												
A	0.39 ±0.008	0.50 ± 0.010	0.44 ± 0.008	0.48 ±0.008	0.50 ±0.008	0.46 ±0.008	0.46 ±0.01	0.50 ±0.002	0.47 ±0.008	0.49 ±0.008	0.47 ± 0	0.51±0.010
B	0.46 ±0.01	0.52 ±0.013	0.46 ± 0.01	0.43 ±0.006	0.52 ± 0.006	0.48 ±0.013	0.41 ±0.008	0.45 ±0.004	0.47 ±0.006	0.45 ±0.006	0.48 ±0.013	0.50±0.012
C	0.48 ±0.004	0.53 ±0.010	0.48 ± 0.006	0.46 ± 0.006	0.56 ± 0.010	0.49 ±0.010	0.44 ± 0.01	0.45 ± 0.002	0.45 ± 0	0.52 ±0.010	0.51 ± 0	0.55 ±0.010
D	0.82 ± 0.06	0.76 ± 0.014	0.79 ± 0.002	0.77 ±0.008	0.72 ± 0.006	0.68 ±0.004	0.60 ±0.006	0.84 ± 0.006	0.63 ±0.002	0.65 ±0.006	0.74 ± 0.010	0.67 ± 0.012

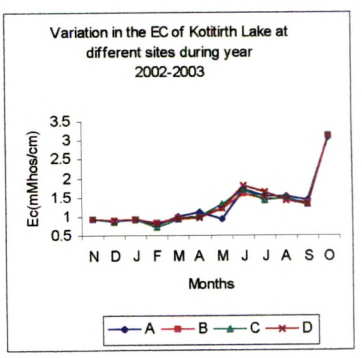
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mMhos/cm

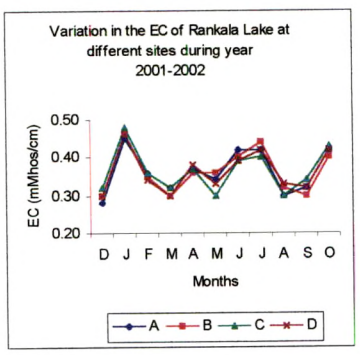
FIG. 8 : VARIATION IN THE EC DURING YEAR 2001-2003

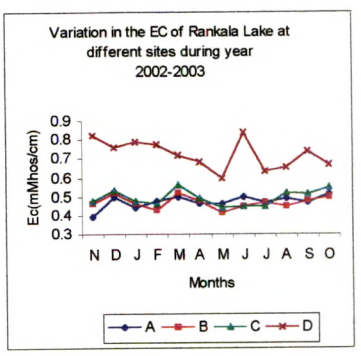












The electrical conductivity ranges from 0.28 to 3.1 mMhos/ cm in all the three lakes during the year 2001-2003 (Table 6 and7). In winter season, low values of conductivity are found in Rajaram (0.28 mMhos/ cm) in the month of December 2001 at site B, Kotitirth (0.50 mMhos/ cm) in January 2002 at site A and C. Rankala (0.28 mMhos/ cm) in December 2001 at site A respectively. Highest values of conductivity are observed in Kotitirth lake than Rankala (3.1 and 0.56 mMhos/ cm respectively). Seasonal variation in conductivity shows this difference in detail (Fig. 8).

EC ranges between 1.278 to 13.490 mMhos/ cm in city area water samples (Pandey et al., 2002). The conductance of distilled water ranges between 1 to 5 μmhos/ cm, but the presence of salts and contamination with waste waters increased the conductivity of the water (Trivedy and Goel, 1984). A sudden rise in conductivity will indicates addition of some pollutants to it. In Kotitirth lake during monsoon season July 2002, the EC was found to be highest (0.82 mMhos/ cm), while in same month next year (2003) value increased to 3.1 mMhos/ cm. From this, it is clear that the influence of sewage and other waste found to be increased, year by year.

In Rajaram lake in the month of September (2003), the value of electrical conductivity is found to be highest (0.71). It may be because of reduction in volume of water, as well as the level of water which has been found to be tremendously decreased by 35 feet.

TABLE 8 : SEASONAL VARIATION IN THE TOTAL SOLIDS (TS) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	2200± 1.12	2180± 2.21	2300± 2.20	2380± 3.61	2420± 2.05	2530± 2.21	2320± 1.21	2300± 2.15	2260± 3.21	2120±2.21	2450± 2.21
B	1920± 4.40	1780± 4.41	1820± 3.10	1990± 2.10	2050± 2.61	2150± 2.61	1850± 1.30	1780± 3.33	1820± 1.61	1650± 3.71	2100± 3.61
C	2220± 3.82	2220± 2.71	2350± 2.61	2460± 1.60	2530± 2.31	2570± 2.08	2280± 1.09	2230± 2.21	2320± 1.14	2200± 4.01	1820 ± 4.61
D	2120± 5.51	2200± 1.19	1980± 2.21	2100±2.21	2100± 2.10	2600± 1.61	1760± 3.12	1750± 3.30	1720± 2.61	1750± 4.42	1770± 4.12
KOTITIRTH											
A	1830± 4.41	1900± 1.22	1820± 3.12	1900± 1.67	2100± 4.41	2600± 3.61	2500± 2.21	2200± 6.62	2050± 4.41	2200± 3.20	2100± 2.10
B	1770 ± 1.12	1830 ± 2.21	1800 ± 3.71	1880 ± 4.41	1920± 1.20	1980± 2.45	1970± 3.65	1980± 3..31	2100± 6.10	2150± 5.12	2100± 2.10
C	1760 ± 2.21	1800 ± 2.25	1780± 6.12	1820± 4.10	1880± 1.61	2100± 3.62	2050±2.08	1950± 2.10	2060 ±2.08	2200 ± 2.32	2120± 2.41
D	1880 ± 2.81	1920± 3.01	1720± 3.12	1780± 6.10	1800±2.21	2200± 3.25	2100 ± 4.14	2050 ± 1.81	2050± 3.01	2320 ± 2.10	2060± 2.30
RANKALA											
A	2160± 2.12	1980 ± 2.61	1990 ± 2.02	2200 ± 3.10	2600 ± 2.12	2700 ± 3.12	2250 ± 3.12	2200 ± 2.21	2500 ± 2.07	2120 ± 2.06	2400± 3.08
B	2260± 2.61	2420 ± 2.18	2480 ± 2.12	1980 ± 2.61	2100 ± 2.21	2800 ± 3.12	2200 ± 2.12	2100 ± 3.10	2450 ± 2.21	2560 ± 1.80	2300± 2.08
C	2370± 3.12	2400 ± 1.10	1750 ± 4.05	1900 ±3.35	2150 ± 1.16	2100 ± 1.08	2100 ± 2.10	2000 ± 4.10	2050 ± 4.05	2100 ± 2.70	2350± 2.32
D	2200 ± 2.72	228 ± 1.82	2460 ± 1.25	1950 ± 2.35	2500 ± 1.81	2200 ± 1.90	2200 ± 1.75	2050 ± 1.27	2350 ± 3.15	2450 ± 4.05	2480± 3.12

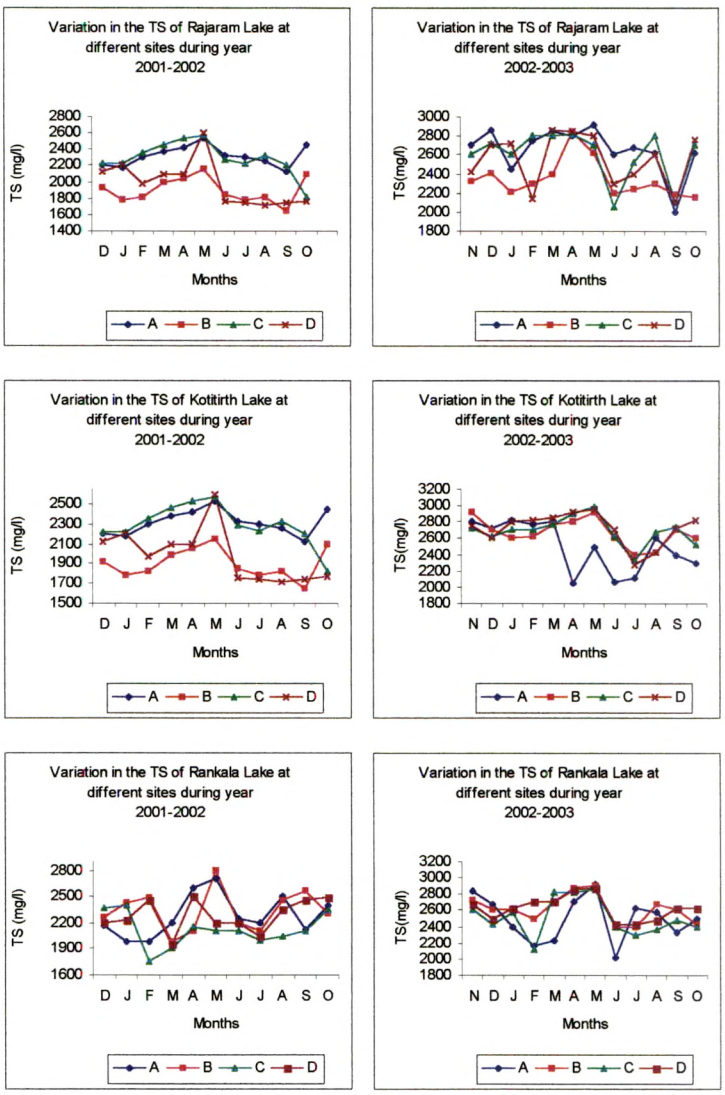
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 9 : SEASONAL VARIATION IN TOTAL SOLID (TS) CONTENT DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	2700± 1.10	2860.7±1.12	2450± 1.12	2750± 1.12	2840± 2.12	2800± 2.12	2920± 2.61	2600± 2.12	2670± 2.60	2620± 3.15	2000± 3.10	2620± 2.08
B	2320± 0.01	2400.6± 1.12	2210.5 ± 2.60	2300± 2.72	2400± 2.61	2850± 2.12	2620± 2.10	2200.6± 3.10	2240.2±2.10	2300± 2.61	2180± 2.10	2160± 2.02
C	2600± 2.21	2720± 2.12	2600.2 ± 2.71	2800.6± 2.60	2800± 2.12	2820± 2.12	2700± 2.12	2060± 2.45	2520.8± 2.12	2800± 2.62	2100± 2.12	2700± 2.42
D	2420± 1.60	2700± 4.16	2720.4 ± 4.10	2140.2± 4.16	2860± 3.20	2840± 2.80	2800± 2.21	2300± 3.12	2400± 3.10	2600± 2.61	2100± 2.10	2760± 2.08
KOTITIRTH												
A	2800± 1.21	2730± 2.61	2820 ± 2.42	2780± 1.62	2800± 1.15	2040± 3.45	2500± 3.47	2060± 2.77	2120± 2.87	2610± 2.12	2400± 1.97	2300± 2.17
B	2920± 1.02	2700.6± 2.16	2600 ± 2.62	2620.3± 2.80	2770± 2.42	2800.4± 3.12	2920± 3.09	2600± 2.61	2400.8± 2.12	2420± 2.08	2710± 2.12	2600± 3.07
C	2720± 1.12	2620± 2.12	2700 ± 2.72	2710± 2.72	2780± 2.61	2900± 2.62	2980.8± 3.10	2620.9± 3.12	2320.2± 3.00	2680.1± 0	2740± 1.12	2520± 1.61
D	2750± 1.40	2600± 2.10	2800 ± 3.14	2820± 2.07	2860± 1.21	2920.6± 1.61	2960± 2.60	2700± 2.40	2280± 3.12	2420± 3.2	2720± 3.60	2820± 3.12
RANKALA												
A	2840± 1.20	2670± 2.17	2400 ± 3.05	2170± 1.28	2300± 2.12	2700± 1.61	2920.6± 1.12	2020± 2.61	2620± 3.10	2580± 2.10	2320± 3.61	2500± 2.62
B	2720± 3.10	2600± 2.61	2600 ± 1.61	2500± 2.37	2700± 3.02	2870± 1.82	2900± 2.14	2400± 1.64	2400.7± 1.161	2670.8± 3.12	2600.9± 2.80	2420± 3.01
C	2600± 2.21	2420± 2.62	2580 ± 2.71	2120± 1.62	2820± 2.12	2820.5± 2.12	2860± 1.71	2400± 1.61	2300± 2.12	2360± 2.10	2480± 2.08	2400± 3.10
D	2680± 3.12	2500± 3.61	2620 ± 2.10	2700± 2.67	2710± 2.12	2860± 1.41	2870± 1.12	2420± 3.61	2420± 2.42	2480± 3.22	2620± 3.10	2620± 2.72

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

FIG. 9 : VARIATION IN THE TS DURING YEAR 2001-2003



High values of EC reported by Kadam (1990), 1.96 Mohs/ cm in Rankala and 5.2 Mohs/ cm in Kotitirth lake.

- **Total Solids (TS)**

The amount of solids in a water are depending upon the exact source of water, surrounding of water body geology and geography of water body and the use of that water body. A high amount of solids in water restricts the use of water for cooking of food, washing of clothes, bathing, agricultural purpose and industrial uses. Solids put more load in water through peoples activities like disposal of unwanted material, mixing of sewage and industrial effluents.

In present study total solids ranges from 1720 mg/l to 2920 mg/l in all the lakes in year 2001-2003 (Table 8 and 9) respectively. the amount of solids goes to rise in summer season and it was found highest (2920 mg/l) in Rajaram lake in the month of May 2003 at site A and in Rankala at site A respectively. In monsoon season also high concentration of solids are found in all the three lakes (Fig. 9), may be due to mixing of sewage. High values of total solids were found in site A (2920 mg/l) of Rajaram, Site A (2960 mg/l) of Kotitirth and site A (2920 mg/l) and D (2870 mg/l) of Rankala. It clearly indicates that these sites are highly influenced with city sewage as well as surrounding surface ground water run off which add more and more solids at these sites.

TABLE 10 : SEASONAL VARIATION IN TOTAL DISSOLVED SOLIDS (TDS) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	1750 ± 1.12	1700 ± 3.21	1750± 2.30	1760± 2.12	1780± 2.21	1800 + 2.12	1600± 3.13	1600± 2.27	1670± 2.81	1700± 2.90	1780± 2.72
B	1060 ± 2.10	1100 ± 4.42	1420± 1.62	1460± 2.62	1420 ± 2.60	1500 ± 2.52	1150± 3.70	1100± 1.77	1120± 2.21	1160± 2.61	1480± 2.42
C	1100 ± 4.10	1050 ± 2.61	1120± 3.12	1150± 2.08	1200 ± 3.63	1300 ± 2.43	1100± 2.32	1150± 2.36	1160± 2.08	1220± 2.13	1180± 2.24
D	1200 ± 3.25	1250 ± 2.46	1050± 1.12	1000± 3.10	1020 ± 2.42	1400 ± 3.31	1060± 1.81	1080± 2.62	1100± 3.08	1050± 3.21	1160± 2.52
KOTITIRTH											
A	1000 ± 2.21	1060 ± 2.12	1040± 3.10	1120± 2.12	1100± 2.10	1400± 2.21	1200± 2.61	1150± 3.02	1300± 2.81	1320± 2.60	1150± 2.42
B	1050 ± 2.61	1220 ± 2.16	1200± 2.62	1050± 3.15	1180± 2.10	1300± 2.61	1280± 2.12	1160± 2.10	1120 ± 3.12	1250± 5.50	1200± 5.12
C	1120 ± 2.71	1160 ± 2.20	1180± 1.61	1200± 3.61	1520± 3.10	1400± 3.02	1380± 1.71	1280± 2.42	1200± 3.12	1150± 3.10	1220± 3.27
D	1160 ± 2.12	1220 ± 2.21	1180± 1.12	1160± 2.21	1200± 4.10	1450± 2.12	1380± 4.40	1300± 4.61	1280± 2.61	1320± 2.10	1360± 2.61
RANKALA											
A	1100 ± 4.10	1450± 3.10	1600± 1.42	1400± 1.60	1380± 2.62	1580± 3.10	1400± 2.81	1380± 3.10	1350± 2.52	1600± 1.81	1420± 1.62
B	1220± 2.12	1300± 3.10	1320± 3.12	1050± 3.71	1160± 3.92	1400± 2.61	1200± 2.12	1050± 6.10	1120± 2.10	1680± 2.42	1200± 2.33
C	1160± 1.61	1220± 2.71	1050± 1.61	1100± 1.62	1280± 2.12	1300± 3.12	1100± 3.12	1060± 1.72	1100± 1.40	1300± 2.31	1160± 2.72
D	1300± 3.08	1320± 3.12	1330± 2.12	1060± 1.16	1100± 2.70	1450± 1.61	1400± 1.61	1380± 3.10	1300± 2.82	1280± 2.80	1300± 1.12

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 11 : SEASONAL VARIATION IN TOTAL DISSOLVED SOLIDS (TDS) DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	1620 ± 2.10	1420 ± 2.61	1270± 1.61	1400 ± 1.42	1220± 3.52	1350± 1.61	1420± 2.62	1920.2± 1.42	2050± 2.40	2300± 3.72	2120± 2.32	2320± 3.12
B	1650 ± 2.71	1300 ± 3.01	1280± 2.62	1200± 2.28	1280.5± 2.61	1300± 2.10	1330± 3.12	1290.3± 3.02	1220± 4.12	1280± 1.92	1300± 3.10	1880± 1.61
C	1400 ± 1.12	2060 ± 2.16	2050± 3.12	1820± 4.12	1850± 2.21	1920.8± 2.14	1060.5±3.10	1820.4± 2.16	1900± 2.62	2040± 2.60	2100± 2.61	2020± 2.21
D	1450 ± 2.12	1620.9± 3.21	1780.8± 3.10	1800± 4.08	1720.6± 3.03	1760± 1.61	1900.6± 2.12	1600± 3.12	1670± 1.61	1720± 3.04	1650± 1.72	1600± 2.12
KOTITIRTH												
A	1850 ± 3.01	1580 ± 1.71	1620± 2.71	1700± 2.12	1670± 2.62	1660± 2.33	2070± 3.34	2020± 3.61	1960± 2.21	1700± 2.92	1940± 3.72	1920± 3.08
B	1820 ± 2.17	1550 ± 1.61	1450.8± 1.82	1620.5± .90	1580.6± 2.90	1520± 2.82	1430± 1.67	1300± 1.38	1300.6± 1.41	1320.8± 2.62	1400± 2.22	1430± 2.20
C	1400 ± 3.10	1480 ± 2.10	1520± 1.61	1500± 2.61	1400± 2.60	1530.9± 2.12	1450.2± 3.10	1280.3± 1.72	1400± 1.12	1300± 1.10	1250± 1.61	1320± 1.12
D	1300 ± 1.91	1500 ± 2.62	1600± 2.21	1720± 2.12	1800± 3.10	1600± 3.30	1720± 1.61	1750± 1.61	1250± 2.10	1420± 3.08	1490± 3.12	1600± 2.71
RANKALA												
A	1650± 1.12	1020± 2.16	1620± 2.27	1300± 3.33	1620± 1.71	1720± 2.62	1900± 1.14	1700± 3.14	1780± 4.10	1770± 2.12	1260± 2.10	1920± 2.62
B	1680± 1.72	1060 ± 1.77	1420± 1.62	1720.2± 1.12	1210± 1.28	1260± 1.12	1320.4± 2.10	1880.5± 3.12	1990.6± 3.61	1820± 3.22	1500± 3.61	1720± 3.22
C	1200± 2.10	1070 ± 2.71	1620± 2.12	1060± 2.82	1040.3± 3.15	1120.6± 3.10	1170.8± 1.12	1050± 1.61	1200± 1.10	1120± 1.72	1180± 1.62	1200± 2.10
D	1000± 3.10	1050 ± 3.05	1720± 2.12	1820± 2.81	1120± 2.12	1700± 2.10	1350± 1.72	1820± 1.61	1900± 1.10	1820± 1.91	1980± 2.70	2100± 2.12

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

In present study, the concentration of solids seems to be influenced by the evaporation forces, which is evident by sharp fall of solids in the month of September 2003 by (2000, 2180, 2100, 2100 mg/l) in four sites of Rajaram lake respectively, due to high temperature, which show resemblance with the observations of Daborn (1976).

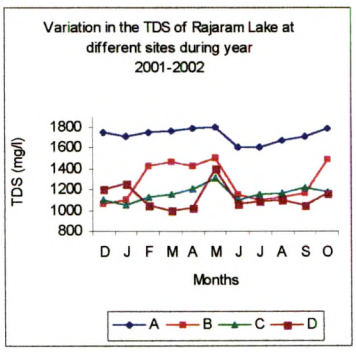
- **Total Dissolved Solids (TDS)**

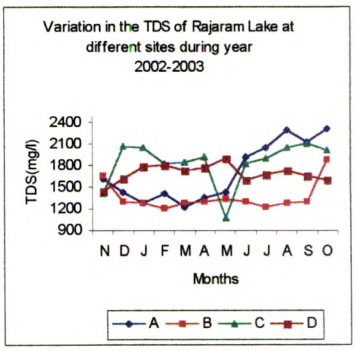
Dissolved solids are the contents of the salts or ions which get degraded from the organic and inorganic waste matter. Some of the waste like industrial effluent, city sewage and human activities are directly adding load of salts in water.

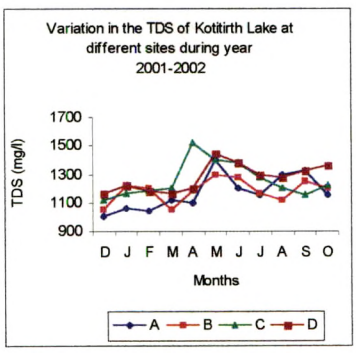
Dissolved solids ranges from 1000 mg/l to 2320 mg/l in all the lakes during year 2001-2003 (Table 10 and 11). In summer season high values of total solids Rajaram (2320 mg/l), Kotitirth (2070 mg/l) and in Rankala (2100 mg/l) in the month of May 2003, may be due to the high load of suspended solids in monsoon season which slowly degrade in water which gives high level of dissolved solids in the summer season.

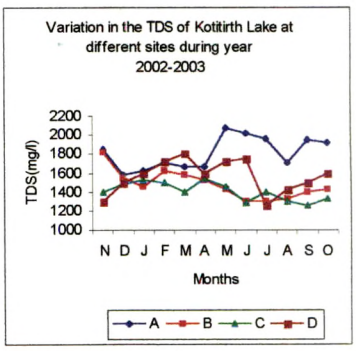
Values of total dissolved solids 545 mg/l in Rankala and 763 mg/l in Kotitirth samples was recorded by Kadam (1990), 191 to 270 mg/l in Kalamba sample was measured by Goel et al. (1988).

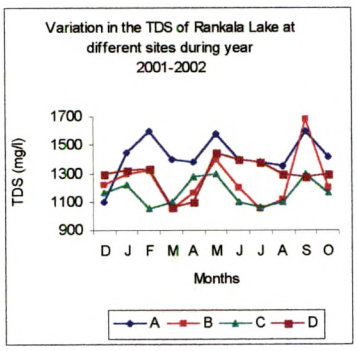
FIG. 10 : VARIATION IN THE TDS DURING YEAR 2001-2003











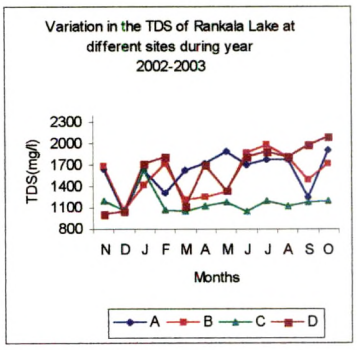


TABLE 12 : SEASONAL VARIATION IN TOTAL SUSPENDED SOLID (TSS) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	1450± 1.17	1480 ± 1.42	1550± 1.61	1620 ± 2.21	164 ⊥ 2.05	730 ± 1.12	172 ± 1.21	170 ± 1.08	590 ± 2.21	420 ± 1.12	670 ± 1.71
B	860± 1.10	680 ± 1.15	400 ± 1.12	530 ± 2.10	63 ± 1.80	650 ± 1.61	70 ± 1.12	68 ± 1.61	700 ± 1.12	490 ± 1.81	620.5 ± 2.12
C	1120± 2.61	1170 ± 1.61	1230 ± 1.25	1310 ± 1.71	133 ± 1.61	1270 ± 1.12	118 ± 4.10	108 ± 1.12	1160 ± 1.61	980 ± 1.61	640 ± 2.62
D	920± 1.12	950 ± 1.12	930 ± 1.67	1100 ± 1.61	108 ± 1.67	1200 ± 1.12	70 ± 1.60	67 ± 1.21	620 ± 2.10	700 ± 1.12	610 ± 2.45
KOTITIRTH											
A	830± 1.71	840.4 ± 1.12	780 ± 1.21	780 + 61	1000 ± 2.21	1200 ± 0	1000 ± 1.61	1050 ± 1.14	750 ± 1.08	880 ± 1.12	950 ± 1.16
B	720 ± 2.61	610 ± 1.61	600.2 ± 1.61	830.6 ± 1.12	740 ± 2.12	680 ± 3.61	690 ± 5.10	820 ± 4.67	980 ± 1.12	900 ± 1.71	900 ± 1.12
C	640 ± 1.08	640 ± 2.18	600 ± 1.12	620 ± 1.81	360 ± 3.10	700 ± 3.12	670 ± 4.10	670 ± 4.12	860 ± 1.61	1050 ± 1.61	900 ± 2.07
D	720 ± 2.61	700.6 ± 1.12	540.6 ± 1.12	620± 1.12	600 ± 1.81	750 ± 3.12	720 ± 2.12	750 ± 1.71	770 ± 1.61	1170± 1.12	700 ± 1.21
RANKALA											
A	1060 ± 1.61	530 ± 2.61	390 ± 1.12	800± 3.61	1220 ± 1.12	1120 ± 1.71	850 ± 2.08	820 ± 1.62	150 ± 1.31	520 ± 1.62	980 ± 2.71
B	1040 ± 1.12	1120 ± 1.18	1160 ± 2.05	930 ± 3.05	940 ± 2.04	1440 ± 1.12	1000± 3.12	1050 ± 1.12	1330 ± 1.61	880.6± 1.12	1100 ± 1.12
C	1210 ± 2.61	1180 ± 1.61	700 ± 1.72	880 ± 1.82	870 ± 2.17	1050 ± 1.61	1000 ± 2.10	940 ± 1.71	950.5 ± 1.61	800 ± 1.12	1190 ± 1.61
D	900± 2.12	960 ± 2.68	1130 ± 3.12	890 ± 2.80	1400 ± 2.61	950 ± 2.42	800 ± 1.61	670 ± 1.61	1050 ±0	170 ± 1.71	1180 ± 2.10

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 13 : SEASONAL VARIATION IN TOTAL SUSPENDED SOLID (TSS) DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	1080± 1.61	1400± 1.12	1180 ± 1.71	1350± 1.61	1620± 1.12	1450 ± 1.21	1500± 1.61	680± 1.71	620± 5	320± 1.12	880± 2.10	1300± 2.61
B	670 ± 1.12	1100± 1.12	930± 2.12	1100.5± 1.61	1120± 2.81	1550 ± 3.20	1290± 1.12	910± 2.12	1020± 4	1020± 4.1	880 ± 2.12	280± 2.10
C	1200 ± 1.62	660 ± 4.61	550± 1.61	980.6± 1.21	950± 2.62	900 ± 2.40	640± 1.14	240± 2.41	620± 1.10	760 ± 3.12	1000 ± 2.61	680± 2.17
D	970 ± 1.71	1080 ± 3.12	940± 2.12	340± 2.10	1140± 1.10	1080 ± 1.61	900 ± 4.10	700± 6	730± 0	880± 1.21	1150± 1.17	1160± 3.05
KOTITIRTH												
A	1950 ± 1.10	1150± 1.12	1200± 3.12	1080± 2.12	1130± 1.12	380 ± 1.12	1230± 1.12	1040± 3	160± 4.10	910 ± 4	460 ± 6	380± 2.12
B	1100 ± 2.12	1150± 1.82	1150± 2.81	1000± 1.81	1190 ± 0	1280 ± 0	1490± 1.61	1300± 4	1100±2.10	1100± 6	1310 ± 7	1170± 2.10
C	1320± 1.17	1140± 2.12	1180± 2.10	1210± 1.62	1380 ± 1.71	1370 ± 0	1530± 2.10	1340± 6	920± 2.10	1380± 0	1490 ± 3	1200± 2.12
D	1200± 1.71	1100± 3.12	1200± 1.90	1100± 1.10	1060 ± 0	1320 ± 1.61	1240± 2	950± 4	1030± 3.12	1000± 1.10	1230 ± 2	1220± 2.10
RANKALA												
A	1190± 1.62	1650± 1.62	780± 2.91	870.5± 2.60	680 ± 2.12	980.6 ± 1.11	1020± 1.71	320.5± 2	840± 1.71	730± 1.62	1060 ± 1.12	580± 2.10
B	1040± 2.21	1540± 1.62	1180± 1.72	780± 2.60	1490 ± 1.62	1610 ± 2.12	1580± 1.12	520± 1.17	410± 1.62	850± 2.12	1100± 1.12	700± 1.12
C	1400± 3.30	1350± 3.10	960± 1.61	1050± 1.61	1780 ± 1.15	1700 ± 2.12	1690± 3	1350± 1	1100± 1.71	1240± 1.71	1300± 2.10	1200± 3.20
D	1480± 2.12	1450± 0	900± 2.21	880± 1.12	1590 ± 2.30	1160 ± 2.20	1520± 0	600± 1.12	520± 2.21	660± 1.61	640± 3.12	920± 2.60

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/l

Seasonal variation in the values of total dissolved solids shown in Fig. 10. From this, it is clear that, during the year 2001-2003 values are found to be increased in all the sites of three lakes. Addition of chemicals and salts increases amount of solids in water. The high content of salt degrade the quality of water, this type of water is found to be harmful for drinking, bathing and irrigation purpose even it hampers aquatic life. Amount of solids in water too harm in water quality standard and which is adversely affecting the growth, survival regeneration in plants and animal kingdom with the ecological sense in any water ecosystem. Increase in load of solids can create problem like eutrophication in water ecosystem, which is more harm to aquatic life as well as it can cause the problem, ageing process of lakes. Unprotected and shallower sites attract people for their daily activities like cattle washing, bathing, cloth washing which put more and more dirt to water and make this water unfit for increasement. Thus year by year, the condition of lake water is found to be deteriorating.

- **Total Suspended Solids (TSS)**

The dissolved and suspended solids affect hardness, alkalinity which ultimately affect the physiological activities of flora and fauna.

The observations of suspended solids revealed that no major fluctuations during both the year respectively (Table 12 and 13). However, moderately low total suspended solids (T.S.S.) were

FIG. 11 : VARIATION IN THE TSS DURING YEAR 2001-2003

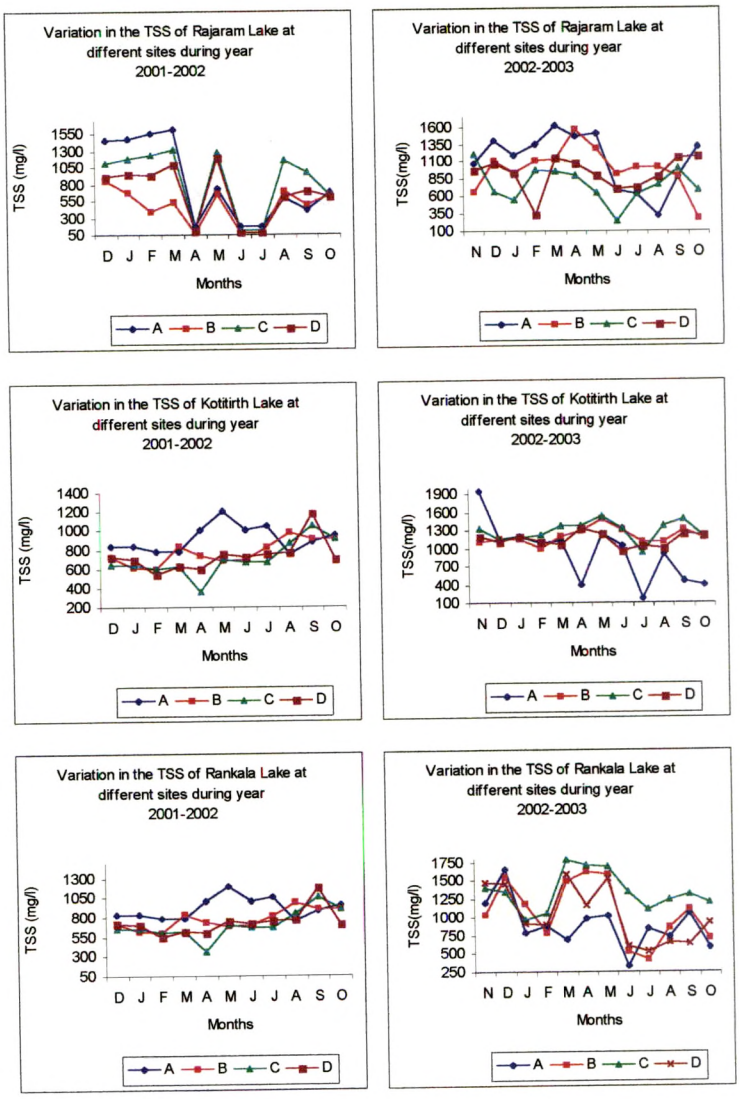


TABLE 14 : SEASONAL VARIATION IN COLOUR DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
B	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
C	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
D	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
KOTITIRTH											
A	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow
B	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
C	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
D	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
RANKALA											
A	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
B	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
C	- do -	- do --	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
D	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow

A - Site A B - Site B C – Site C D – Site D

TABLE 15 : SEASONAL VARIATION IN THE COLOUR DURING YEAR 2002-2003

Months / Site	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
B	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
C	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
D	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
KOTITIRTH												
A	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow	Greenish Yellow
B	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
C	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
D	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
RANKALA												
A	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
B	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
C	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -	- do -
D	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow

A – Site A B - Site B C - Site C D - Site D

recorded during June to August in 2001-2003 respectively. the high suspended solids (1780 mg/l) were noticed in Rankala lake at site C in March 2003 and in the month of May at site B in Kotitirth (1530 mg/l) , Rajaram site A (1500 mg/l) respectively.

Invariably, highest total suspended solids (T.S.S.) were recorded in the year 2001-2002 at site A (1620) of Rajaram lake, March 2002 followed by site C in Rankala (Fig. 11).

TSS denote the suspended impurities present in the water. In most of cases, they are of organic in nature and pose severe problems of water pollution.

- **Colour**

Naturally water is a colourless solvent, which dissolves number of organic and inorganic degradable colour compounds, which gives different colour appearance to water. During study it is found that Rajaram lake shows green colour, while Kotitirth lake shows yellowish green colour in all site in the year 2001-2003 (Table 14 and 15). In case of Rankala lake A, B and C site water is colourless and 'D' site is with yellow colour in both the years. The various colours imparted to the water. By considering external appearance in rainy season due to rainfall colour of water become light green but day by day colour is become dark in January, February it becomes very green and green algal blooms are present on surface (Doiphode, 1992).

The manmade activities which are more influence of water pollution due to disposal of untreated, toxic colour chemicals and biologically degradable organic waste. This type of waste mainly contain dissolved, suspended, volatile solids which slowly degrade in water and remains their forms for long time with it's colour pigments. Mixing of colour compound and growth of aquatic plants, both gives colour to water which may create problem for water penetration. It may reduce photosynthetic rate and create problem to primary and secondary consumers. Any colour compounds and solid mix turbid environment in water, which is harmful to aquatic life.

In our survey although the lake waters were observed yellowish green, green and yellow, do not found to be hamper the aquatic life.

2. CHEMICAL PARAMETERS

- **Dissolved Oxygen (DO)**

Atmospheric oxygen is dissolved in water which is useful for respiration of aquatic flora and fauna. It is most significant characteristic of water for assigning the water quality. The amount of oxygen in water reflects physical and biological, prevailing in water. Each and every organism has specific requirement of oxygen in water. According to Trivedy and Goel (1984), Game fish requires 5 mg/l oxygen and Coarse fish requires 2 mg/l oxygen in water.

TABLE 16 : SEASONAL VARIATION IN THE DISSOLVED OXYGEN DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	7.61 ± 0.43	9.20 ± 0.47	11.80 ± 0.14	13.20 ± 0.10	12.20 ±0.35	14.00 ±0.03	11.20 ± 0.28	10.80 ± 0.12	12.20 ±0.50	8.50 ± 0.27	5.20 ±0.04
B	7.00 ±0.20	9.00 ± 0.20	11.00 ± 1.09	13.00 ± 0.40	10.00 ± 0.20	14.20 ± 0.06	11.00 ±0.44	10.00 ± 0.14	11.20 ±1.16	8.80 ± 0.14	5.00 ± 0.02
C	7.21 ± 0.06	9.50 ± 0.22	11.60 ±0.04	13.60 ± 0.34	11.80 ±0.14	14.00 ± 0.02	11.40 ± 0.10	10.20 ± 0.10	12.90 ± 1.28	8.90 ±0.40	5.80 ± 0.01
D	7.30 ± 0.44	9.30 ± 0.30	11.40 ± 0.02	13.00 ± 0.30	12.00 ±0.12	14.00 ± 0.01	11.60± 0.12	10.60 ±0.04	11.90 ± 0.40	8.20 ± 0.32	5.50 ± 0.06
KOTITIRTH											
A	12.00 ± 0.01	10.50 ± 0.12	10.20 ± 0.20	9.20 ±0.18	13.20 ± 0.15	14.40 ± 0.01	8.20 ±0.43	10.20 ± 0.02	11.00 ± 0.27	8.90 ± 0.40	5.20 ± 0.07
B	12.28 ± 0.04	10.00 ± 0.30	10.00 ± 0.04	9.00 ±0.30	13.60 ± 0.20	14.70 ± 0.02	8.50 ± 0.33	10.00 ±0.01	9.20 ± 0.25	8.60 ±0.15	5.00 ± 0.08
C	12.40 ±0.06	10.20 ± 0.14	10.50 ± 0.14	8.90 ± 0.06	13.00 ±0.25	15.00 ± 0.20	8.60 ± 0.26	11.50 ±0.04	10.20 ± 0.20	9.00 ± 0.32	6.20 ± 0.15
D	12.00 ±0.02	10.50 ± 0.14	10.60 ± 0.12	8.00 ± 0.08	13.50 ± 0.06	14.00 ± 0.14	8.50 ± 0.16	11.00 ± 0.04	11.00 ± 0.15	9.20 ±0.10	6.00 ± 0.20
RANKALA											
A	10.50± 0.021	12.28 ±0.07	12.90 ± 0.01	13.70 ± 0.10	12.80 ±0.10	14.70 ± 0.18	12.00 ± 0.01	11.20 ±0.01	12.20 ± 0.30	13.20 ±1.09	6.30 ±0.12
B	10.00 ± 0.04	12.00 ±0.04	12.60 ±0.02	13.60 ± 0.36	12.90 ± 0.04	14.00 ± 0.04	12.50 ±0.16	11.00 ± 0.12	12.00 ±0.04	13.00 ±0.14	6.20 ± 0.14
C	10.20 ± 0.06	12.48 ± 0.01	12.80 ±0.18	13.90 ± 0.40	12.20 ± 0.02	14.60 ±0.32	13.60 ± 0.17	11.60 ± 0.20	12.60 ± 0.15	13.60 ± 0.12	6.30 ± 0.16
D	10.00 ±0.02	12.21 ±0.07	12.00 ± 0.12	13.80 ± 0.08	12.40 ±0.06	14.80 ±0.30	12.00 ±0.25	11.90 ± 0.30	12.00 ±0.43	13.40 ± 0.12	6.30 ± 0.12

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 17 : SEASONAL VARIATION IN THE DISSOLVED OXYGEN IN THE YEAR 2002-03

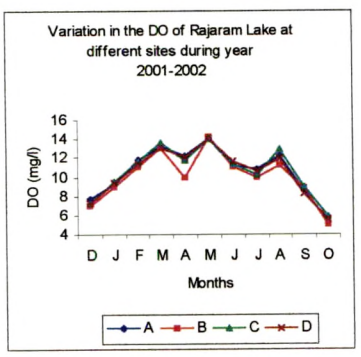
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	10.05 ± 0.01	10.80 ± 0.43	12.17± 0.02	12.80±0.22	14.80± 0.47	15.60 ± 0.50	16.80±0.30	12.13± 0.12	12.30± 0.14	13.60± 0.12	10.46± 0.44	6.67±0.053
B	13.60 ± 0.33	10.70 ± 0.12	13.20 ±0.27	13.60±0.14	14.70 ±0.20	14.80 ± 0.22	16.00±0.20	12.31±0.16	12.49±0.14	14.00 ± 0.12	10.00±0.06	6.20±0.037
C	12.12±0.008	10.80±0.14	13.49 ± 0.32	14.60±0.01	14.20 ±0.20	15.50 ± 0.30	16.20±0.43	12.74± 0.11	12.12±0.14	13.00 ±0.22	9.46± 10.23	6.40±0.044
D	11.62 ± 0.34	10.60± 0.45	13.26± 0.20	15.00±0.04	14.50 ± 0.20	14.40 ± 0.42	16.10±0.26	12.49± 0.14	12.10±0.14	14.44 ±0.11	10.40±0.20	6.60± 0.33
KOTITIRTH												
A	12.48 ± 0.43	12.50±0.01	12.60 ± 0.25	13.80±0.12	12.90 ± 0.02	11.70 ±0.16	Ab	Ab	Ab	11.27±0.01	14.00±0.02	3.22± 0.07
B	12.50 ±0.30	12.70± 0.04	12.80 ± 0.15	13.70±0.16	12.70 ±0.01	11.60 ± 0.30	7.90 ± 0.01	Ab	Ab	10.80± 0.20	12.20± 0.27	4.50± 0.04
C	12.80 ±0.50	12.60± 0.06	12.70 ± 0.20	13.60±0.14	12.60 ±0.02	11.60 ± 0.23	8.20 ± 0.12	12.00± 0.02	Ab	11.00± 0.43	12.07±0.04	4.00± .010
D	12.70 ± 0.44	12.50±0.020	12.60 ±0.22	13.70±0.10	12.50 ±0.04	11.50 ±0.44	8.80± 0.12	14.45±0.22	Ab	12.10 ±0.24	11.36± 0.02	4.20 ± 0.07
RANKALA												
A	14.39 ±0.15	12.25±0.021	13.46± 0.33	13.26±0.12	14.06 ±0.01	13.06± 0.30	15.07±0.25	13.30± 0.02	12.21±0.12	15.26± 0.20	14.10±0.40	6.70± 0.04
B	14.40± 0.17	11.06 ± 0.04	13.48±0.27	13.33±0.12	14.05±0.16	13.12±0.23	15.06±0.12	13.10±0.33	12.12±0.15	15.00 ± 0	15.07± 0.12	6.90±0.02
C	14.38 ± 0.01	12.28 ± 0.06	13.00 ±0.26	13.10±0.12	14.58± 0.02	14.36±0.22	15.26±0.22	13.89± 0.01	12.12±0.15	15.26±0.12	15.00± 0.25	6.20± 0.04
D	14.06 ± 0.27	9.07± 0.02	13.26 ± 0.16	8.80 ± 0.10	14.09± 0.02	13.60±0.12	15.7 ± 0.01	12.8± 0.03	12.9± 0.12	13.86± 0.30	14.00± 0.22	6.30± 0.04

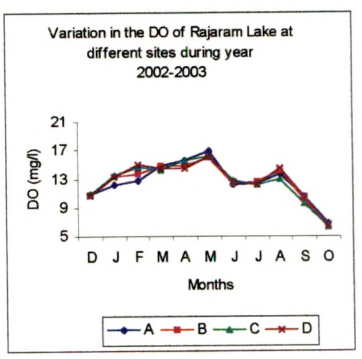
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

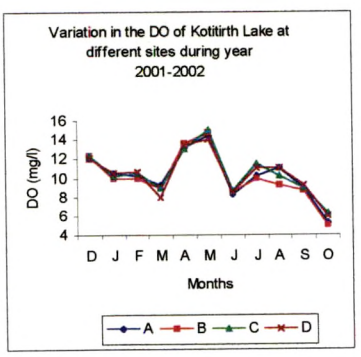
In the present investigation, the values ranges from 5 to 14.8 mg/l in the year 2001-2002 and 0 to 15.7 mg/l in year 2002-2003 (Table 16 and 17). Maximum value 15.7 mg/l is observed in the month of May (2003) in Rankala lake, at the site A and D respectively. Minimum values were observed in the month of October 2002-2003 (5- 6.3 mg/l and 3.22 – 6.9 mg/l) in 2001-2002 in all the three lakes respectively. In May (site A), June (site A and B), July (site A, B, C, D) of Kotitirth shows tremendous decline in dissolved oxygen upto zero. Prokrovskaya (1983) suggested that macrophyte overgrown lakes show important indication of eutrophication such as drop in oxygen content of water. Highest value (15.7 mg/l) is observed in site A of Rankala lake, May 2003.

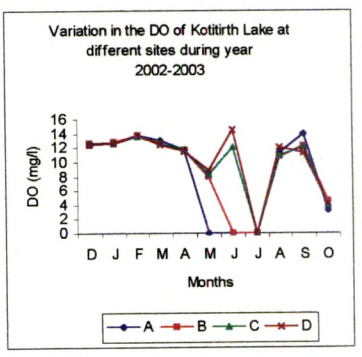
In the year 2002, values of Dissolved oxygen in Kotitirth lake, in monsoon season shows low values (8.2 – 8.6 mg/l) in all the four sites, in the month of June, but in the month of May, these values were increased upto 14.7 mg/l. In the year 2003, due to late monsoon, even in the months of June and July, these are found to be high in all the lakes. But as soon as there are rain starts, the values of oxygen get declined. It may be because of high load of sewage pollution in monsoon and the sources and their ways become dry in summer season which restricts, the mixing of organic wastes at the sites and might helped to rise in the level of oxygen, in post summer season. Low oxygen concentrations are generally associated with heavy contamination by organic matter. It also reflects the anaerobic

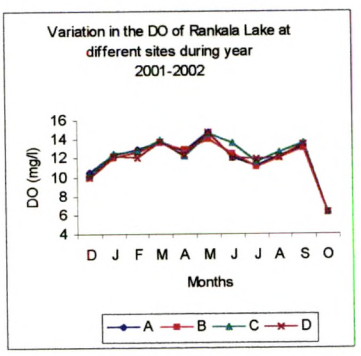
FIG. 12 : VARIATION IN THE DO DURING YEAR 2001-2003

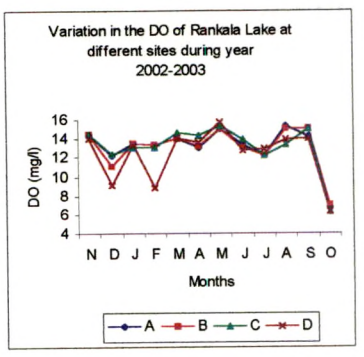












process, in such conditions oxygen was found to be totally disappeared from Kotitirth lake in the months of May, June and July 2003. The absence of oxygen is a striking feature, might be due to invasion of an aquatic weed *Salvinia molesta* Mitchell, which has occupied the total surface area of the lake as discussed in 3.

When organic waste enter into water way, dissolved oxygen is consumed for their breakdown by microorganism. Sometimes, the level of oxygen in water, goes on decreasing at specific level due to mixing of sewage, industrial effluents and discharge of domestic sewage (Kadam, 1990). Low levels of dissolved oxygen increases, in summer season, it may be because of mixing of sewage. The another reason for increasing oxygen level in water may be the wind and wave action which might be recreating the water body in summer season. Seasonal variation in dissolved oxygen has shown in Fig. 12.

Rao, et al. (1999) have reported more dissolved oxygen in Mudasarlova reservoir.

Dissolved oxygen showed an inverse relationship with water temperature. This is probably due to two reasons. In summer at high temperature, the rate of oxidation of organic matter in water increases and oxygen get consumed during the process. Secondly, at higher temperature, the water has a lesser oxygen holding capacity and some oxygen is lost to atmosphere (Rajendran Nair, 2000). So, the present

TABLE 18 : SEASONAL VARIATION IN THE BIOCHEMICAL OXYGEN DEMAND (BOD) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	11.70± 2.62	13.20± 0.60	13.60±1.06	15.60± 0.14	16.80± 1.12	18.10± 1.71	12.10 ± 1.12	13.26± 1.21	15.10± 1.12	11.10± 1.70	10.90± 1.82
B	10.80± 0.80	12.70± 0.50	13.20± 1.12	15.90± 0.60	16.10±1.70	18.00± 1.62	12.00 ±2.10	13.00± 1.71	15.00± 1.62	12.00± 2.12	11.20± 1.08
C	11.63± 1.62	13.60± 0.42	13.30±0.82	16.00± 1.24	16.20± 2.12	18.26± 0.84	13.10± 1.64	14.26±0.82	16.20± 1.10	11.90± 0.82	10.70± 1.21
D	11.21± 2.10	13.80± 0.20	13.00± 0.70	16.10 ± 0	16.66± 1.10	17.90± 1.61	13.00± 1.61	14.00 ±0.82	15.90±1.61	12.10±1.61	10.20± 2.10
KOTITIRTH											
A	15.60± 1.08	14.00± 1.64	14.90± 1.16	13.26±1.60	16.10± 1.64	17.10± 1.08	12.12± 1.12	14.60 ± 1.24	15.20± 1.60	12.00± 1.60	10.8±0.60
B	15.45± 2.12	13.80± 1.71	14.70± 0.82	13.90±1.71	16.05± 1.62	17.00 ± 2.31	12.00 ± 1.24	14.00± 1.61	14.60± 1.12	10.90± 1.71	12.60± 0
C	15.00 ± 1.61	14.20±1.12	14.40±0.70	13.70± 1.00	16.60± 2.10	17.80 ± 2.64	11.77± 1.62	15.60± 1.67	14.00±0.62	11.66± 1.24	12±1.28
D	14.90 ±1.12	14.90± 0.45	14.60± 1.61	13.80± 0	16.80± 1.14	17.20 ± 1.18	12.10± 1.71	15.00± 1.12	15.00±0.71	12.30± 0	10.90± 1.10
RANKALA											
A	13.10± 1.12	14.10±0	15.10±1.62	16.90± 1.71	16.70± 1.25	19.10 ± 1.46	15.10± 1.16	14.10± 0.82	15.10±0.70	17.2± 0.86	8.9± 0.71
B	12.90± 1.64	14.00± 2.17	16.00± 2.10	16.10± 1.12	15.80± 1.62	19.00 ± 2.10	15.00 ±2.62	14.00 ± 1.64	15.00 ± 1.46	16.10 ± 1.70	8.5±1.72
C	13.30±1.29	14.26± 1.12	16.10± 1.67	15.70± 1.71	16.10±1.14	19.60 ±1.12	14.60 ± 1.08	14.26± 1.08	15.07± 1.60	17.0 ± 1.10	9.2±1.62
D	13.00± 0.30	13.00± 2.06	15.00± 1.12	15.20± 1.00	15.60± 0	18.70 ± 0	14.20 ± 1.12	13.10± 1.81	14.30± 1.12	15.67± 0	8.2±1.12

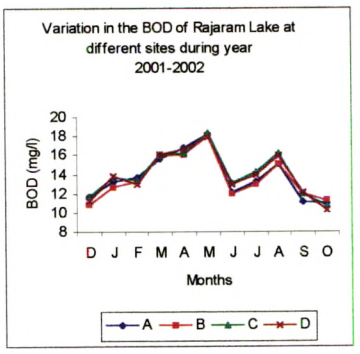
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

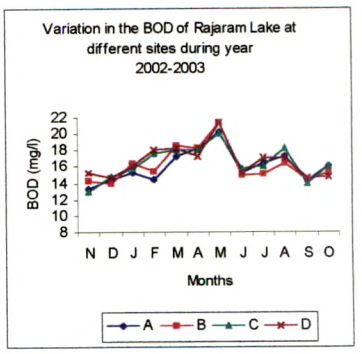
TABLE 19 : SEASONAL VARIATION IN THE BIOCHEMICAL OXYGEN DEMAND (BOD) CONTENT DURING YEAR 2002-03

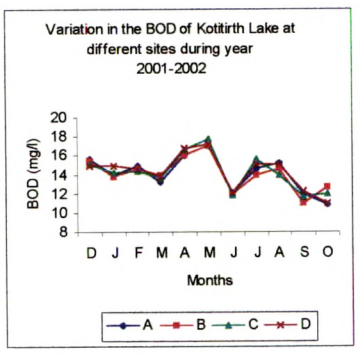
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	13.26 ± 0	14.42± 1.70	15.26± 0.65	14.38±1.71	17.20± 1.10	18.20±1.71	20.20± 1.62	15.23± 0	16.40± 0	17.20± 1.12	14.20±1.25	16.10± 1.61
B	14.30±0.20	14.00± 2.12	16.38± 0.39	15.45± 1.24	18.50 ± 0.82	18.23± 0.82	21.26± 0.59	15.00± 1.12	15.10±0.80	16.45±0.80	14.36± 0.40	15.20±1.08
C	13.00± 1.12	14.70± 1.80	15.70± 1.15	17.60±1.71	18.00 ± 0.10	18.00±0.22	20.10± 1.12	15.67± 0.62	16.10± 0.30	18.20± 1.52	14.00±1.48	16.00± 1.50
D	15.26± 0.82	14.62± 0.92	16.00± 2.12	18.10±0.87	18.20 ±0.64	17.23±0.16	21.36± 0	15.30 ± 0	17.10± 1.64	17.00 ±0	14.60± 1.07	14.70± 2.10
KOTITIRTH												
A	16.10± 0.60	15.23± 1.61	14.20± 1.12	17.30±1.71	18.93± 1.60	16.30± 1.72	19.26± 0.88	15.30 ± 0	13.00±1.14	12.00± 1.18	16.00± 1.02	10.50±1.13
B	16.00± 1.71	15.63± 0.90	15.67±0.80	17.00± 0.60	18.20± 1.71	16.10± 1.60	19.46± 2.05	15.10± 2.12	13.36± 1.22	13.26± 1.74	16.60± 1.62	12.2± 1.18
C	17.20± 1.40	15.10± 0.95	15.00± 0.72	18.23± 0.12	18.00± 2.10	16.00± 1.72	19.20± 1.61	15.60± 1.18	13.70± 1.60	13.00± 1.24	17.00± 2.08	10.00±2.21
D	15.60± 1.62	15.40±0.82	14.93 ± 0	17.93 ± 0	18.08± 1.10	16.73± 2	19.00 ± 3	15.00± 1.10	13.40± 1.12	12.90± 1	17.10± 0	10.80± 0
RANKALA												
A	18.60± 1.24	15.60± 1.07	17.10± 0.82	18.08± 1.71	17.10± 0	18.10 ± 2	20.10 ± 1	16.40± 2.21	15.10±1.70	18.10± 1.12	18.10± 1.71	9.20± 0
B	18.10±1.60	15.00± 2.10	17.20±0.62	18.00±1.42	17.00 ± 1.82	18.00±1.92	20.00 ± 1.62	16.00± 2.10	15.00±2.05	19.00± 1.17	19.20± 0	10.40± 1.10
C	17.07±1.12	15.70 ± 0	18.20± 1.08	17.60± 1.28	17.90 ±1.12	18.20 ± 1.61	21.20± 1.12	16.10±1.28	14.90± 1.0	19.30± 2	19.00 ±0	10.0± 0
D	16.60± 1.61	14.40± 1.10	17.00± 1.12	14.10±1.75	14.40± 2.12	14.10 ± 0	18.10±1.10	13.00 ± 0	14.10±0.82	18.20±1.12	17.10 ±1.71	9.10±1.10

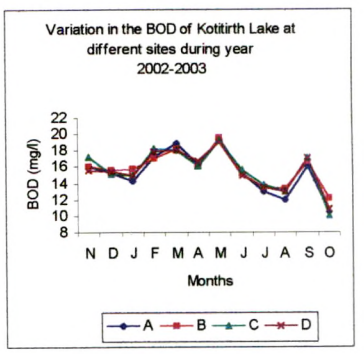
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

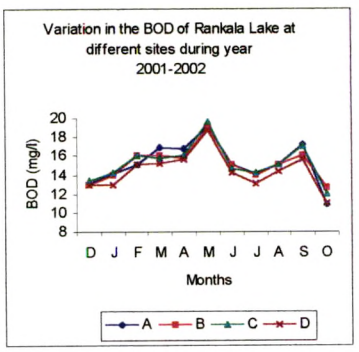
FIG. 13 : VARIATION IN THE BOD DURING YEAR 2001-2003

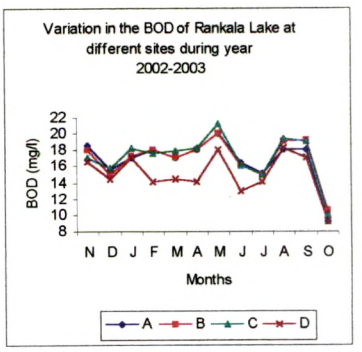












study also shows inverse relationship (Ganapati 1943, Saha et al. 1959 and Singh 1960).

Biochemical Oxygen Demand (BOD) :

Bacteria and other microorganisms use the organic substance as their food. They consume oxygen in metabolizing, these organic compound when this process occurs in water, DO get used and the level decreases. This is the need for oxygen and is called as Biological oxygen Demand (Gautam, 1990). The requirement of oxygen is proportional to the amount of organic waste to be degraded aerobically hence, the BOD value can be used as a major of waste strength. It is also important to know the amount of organic matter present in the waste water and that the quantity of oxygen required for it's stabilization.

Present study reveals that BOD ranges from 10.2 mg/l to 22.10 mg/l in Rajaram lake, site D, Oct. 2002, and Rankala lake, site D May 2003 respectively (Table 18 and 19).

In monsoon season, BOD values are low and in summer season higher in both the years. Variations in BOD values in different seasons focuses on nature of water body and their influence with human activities and mixing of sewage (Fig. 13). BOD values might have got more affected due to mixing of huge load of organic waste in monsoon season which show higher BOD (18.10 mg/l, Rankala lake July, 2003). As compared to other sites, less BOD is specifically

observed in the protected site 'D' of Rankala lake, which prohibits the socioeconomic aspects. In summer season and winter season BOD is increased due to decrease in oxygen content. The high values of BOD are observed which might be due to the sewage pollution as these are mostly drenched by sewage waste (HariHaran, 2002).

The dead remains of biological material get decomposed into water which may help to rise in BOD. Another reason, which is most responsible to increase the level in BOD i.e. direct disposal of organic matter through peoples activities. In summer season, in Rankala, most of peoples and visitors attract towards it, where they come and enjoy with sweets, bhelpuri, vada and some other eatable materials. As per the common habit, remaining food material, paper and plastic bags they throw into lake water (Plate 8).

A sitewise comparative study shows that in summer season the BOD values are increasing at all sites in all the lakes. It may be due to transformation of waste with the help of wind flow water flow and current, wave action and boating activities. The one more reason that may help to rise in BOD values is the death of phytoplankton as well as zooplankton due to increasing in temperature and reduction in volume of water. The dead remains of biological material get decomposed into water which may help to rise in BOD.

The BOD concentration is 46.32 mg/l in Rankala and 86.23 mg/l in Kotitirth was measured by Kadam (1990).

TABLE 20 : SEASONAL VARIATION IN THE FREE CARBON DIOXIDE (Free CO_2) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
KOTITIRTH											
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
RANKALA											
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation Ab – Absent

TABLE 21 : SEASONAL VARIATION IN THE FREE CARBON DIOXIDE DURING YEAR 2002-03

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	4.8 ± 0.62	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	Ab	Ab	1.32 ± 0	Ab	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	1.54 ± 1.12	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	1.1 ± 0.40	Ab	Ab	Ab	Ab
KOTITIRTH												
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	5.6 ± 1.14	4.4 ±1.70	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	Ab	Ab	6.6 ± 1.71	4.4 ± 1.10	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	4.4 ± 0	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	5.28 ± 1.17	Ab	Ab	Ab	Ab
RANKALA												
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

Free Carbon Dioxide (Free CO_2) :

The carbon dioxide liberated in the process of respiration is dissolved in water and founds forms compounds like bicarbonates and carbonates, unbound CO_2, called as free CO_2. It enters in aquatic system through respiration or from the atmosphere. Most of carbon dioxide undergoes bonding while some remains unbound i.e. termed as free CO_2.

Free CO_2 in the water accumulates due to microbial activity and respiration of organisms. This imparts the acidity to the waters because of the formation of carbonic acid (Trivedy, Goel and Trisal, 1987).

The observations on free carbon dioxide reveal that no any values showed in Rajaram and Kotitirth lake in both the years 2002 and 2003 (Table 20 and 21), except in the month of June and May, 2003. In Rajaram lake in the month of June 2003, it ranges from 1.54 mg/l to 4.8 mg/l and in Kotitirth 4.4 to 6.6 mg/l in all the sites. In July 2003 at site A and B it is 4.4 mg/l in Kotitirth lake. In Rankala lake it is throughout absent in both the years.

Thus, free CO_2, dissolved in water is essentially the only source of carbon that can be assimilated and incorporated into the 'Skeleton' of the living matter of all the aquatic autotrophs; once fixed it can further be utilized by the organisms of other categories. In the absence of free CO_2, plants utilize the bicarbonates. Carbondioxide

TABLE 22 : SEASONAL VARIATION IN THE CHLORIDE CONTENT DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	60.2± 0.16	65.0 ± 0.20	70.2 ±0.60	88.0 ± 0.45	120.0 ±0.22	166.0 ± 1.16	87.0 ± 1.18	64.0 ± 1.28	70.2 ±0.42	120.0 ± 2.20	70.0 ± 0.62
B	65.6 ±0.14	68.0 ±0.40	70.8 ±0.25	85.0 ±0.60	130.0 ±0.20	167.2 ±1.08	90.0 ±1.20	66.2 ± 1.61	78.2 ±0.60	122.2 ±1.17	72.2 ±0.73
C	63.2 ± 0.14	62.5 ± 1.21	68 ± 0.20	86.2 ± 0.14	135.0 ± 0.22	168.0 ± 1.21	92.4 ± 1.17	62.0 ±1.20	75.0 ±0.20	126.2 ± 1.10	70.2 ± 0.40
D	61.2 ±1.25	65.5 ± 1.09	60.2 ±0.20	84.8 ± 0.14	140.2 ±0.22	162.6 ± 1.60	90.2 ±1.10	62.9 ±1.32	76.0 ± 0.20	116.2 ± 1.12	76.2 ± 0.42
KOTITIRTH											
A	120.00± 0.25	110.0 ± 0.50	140 ±0.12	120.0 ± 0	152.0 ±1.14	187.2 ± 0	160.2 ±1.21	140.2 ±0.10	125.0 ± 0	132.7 ±0.17	146.0 ±0.12
B	110.0 ± 0.20	155.0 ± 0.15	150 ±0.60	172.2 ± 0.10	140.2 ±0.42	180.0 ± 1.16	170.2 ±.1.09	162.2 ± 0.22	142.0 ±0.45	160.0 ± 0.12	152.2 ± 0.14
C	125.2 ±0.20	140.0 ±0.14	150.2 ±0.62	152.0 ± 0.62	142.0 ± 1.18	162.8 ±0.14	154.2 ±1.08	130.0 ±0.68	142.0 ±0.30	132.0 ± 0.10	130.0 ±0.14
D	160.0 ±1.15	162.0 ± 0.14	150.8 ±0.10	162.0 ± 1.16	145.2 ± 0	204.2 ±0.14	170.0 ±0.15	140.8 ± 0.27	170.2 ±0.36	180.0 ±0.10	177.2 ± 0.14
RANKALA											
A	130.0 ± 2.14	142.0 ±1.18	172.0 ± 0.62	180.0 ± 1.25	187.0 ± 1.07	192 ± 0.35	70.0 ± 1.09	120.0 ± 0.21	142.0 ± 1.17	105.0 ± 0.33	100.0 ±0.10
B	125.2 ±1.09	100.0 ±1.10	68.2 ± 0.60	52.8 ±0.20	60.8 ± 1.09	70.9 ± 0.22	50.2 ±1.21	58.2.0 ±0.16	102.7 ±0.72	95.2 ± 0.32	70.0 ± 0.60
C	135.3 ± 0.40	140.0 ± 1.12	120.0 ± 1.15	65.0 ±0.20	70.0 ± 0.92	165.2 ± 0.18	72.2 ±0.31	62.2.0 ± 0.15	120.2 ±0.61	100.0 ± 0.22	105.0 ± 0.06
D	180.0 ± 0.30	172.5 ± 1.10	175.2 ± 1.10	182.0 ±0.20	188.0 ±0.50	190.2 ± 0.14	175.2 ±0.26	160.2 ±0.14	180.7 ±0.41	170.0 ± 0.22	182.2 ±0.32

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 23 : SEASONAL VARIATION IN THE CHLORIDE CONTENT DURING YEAR 2002-03

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	140.0± 0.80	152.0±0.72	136.0 ±0.62	142.0± 1.08	182.0± 1.09	185.5± 0.33	198.0±1.61	160.0± 1.71	130.0± 1.10	88.73± 1.10	142± 1.71	85.5± 0.62
B	148.0± 1.08	160.0± 1.81	135.5± 0.23	135.0± 1.12	181.2± 0.13	186.0±0.72	199.2± 1.10	172.0± 0.82	140.0± 1.62	90.0± 1.67	130.0±1.12	80.0±0.14
C	139.0± 0.40	158.2±0.60	136.0 ± 1.12	134.4± 1.10	180.0± 0.22	175.0±0.07	200.0±0.62	152.0± 0.45	127.0± 1.71	82.28±0.80	134.0±0.62	82.7± 1.24
D	125.0± 0.62	150.0± 0.45	140.0± 1.10	148.0±1.61	178.0±0.14	182.0± 1.12	202.5± 0.35	170.0± 1.08	116.0± 1.10	87.00± 1.07	128.0±0.45	79.7± 0.16
KOTITIRTH												
A	160.2± 1.16	172.0± 1.61	160.0± 0.42	180.2± 1.10	195.0± 0.20	200.0±0.65	240.0± 1.22	210.0±0.10	192.0±0.24	170.0 ±0.70	140.0±0.30	150.0±0.17
B	165.2± 1.15	175.2± 1.16	165.0± 0.55	172.0± 1.67	192.2± 0.22	205.0±0.67	225.5± 0.20	200.0±0.20	190.0±1.22	175.0 ± 0.62	142.0±0.20	160.2±0.33
C	152.5 ± 0	180.2± 1.10	164.0± 0.83	168.0± 0.18	190.0± 1.26	192.2± 1.10	212.5±1.09	205.0±0.19	182.2±1.14	172.0±1.10	112.0±0.21	160.0±0.12
D	170.0± 0.10	183.0 ±0.80	160.2± 1.06	160.0±2.10	182.2±2.19	198.0± 1.87	235.0± 1.20	200.2± 0	180.0± 0.63	162.0 ± 1.17	120.0±0.62	162.2±0.17
RANKALA												
A	150.2± 0	160.2 ± 0	189.2± 1.12	210.2± 1.67	200.2± 0.62	230.0± 1.71	240.2±1.60	178.1±0.72	160.5±1.08	180.0 ± 0	142.0±1.22	150.0±0.68
B	110.2± 2.17	120.2± 1.17	100.2±1.71	65.06± 0.12	75.2±1.10	120.2±1.71	140.2± 1.12	61.06 ± 0	100.0±1.67	102.0±0.28	120.0±1.12	70.2± 1.21
C	100.7±0.52	80.0 ± 1.70	122.0± 1.12	77.0 ± 1.71	78.0± 1.71	79.22± 1.10	175.0±0.42	171.0± 1.14	144.0± 1.18	122.0±2.20	110.0±0.80	80.0± 0.72
D	212.2± 0.12	220.2± 1.67	221.3± 1.61	200.3± 1.17	210.3± 0	210.3± 0.60	230.2±0.30	223.2±0.42	231.4 ± 0	213.0± 1.71	200± 1.22	210.2± 0

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

dissolved in natural waters actively participates in the carbonate system (Adoni, 1985). The free CO_2 concentration is near about nil/ trace was recorded by Trivedy, 1983 in Kalamba samples. The free CO_2 of the most of the reservoirs, was low probably due to it's faster utilization by phytoplankton (V.R. Desai and A. K. Das, 1998).

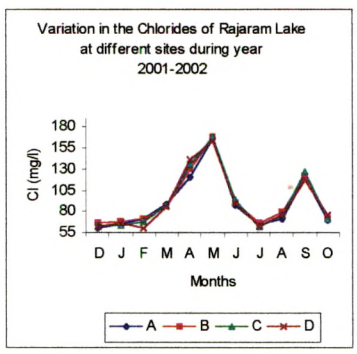
According to Hutchinson (1957) if the pH increases to a high level above 8, it may result in the complete absence of free CO_2.

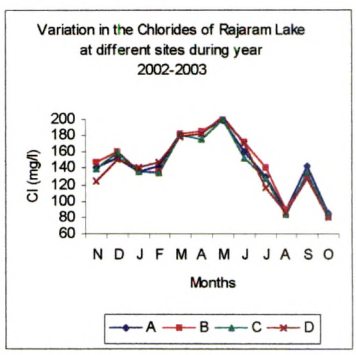
- **Chloride**

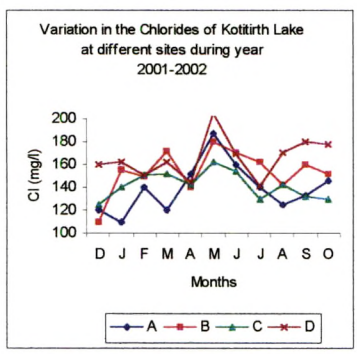
Chlorides are usually present in low concentrations in natural waters and play metabolically active role in photolysis of water and photophosphorylation reactions in autrotrophs. In natural freshwaters, however, it's concentration remains quite low and is generally less than that of sulphates and bicarbonates. The most important source of chloride in the water is the discharge of domestic sewage. Man and other animals excrete very high quantities of chlorides together with nitrogenous compounds. About 8-15 gms of NaCl is excreted by a person per day (Trivedy and Goel, 1984). Therefore the chlorides concentration serves as an indicator of pollution by sewage. Even though it is harmless upto 1500 mg/l in concentration, but it produces a salty taste at 250 – 500 mg/l of concentration.

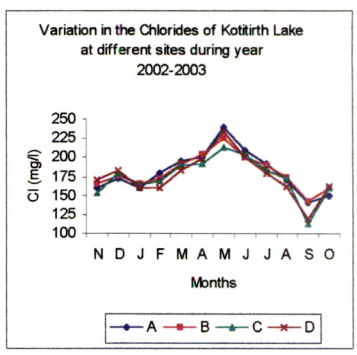
In the present study, low level of chlorides were found in Monsoon season and it was high in summer season (Table 22 and 23). The chloride level ranges in between 60.2 to 240.2 mg/l in both the

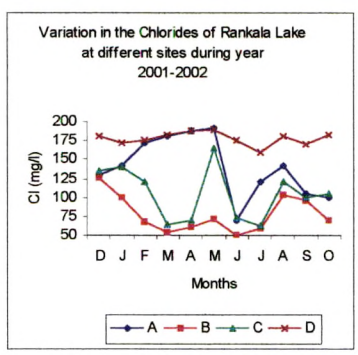
FIG. 14 : VARIATION IN THE CHLORIDES DURING YEAR 2001-2003

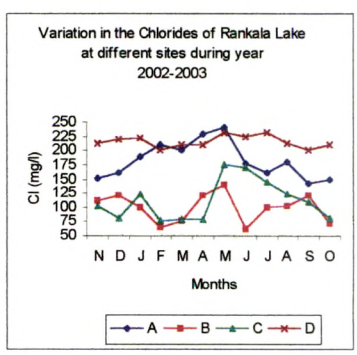












years in all lakes. Site 'D' of Rankala lake shows high values of chlorides (190.2 and 230.2 mg/l) in both the years respectively. Seasonal variation in the chloride levels shown in Fig. 14. After completion of monsoon season the levels of chlorides at all site in all lakes going on increase, it may be due to high rate of evapotranspiration rate of water which reduces the depth of water as well as reduction in volume of water and at last which increases the chloride content in water which was diluted earlier in the monsoon season. The chloride level increases upto 240 mg/l at site A Kotitirth, which was highest in summer and lowest was noted from Rajaram lake site 'A' and it was 60.2 mg/l.

From all above the observations it is clear that the site 'A' of Kotitirth and site 'D' of Rankala are highly influenced with domestic sewage in both the years 2002-2003. While remaining sites of Rajaram lake indicate quite equal balance in both years in all seasons. The higher concentration of chloride is considered to be an indicator of pollution due to higher organic waste of animal origin. There is a direct correlation between chloride concentration and pollution level (Munawar, 1970). This could be also due to sewage mixing and increased temperature and evapotranspiration by water (Govindan and Sudarsan, 1979, Jana, 1973). Agarkar (1998) has reported 36.2 mg/l of chlorides in summer season and 33.90 mg/l in monsoon season from the Chandai reservoir. Rao and Mahamood (1995) have also reported chloride content in the month of May and September as 560

TABLE 24 : SEASONAL VARIATION IN THE HARDNESS DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	90.2 ± 0.40	80.2 ± 1.12	105.0 ± 2.12	110.0± 0.72	122.2± 1.04	125.0± 0.20	110.0± 0.62	80.0± 0.78	102.2 ± 1.29	100 ± 1.41	70± 0.10
B	80.0 ± 1.09	79.0 ± 2.16	105.0± 0.85	115.0± 1.26	122.0 ± 0.70	130.0± 0.32	125.0 ± 0.54	82.2 ± 1.09	102.0± 1.40	102 ± 0.88	78 ± 2.07
C	90.0 ± 0.50	80.0 ± 3.12	105.2± 0.40	112.0 ± 0.62	125.0 ± 0.89	148.0± 0.18	121.0 ± 2.32	82.0 ± 1.51	102.0± 1.27	100.5 ± 1.09	72.5± 1.26
D	90.0± 1.16	80.0 ± 0.70	105.0± 0.14	115.2 ± 1.18	122.0± 1.141	150.0± 0.60	120.2 ± 1.09	80.0 ± 0	105.0 ± 0	102± 1.71	70 ± 0.20
KOTITIRTH											
A	132.0 ± 0.60	160.0 ± 0.65	150.0 ± 2.60	142.0± 0.32	172.0± 1.30	192.0± 1.17	140.0 ± 1.73	152.0± 1.27	160.2± 1.42	142± 0.52	150± 1.17
B	130.5 ± 0.72	162.0 ± 1.32	150.2± 1.17	140.0± 1.09	170.2± 1.67	193.0± 1.09	145.0 ± 1.21	150.0 ± 0.70	160.0 ± 0.82	140 ± 0.57	152± 1.28
C	130.0 ± 1.22	160.5± 2.10	150.0 ± 1.62	140.2± 1.16	172.0± 1.51	190.0± 1.18	145.5 ± 1.09	150.0 ± 2.61	155.0 ± 0.88	140 ± 0.60	150 ± 0.40
D	130.0 ± 0.30	160.0 ± 0.82	148.0 ± 0.60	140.0± 2.30	172.0± 0.80	196.0 ± 1.09	140.0 ± 1.09	150.0± 1.27	140.0 ± 1.51	140 ± 0.62	150± 70
RANKALA											
A	105.0 ± 1.51	130.0 ± 1.28	120.0± 1.17	126.0 ± 0.40	120.0± 0.58	140.0 ± 0.48	122.0± 0.40	80.0± 1.11	130.0 ± 1.11	100± 0.88	82 ± 0.12
B	100.2 ± 1.20	130.5± 0.62	122.0± 1.82	124.2± 0.32	122.5± 1.12	145.0± 0.30	125.2± 0.52	80.2± 1.42	132.0 ± 0.70	120 ± 0.70	80± 1.16
C	100.2 ± 0.62	130.0 ± 2.65	123.0± 0.92	124.0 ± 0.14	120.0± 1.34	146.0± 0.28	122.0± 0.50	80.0± 2.61	130.0± 0	100± 1.71	82 ± 0.50
D	100.0 ± 0.52	130.0 ± 1.17	120.0± 0.62	126.0 ± 0.14	120.0 ± 0	150.0± 0.32	122.0 ± 0.56	80.0± 0	132.0 ± 1.11	120 ± 1.09	80 ± 1.28

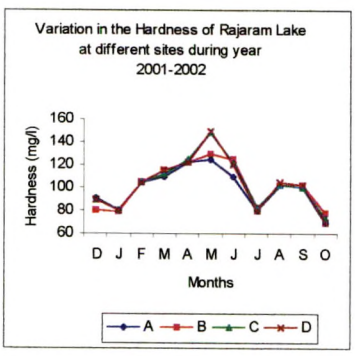
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

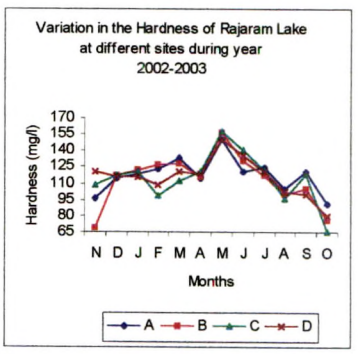
TABLE 25 : SEASONAL VARIATION IN THE HARDNESS DURING YEAR 2002-2003

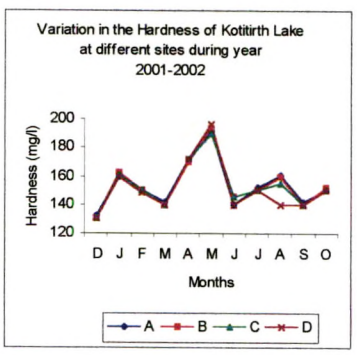
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	96.2 ± 1.09	114.6± 0.89	118.2± 2.6	123.4 ± 1.94	133.0 ± 1.71	114.0± 0.70	150.0± 2.42	120.0± 0.89	124.2± 1.27	104.4 ±0.89	120.0± 1.71	90.7 ± 1.29
B	68.8± 1.64	116.8± 1.09	122.0± 1.54	126.2 ± 1.09	128.2± 0.88	116.0± 1.09	156.3± 1.09	130.0± 0	116.3± 1.61	100.2 ±0.69	105.0± 1.84	75.6 ± 1.40
C	108.4± 0.89	116.6± 2.30	120.0 ± 2.04	98.0 ± 1.12	112.0 ± 0.66	121.2± 1.78	158.0 ± 0	140.0± 0.78	122.2± 0.60	95.3± 0.78	118.0 ±0.92	65.2 ± 1.27
D	120.4± 0.89	116.0± 1.73	116.0± 2.40	108.0 ± 1.21	120.0±1.61	118.0± 1.41	150.0 ± 0	135.0± 0.82	120.2± 0.80	102.0± 0.82	100.0 ± 0.78	80.0 ± 1.29
KOTITIRTH												
A	187.4 ± 1.51	189.4±0.54	210.0±0.62	190 ± 1.71	186.0± 1.41	192.0± 0.80	230.7 ± 0	175.2±1.64	180.2± 1.42	201.4± 2.19	210.6 ± 1.34	181.2 ± 1.09
B	180.2± 1.42	186.2± 0.57	200.0±0.42	192± 1.31	188.3± 1.61	196.0± 0.58	228.0± 2.32	180.0±0.82	190.0±0.89	210.0±0.040	195.2 ±1.64	170.2± 1.09
C	182.4± 1.71	188.0±0.58	185.0± 0.60	194.2 ± 1.67	187.2 ± 1.28	200.0±0.67	240.0 ± 1.09	190.3± 0.03	150.0± 1.09	240.6 ± 0.52	190.3 ± 1.09	151.6± 2.30
D	178.0± 1.62	190.0± 0.71	188.0±0.53	192.3± 1.62	184.0± 1.25	210.0±0.72	230.0± 2.40	210.0± 0	100.0± 1.73	260.2± 0.62	180.0 ± 1.21	174.8± 1.78
RANKALA												
A	156.6± 0.89	150.0± 0	146.0± 0.82	142 ± 1.41	135.6± 1.34	145.0±0	150.0± 2.21	152.0 ±1.37	98.2± 3.49	110.4± 0.89	120.6± 0.54	120.0± 1.41
B	145.2⊥ 0.87	140.4± 0.89	145.0± 0.71	136.2± 1.12	140.2 ±0.88	130.0±0.89	145.1± 1.27	140.2± 1.42	148.4± 2.61	135.0± 0	125.0± 0	90.4± 0.89
C	140.7± 1.21	135.2± 0.71	130.0± 0	125 ± 0	120.4±0.70	110.2± 1.21	115.2± 0.70	120.4± 0.72	66.2± 1.42	115.0± 0	105.2±1.11	92.0 ± 1.41
D	152.0 ±0	155.0± 0.45	145.2± 0.77	140 ± 0	158.0± 1.51	128.4± 2.61	180.3± 1.27	184.2± 1.11	250.0± 0	230.0± 0.70	170± 0.82	88.8± 1.30

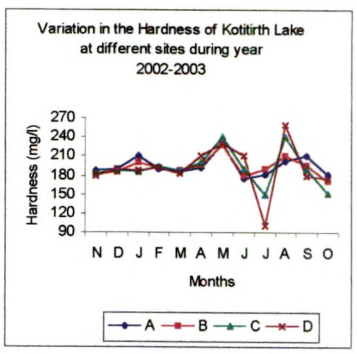
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

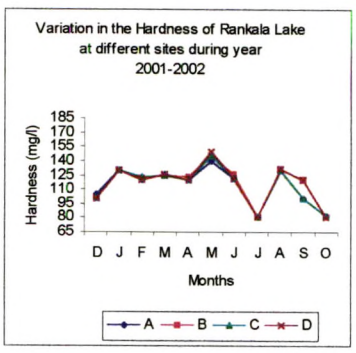
FIG. 15 : VARIATION IN THE HARDNESS DURING YEAR 2001-2003

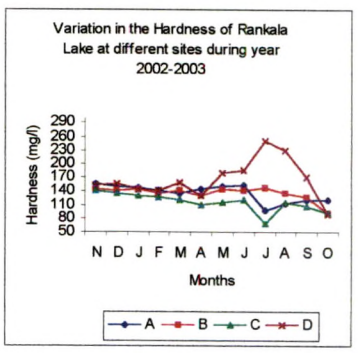












ppm and 320 ppm respectively from the Hubsigunda Pond (A.P.). Kumar and Singh (1996) have reported 34 to 52 mg/l of chlorides in the summer season and 31 to 45 mg/l of chlorides in monsoon season from the lake of Santhal Pargana (Bihar).

- **Hardness**

Hardness is the property of water which prevents the leather formation with soap. It is mainly due to calcium and magnesium ions and some other polyvalent ions such as Al, Fe, Mn and Zn.

The permanent hardness is mainly caused by sulphates and chlorides of the metals. This type of water is unsafe for various uses like washing, cleaning and laundering. As well as hard water creates problems to the swimmers. The high or low hardness of water even though it does not affect human health.

Hardness occurred in the range of 100 to 180 mg/l General scale of hardness of water provided by Lehr et al. (1980), is 60-120 mg/l as moderately hard, 120-180 mg/l as hard and more than 180 mg/l as very hard.

Hardness ranged from 70-196 mg/l in year 2001-2002 and 80 – 240 mg/l in 2002-2003 (Table 24 and 25). In summer season water of three lakes ranges from hard to very hard (148 mg/l, site C, Rajaram May 2001 and 158 mg/l site 2003 respectively). Seasonal Variation in Hardness shown in Fig. 15.

All above results indicate that as the level of calcium and magnesium goes on reducing in monsoon season, the level of hardness get reduced. It may be because of continuous inflow of rain water to highly reduced volume of water. For the human activities like bathing, cattle washing, cloth washing other water resources are available, but in summer season the human activities are fully loaded in these lakes, which may contribute the high Ca and Mg, which increases hardness of water in summer season.

Rao and Mahmood (1995) have reported 42 ppm hardness in post monsoon and 54 ppm in post summer season from the Habsiguda pond. Agarkar (1998) has stated 202 mg/ l of hardness in monsoon season and 280 mg/l in summer season from the Chandai reservoir, water.

Alkalinity :

Alkalinity is characterised by the presence of all hydroxyl ions capable of combining with the hydrogen. It is it's capacity to neutralise a strong acid. Alkalinity in natural water is due to free hydroxyl ions and hydrolysis of salts formed by weak acid and strong bases. It is imparted by the salts of weak acid like bicarbonate alongwith salts of carbonate, silicates, phosphates as well as humic and fulvic acids. Some of water bodies are polluted, due to organic pollutants have alkalinity. Sometimes it is also govern in natural

TABLE 26 : SEASONAL VARIATION IN THE ALKALINITY DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	200.0± 1.31	162.0± 0.70	130.0± 0.82	122.0±0.79	182.2 ± 0	250.0 ± 0	122.6± 0.50	110.0± 2.21	172.0 ± 1.18	220.0 ± 0.60	210.0 ± 1.30
B	195.0 ± 0	160.0± 2.21	132.0± 1.26	125.2± 2.40	178.0 ± 1.12	260.0 ± 1.09	120.0± 0.14	115.2± 2.09	180.0 ± 2.16	210.2 ±0.18	200.0 ± 1.42
C	180.0 ± 1.18	163.2± 1.80	137.0±1.17	120.0± 2.16	180.0± 2.12	275.0± 1.12	132.0± 1.18	110.0± 2.31	176.0 ± 3.01	190.0 ±1.12	205.0 ± 0.60
D	200.0 ± 2.20	160.5 ± 0	142.2± 1.60	120.0± 1.09	175.0 ± 1.14	192.0± 1.07	130.0± 1.10	120.0± 0.80	182.0 ± 0.50	165.0 ± 2.61	210.2 ± 1.18
KOTITIRTH											
A	180.0 ± 2.10	160.0± 1.70	182.0± 0.60	170.0± 0.50	190.5 ±0.30	210.0± 0.40	172.0± 2.41	192.0± 0.62	152.0 ± 1.09	175.5 ± 0	202.0 ± 0.62
B	190.0 ± 2.72	160.7± 0.40	182.1± 1.10	175.2± 0.40	192.0 ± 0.26	220.0 ± 0.12	175.0± 1.16	190.0± 0.40	150.0 ± 1.70	170.2± 0.20	200.0 ± 1.18
C	192.0 ± 1.09	160.8± 0.70	180.0± 2.15	170.0± 0.40	195.0 ± 0.28	215.0 ± 1.21	170.3± 0.80	195.2± 0.32	155.2± 2.18	172.0 ± 0.40	199.0 ± 2.20
D	180.2 ± 1.50	160.0± 1.40	180.0± 2.17	170.0± 1.16	194.2 ± 0.20	198.0 ± 0.40	170.0± 0.72	195.0± 0.28	150.0 ± 0.60	173.2 ± 0.14	195.2± 1.71
RANKALA											
A	120.0 ± 1.73	122 ± 1.62	170.2± 1.87	162.0± 1.20	175.2 ± 1.10	196.0 ± 0.10	134.0± 0.32	120.0± 0.12	168.0 ± 1.72	180.2 ±0.06	170.0± 0.70
B	120.5 ± 2.23	127.2 ± 1.41	169± 2.26	160.0± 2.12	176.1 ± 0.40	188.0 ±0.06	136.0± 0.25	122.0± 0.14	170.0± 10.09	182.0 ± 0.12	172.0 ± 1.26
C	118.0 ± 2.19	122.5 ± 0.60	168± 2.10	162.0± 1.17	172.2 ± 0.50	180.0 ± 0.32	135.0 ±0.30	120.2± 0.10	160.2± 1.50	187.0 ± 1.31	175.2 ± 1.14
D	120.0 ± 3.53	121.2 ± 1.20	167± 0.80	162.0± 1.10	175.0 ± 0.42	190.0 ±0.30	136.0 ± 1.18	120.0± 0.40	167.0± 1.18	185.0 ± 1.20	170.0 ± 0.50

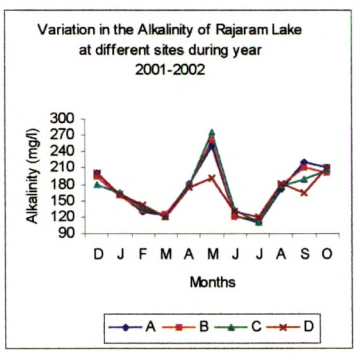
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

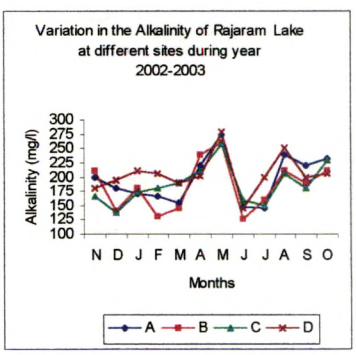
TABLE 27 : SEASONAL VARIATION IN THE ALKALINITY DURING YEAR 2002-2003

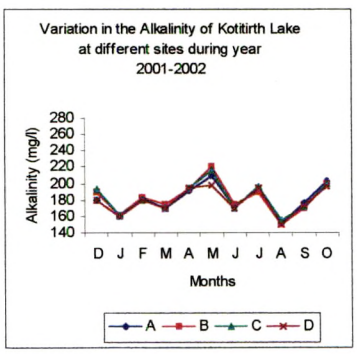
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
RAJARAM												
A	200.0 ± 131	180.8± 2.04	170.4± 1.11	165.0± 2.51	155.2±1.41	220.0± 1.71	275.2± 0.42	147.5± 0.72	145.0± 1.26	240.0.± 1.14	220.0±0.80	230.8± 2.93
B	210.2 ± 1.21	140.2± 2.31	181.0±2.15	130.0± 1.12	145.0± 2.61	240.0± 1.22	260.0± 2.21	125.0± 1.07	160.0± 2.22	210.0± 0.80	190.0± 2.65	210.0± 0.89
C	165.0 ± 3.27	138.6± 3.10	172.0± 1.31	180.4± 2.31	190.0± 1.27	210.2± 2.17	257.0± 2.12	160.0± 1.18	149.2± 0.60	205.0± 3.12	180.0± 1.22	230.0± 4.47
D	180.0 ± 2.71	195.0± 1.71	210.3± 1.42	205.1± 1.27	190.5± 0.62	200.4± 1.19	280.0± 1.61	145.0± 1.61	200.0± 0	250.2± 1.52	200.0± 0.62	205.0± 2.30
KOTITIRTH												
A	221.0 ± 1.41	228.4± 2.30	224.0± 2.23	244.2± 2.38	280.2± 1.09	330.0± 1.63	380.0± 2.14	220.0± 2.18	240.0± 2.70	250.0± 1.42	240.0± 1.71	240.6± 2.19
B	242.0 ± 1.62	251.2± 1.62	237.2± 1.63	241.3± 1.18	262.0± 2.64	342.4± 0.70	370.0± 3.12	230.0± 1.27	220.0±1.26	270.0± 2.20	200.0±1.12	220.0±2.23
C	280.2 ± 2.1	260.0 ± 0	240.4± 1.18	265.0± 1.69	275.0± 2.63	320.0± 1.42	345.0± 1.09	250.0± 2.04	200.0± 3.30	245.0± 0.42	220.0± 1.60	210.0± 2.23
D	260.0 ± 3.22	255.0± 1.57	265.2± 1.26	247.3 ± 0	310.0± 1.62	300.0± 2.30	340.0± 2.20	200.0± 0.65	210.0± 1.20	235.0± 0.20	200.0± 0	220.0± 2.23
RANKALA												
A	165.6 ± 2.30	177.0± 1.87	188.4± 0.89	170.0 ± 3.12	165.0± 2.20	180.0± 1.12	250.0± 0.70	205.0± 2.23	180.0± 0.70	180.0±1.40	190.0±1.50	248.6± 2.19
B	170.2 ± 1.14	160.0± 1.62	185.4±0.70	178.2± 1.21	185.0±3.12	183.0±3.10	220.0± 1.21	160.0± 2.16	190.0± 2.10	170.0± 2.72	180.0± 1.62	220.4± 0.89
C	160.0 ± 0	165.0± 1.31	170± 2.24	175.5± 1.10	160.0± 2.91	182.0± 2.41	210.2±1.09	170.6± 1.20	160.0± 1.30	195.0± 3.10	220.0± 1.25	280.0± 3.53
D	202.2 ± 1.16	190.2± 1.22	220± 1.27	240.0± 1.68	230.0±2.22	260.0± 0.50	300.0± 1.42	230.8± 1.14	230.0± 2.70	240.0± 1.70	220.0± 1.09	260.0± 1.73

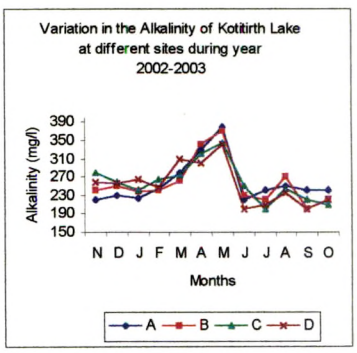
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

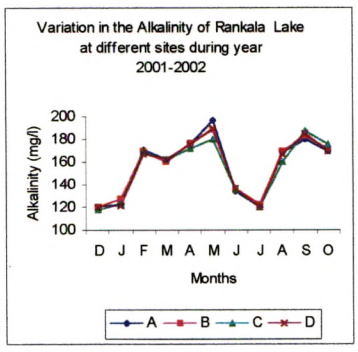
FIG. 16 : VARIATION IN THE ALKALINITY DURING YEAR 2001-2003

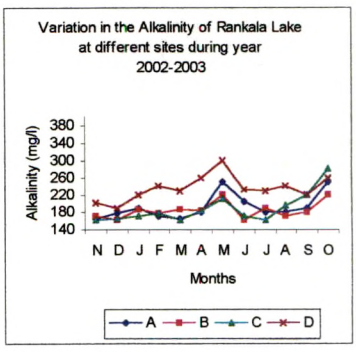












waters by photosynthesis in aquatic plants and decomposition of organic waste through microbes.

The present study shows lowest alkalinity in monsoon season and it was increasing in summer season in Rankala, Rajaram and Kotitirth lake water (Table 26 and 27).

In monsoon season it ranges inbetween 125 to 260 mg/l in 2002-2003 and 120 to 210 mg/l in 2001-2002 in all lakes, and it was lowest range. This range of alkalinity go on increasing from the monsoon season to towards upto summer season (Fig. 16). Highest value of alkalinity (380 mg/l) is found in Kotitirth lake at site A in May 2003. While the same in site D of Rankala, range is 190-300 mg/l. Lowest alkalinity range (118- 210 mg/l) at site C of Rankala lake during year 2002-2003 respectively.

From all observations, it is clear that the alkalinity of all the lake water is decreasing in monsoon and increasing in summer season. It may indicate that, in monsoon season, due to high rainfall, huge load of organic mater gets sufficient space and time for dilution and settlement of organic pollutants in the lake water body. The solid organic waste degrade slowly in water upto summer season, which may help to increase alkalinity in water. The another most interesting aspect, is the human activities like cloth washing before Navratra festival, people use various types of soaps, detergents and other

TABLE 28 : SEASONAL VARIATION IN THE PHOSPHORUS (PO_4-P) CONTENT DURING 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	6.07 ± 1.10	4.80 ± 2.21	5.51 ± 1.08	5.41 ±2.21	5.80 ±1.65	5.05 ± 1.65	5.90 ±0.25	5.60 ±0.50	5.62 ± 1.06	7.71 ±1.13	6.90 ± 1.70
B	6.77 ±2	6.70 ± 1.16	5.60 ±2.07	5.45 ± 1.67	4.18 ±1.12	5.14 ±1.07	5.14 ± 1.67	4.95 ±1.08	5.65 ±0	4.22 ± 1.92	6.75 ±1.64
C	6.44 ± 1.08	5.53 ± 1.10	6.20 ± 1.08	5.73 ± 3.12	5.42 ±1.12	5.12 ±0.70	5.64 ±1.40	4.85 ± 0.80	5.40 ± 1.10	6.60 ±1.56	6.95 ± 0.75
D	6.30 ± 0	6.83 ± 1.67	6.32 ± 2.50	5.82 ±0.50	5.05 ±0.53	5.22 ±0.42	5.22 ± 0.70	5.75 ± 1.40	5.43 ±2.08	6.82 ±1.22	6.01 ±1.44
KOTITIRTH											
A	3.15 ± 1.16	3.10 ±0 .24	3.80 ±0.27	3.25 ± 0.77	4.73 ± 0.61	3.90 ± 1.67	3.80 ± 1	3.05 ± 0.90	4.12 ± 1	3.27 ±0.60	4.40 ± 1.67
B	3.81 ±1.32	3.75 ± 0.32	4.15 ± 0.68	3.65 ±0.17	3.12 ± 1.67	3.75 ± 1.30	3.45 ± 1.80	3.21 ± 2	4.20 ±1.08	3.20 ±1.33	4.50 ±1.82
C	3.93 ± 1.62	3.58 ± 0.15	3.75 ± 1.22	3.03 ± 0.42	4.02 ± 1.80	3.83 ± 1.77	3.30 ± 1.37	3.20 ± 0.67	4.06 ± 0.82	3.18 ±1.80	4.32 ± 1.22
D	3.70 ± 0.46	3.60 ± 0.20	3.05 ± 0.80	3.02 ± 0.70	4.02 ±2.05	3.80 ± 1.12	3.85 ±1.12	3.20 ± 0.32	4.22 ± 0.70	3.10 ± 1.12	4.14 ± 1.67
RANKALA											
A	4.20 ±0.80	4.03 ±1	4.73 ± 1.56	4.62 ± 1.08	4.12 ± 1.27	4.85 ± 1.26	3.72 ±1.24	4.10 ±1.72	4.20 ±1.14	3.45 ± 1.61	4.32 ± 1.64
B	4.68 ± 0.40	4.68 ± 0	4.05 ± 1.24	4.72 ±1.82	4.10 ±2.07	4.65 ± 2.21	3.60 ± 1.64	4.12 ±2.21	4.22 ±1.67	3.40 ±0.82	3.85 ±0.27
C	4.30 ±1.07	4.25 ± 1.96	4.05 ±1.10	4.28 ±1.86	4.25 ± 1.65	4.90 ±1.72	3.68 ±1.12	4.20 ± 0.63	4.12 ± 1.12	3.20 ±1.67	3.60 ± 1.12
D	5.50 ±1.67	4.36 ± 1.80	4.12 ±1.57	4.82 ± 1.37	4.22 ± 1.13	4.92 ± 0	3.70 ± 1.61	4.23 ± 1.10	4.10 ± 0.72	3.50 ± 0.20	4.20 ± 2.21

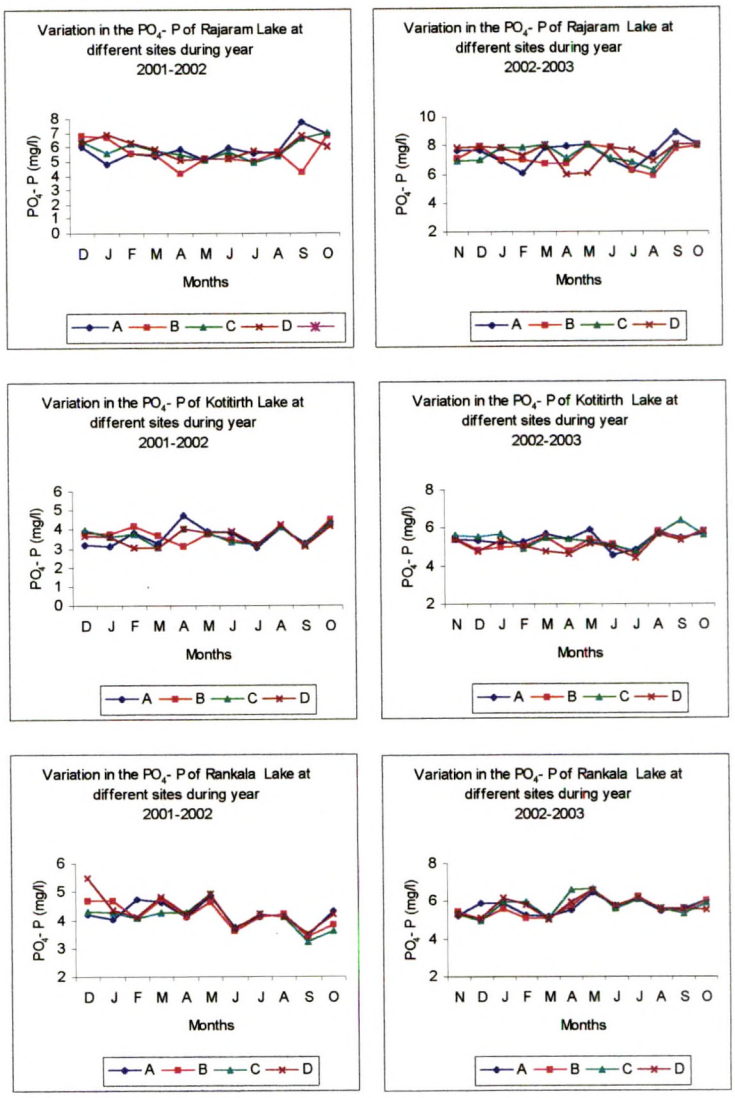
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 29 : SEASONAL VARIATION IN THE PHOSPHORUS (PO_4-P) CONCENTRATION DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	7.63 ± 0.22	7.67 ± 0.10	6.88 ± 0.01	6.02± 0.14	7.87 ± 0.32	7.9 ± 0.26	8.07 ± 0.01	7.02 ± 0.14	6.23 ± 0.25	7.33 ± 0.12	8.87±0.004	8.01 ± 0.02
B	7.08±0.017	7.9 ±0.026	7.01±0.004	7.02±0.10	6.72 ± 0.20	6.7 ± 0.20	8.07 ± 0.13	7.82 ± 0.12	6.22 ± 0.45	5.9 ± 0.14	7.72 ± 0.10	7.95 ± 0.08
C	6.85± .032	7.02 ±0.25	7.79 ± 0.04	7.82 ± 0.12	8.0 ±0.16	7.06 ± 0.30	8.01 ± 0.10	7.07 ± 0.14	6.82 ± 0.20	6.22 ± 0.12	8.02 ± 0.12	7.98 ± 0.13
D	7.85 ±0.021	7.90 ± 0.14	7.82 ± 0.02	7.27±0.12	8.0 ±0	6.0 ± 0.42	6.07 ± 0.02	7.80 ± 0.12	7.67 ± 0.40	6.86 ± 0.12	8.0 ± 0.10	8.01 ± 0.01
KOTITIRTH												
A	5.36 ± 0.02	5.30± 0.02	5.15 ± 0.14	5.26 ±0.30	5.65 ± 0.24	5.38 ± 0.04	5.87 ±0.30	4.55 ± 0.20	4.82 ± 0.16	5.74 ±0.22	5.44 ±0.30	5.64 ± 0.03
B	5.44± 0.02	4.82 ±0.04	4.95 ±0.14	5.02 ±0.02	5.55 ± 0.15	4.78 ±0.06	5.42 ± 0.40	5.12 ± 0.42	4.62 ±0.12	5.78 ±0.20	5.40 ± 0.22	5.83 ± 0.03
C	5.62 ± 0.04	5.52± 0.01	5.68 ±0.12	4.87 ± 0.22	5.48 ±0.10	5.36 ± 0.02	5.25 ± 0.12	5.01 ±0.01	4.77 ±0.12	5.67 ± 0.20	6.40 ±0.10	5.61 ± 0.02
D	5.41±0.008	4.78 ± 0.02	5.30 ± 0.10	5.02 ± 0.20	4.77 ±0.20	4.63 ± 0.04	5.20 ±0.10	5.00 ±0.40	4.43 ±0.12	5.70 ± 0.20	5.30 ±0.20	5.78 ±0.02
RANKALA												
A	5.27 ± 0.01	5.87 ± 0.01	5.87 ± 0.20	5.23 ±0.25	5.17 ±0.22	5.55 ± 0.12	6.45 ± 0.25	5.72 ± 0.12	6.12 ± 0.01	5.47 ± 0.01	5.61 ±0.30	6.0 ± 0.017
B	5.44 ± 0.03	5.07 ±0.03	5.60 ±0.18	5.12 ± 0.14	5.08 ± 0.16	5.75 ± 0.14	6.57 ± 0.10	5.65 ± 0.14	6.22 ± 0.02	5.55 ± 0.06	5.44 ± 0.24	6.0 ±0.008
C	5.32± 0.001	5.0 ± 0.02	5.95 ± 0.14	5.97 ±0.30	5.13 ± 0.30	6.62 ± 0.14	6.67 ± 0.12	5.60 ±0.10	6.10 ±0.04	5.62 ± 0.04	5.34 ± 0.25	5.86 ± 0.02
D	5.35 ± 0.03	5.11 ± 0.008	6.16 ± .008	5.83 ± 0.01	5.02±0.008	5.92 ±0.06	6.60 ± 0.02	5.74 ± 0.01	6.15 ± 0.02	5.6 ±0.03	5.57 ±0.01	5.56 ± 0.08

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/l

FIG. 17 : VARIATION IN THE PO_4–P DURING YEAR 2001-2003



washable drug, which may help to increase alkalinity in lake water. These activities take place on during September to October months.

According to B. guru Prasad (2003) alkalinity content of all the water samples in Tedipalimadal are ranging from 201.66 to 646.66 mg/l which are found to be above prescribed standards.

- **Phosphorus** (PO_4 -P)

For the growth and survival of the life, phosphorous is considered as most important nutrient. It is present mostly in inorganic forms, such as $H_2PO_4^-$, HPO_4^{-2} and $P\text{-}^2O_4$ Phosphorus being an important constituent of biological systems, may also be present in the organic forms. The rocks in which most of the phosphorus is bound, are generally insoluble in water and hence the phosphorus content of natural freshwaters is low and biological growth is limited due to this fact. The major sources of phosphorus are domestic sewage, detergents, agricultural effluents with fertilizers, and industrial waste waters. The higher concentration of phosphorus, therefore, is indicative of pollution (Trivedy and Goel, 1984).

From the table 28 and 29, it is clear that the phosphorus level increase in post monsoon and it decreases in post summer season. The concentration of phosphorus ranges between 3.20 mg/l (Site C, Sept. 2002) in Rankala lake and 8.87 mg/l (site A, Sept. 2003) in Rajaram lake respectively (Fig. 17).

Lowest concentration was noted in Rajaram (4.18 mg/l) at site B in April 2002, Kotitirth (3.05 mg/l) at site A in July 2002, Rankala (4.10 mg/l) at site B in April 2002 respectively.

From above observations it is clear that the phosphorus level was found high in post monsoon season and declined in post summer season, it may be because of high and continuous discharge of domestic sewage, detergents, washing and cleaning of cloths, vehicles, cattle washing, bathing and swimming in post monsoon season and the level of phosphorus decline in post summer season, it may because of drying way of domestic sewage discharge and unavailability of usable sites for bathing, washing and cleaning because of low level of water in lake body. Phosphate is an important plant nutrient associated with eutrophication. Excess of phosphate is reported to be present in domestic sewage. According to Arceivala (1981) raw domestic wastewater may contain an average of 10 mg/l of phosphate.

Available-P was low in amount (0.01 to 0.06 mg/l) which indicated it's faster utilization by the phytoplankton and algal mass (Boyd, 1982).

The higher concentration of phosphorus is therefore an indication of pollution (Trivedy and Goel, 1984).

TABLE 30 : SEASONAL VARIATION IN THE NITRATE (NO_3-N)CONTENT DURING 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	10.9 ± 0.40	12.0 ± 0.24	11.70± 0.16	9.20 ± 0.26	11.6 ±0.16	10.00 ± 1.14	8.60 ±0.01	8.00 ± 0.12	9.20 ± 1.10	7.70 ± 2.30	12.70±1.10
B	10.6 ± 0.32	11.2 ±0.20	12.00 ±0.23	10.60 ±0.17	11.0 ±0.35	10.00 ±0.30	8.20 ±0.17	8.40 ± 0.22	8.60 ± 0.70	7.20 ± 1.17	11.60 ± 0
C	11.5 ± 0.22	11.0 ±0.32	11.40 ± 2	9.50 ±0.004	11.20± .13	10.00± 0.12	8.00± 0.18	10.60 ±0.24	8.20 ± 0.60	7.40± 2.21	11.20±0.62
D	10.02 ± 0.44	11.7 ± 0.36	12.60 ±1	9.70 ± 0.31	11.0 ± 0	10.00± 0.25	8.70 ± 0.19	10.00 ± 0.21	9.40 ± 0.82	7.60 ±0.80	11.40± 0.12
KOTITIRTH											
A	7.50 ± 0.14	6.2 ± 0.20	5.60 ± 2.12	7.70 ± 0.26	8.0 ± 0.42	8.2 ± 1.17	6.2 ±0.30	9.20 ±0.3	7.80 ±0.17	8.20 ± 0.77	8.70 ± 2
B	6.90 ± 0.32	6.7 ±0.14	5.2 ±2.14	7.9 ± 0.42	8.0 ± 0.12	8.0 ± 0.43	6.00 ± 0.43	8.60 ± 0.20	7.60 ± 1.10	8.00 ± 0.62	9.20 ±1.12
C	7.20 ±0.16	6.6 ± 0.12	5.4 ± 0.080	8 .0 ± 0.32	7.7 ±0.28	8.2 ± 0.25	6.40 ± 0.27	8.80 ±1.10	7.20 ±0.25	8.60 ± 0.16	9.00 ±2.15
D	7.50 ±0.12	6.0 ± 0.26	6.0 ± 1.08	8.2 ± 0.28	8.0 ±0.26	8.2 ± 0.21	6.90 ±0.32	9.00 ± 0.20	6.60 ± 0.47	8.40 ±1.16	8.60 ±0.62
RANKALA											
A	8.2 ±0.01	8.4 ± 0.20	7.20 ±0.42	8.60 ± 0	9.20 ±0.65	10.40 ±0.16	7.70±10.05	8.20±2.12	10.20±1.10	6.60 ± 1.01	7.80 ±0.60
B	8 ±0.04	8.5 ± 0.25	6.20 ±0.20	8.70 ±1	9.00 ± 0.72	10.00 ±0.14	7.90 ± 1.17	8.40 ±0.62	10.40 ± 1	6.20 ± 0	7.00 ±0.70
C	8.4 ± 0.16	8.5 ± 0.25	7.70 ± 0.61	8.20 ± 1.10	9.60 ± 0.17	10.20± 0.14	7.90 ±0.90	9.20 ± 0.40	11.00 ± 1	6.00 ±0.30	7.20 ±0.20
D	8.6 ±0.40	8.00±0.14	7.80 ±0.26	9.20 ± 0.70	9.40 ± 0.88	9.60 ±0.14	7.60 ±1.16	9.00 ± 2	11.20±0.60	6.80 ±0.50	7.60 ± 0.26

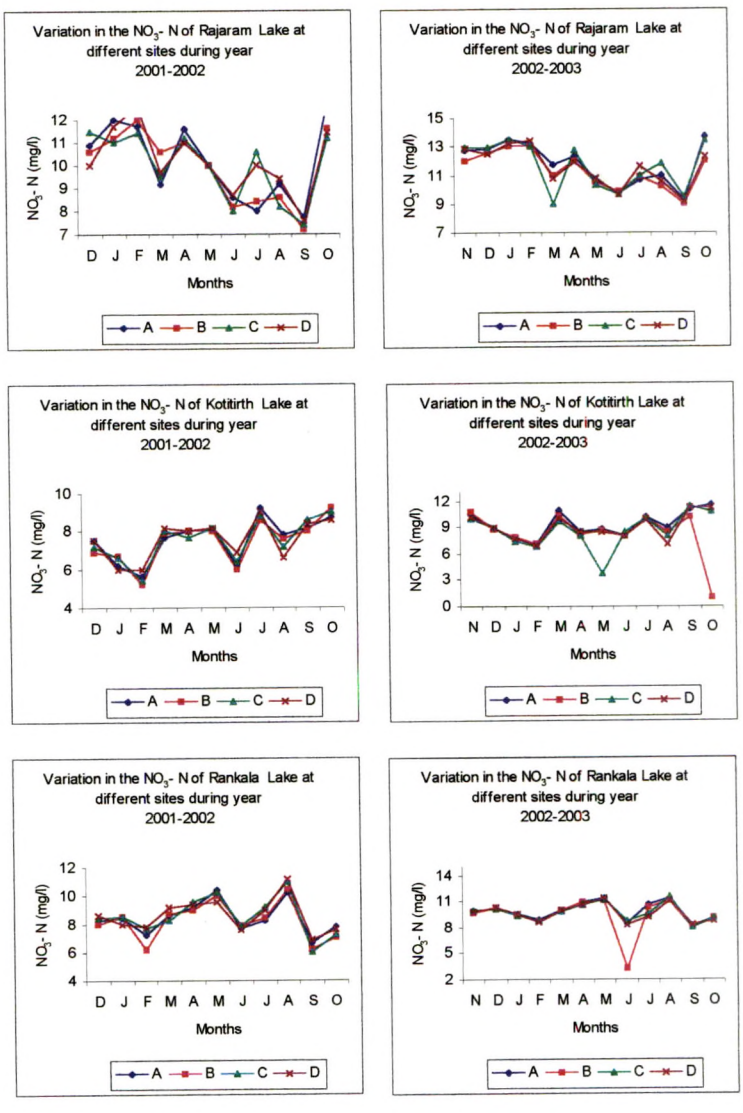
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 31 : SEASONAL VARIATION IN THE NITRATE (NO_3-N) CONTENT DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	12.77±0.28	12.80 ±0.32	13.50± 0.25	13.20±0.10	11.70±0.07	12.3 ± 0.3	10.7 ± 0.50	9.77 ± 0.22	10.7 ± 0.24	11.0 ± 0.32	9.23 ± 0	13.7 ± 0.14
B	12.0± 0.29	12.60± 0.14	13.0±0.35	13.0 ± 0	11.0± 0.18	12.0 ± 1.16	10.5 ± 0.32	9.8 ± 0.30	10.9 ± 0.20	10.2 ±0.43	8.93 ± 0.20	12.0 ± 0.021
C	12.90±0.15	12.90±0.12	13.50 ± 0.20	13.0 ± 0.14	9.0 ± 0.04	12.7 ± 0.26	10.3 ± 0.50	9.6 ±0.20	11.0 ±0.20	11.8 ± 0.30	9.49 ±0.40	13.4 ±0.30
D	12.80± 0.14	12.50 ± 0.12	13.20±0.14	13.40± 0.14	10.80±0.32	11.9 ±0.32	10.8 ±0.53	9.6 ± 0.20	11.6 ± 0.004	10.6 ± 0.30	9.12 ±0.40	12.27± 0.35
KOTITIRTH												
A	10.34 ± 0.23	8.8 ± 0.44	7.71 ±0.25	6.97 ±0.22	10.80± 0.04	8.42 ±0.02	8.72 ±0.54	7.88 ± 0.12	10.03 ±0.14	8.90 ±0.20	11.0 ±0.32	11.5 ±0.35
B	10.7 ± 0.14	8.7 ±0.53	7.87 ±0.42	7.10 ±0.30	10.20±0.01	8.17 ±0.02	8.57 ± 0.26	8.0 ± 10.16	10.0 ± 0.14	8.45 ±0.30	10.03 ±0.25	0.91 ± 0.16
C	10 ±0.14	8.9 ±0.26	7.37 ± 0.36	6.67 ±0.12	9.57±0.02	8.0 ±0.01	3.60± 0.44	8.4 ±0.14	9.87 ±0.14	7.90 ±0.22	11.28 ±0.20	10.66 ± 0.03
D	10.08 ± 0.7	8.8 ± 0.32	7.58 ±0.20	6.86 ±0.12	10.0 ± 0.01	8.34 ± 0.01	8.48 ± 0.40	7.97 ± 0.14	9.77 ±0.14	7.0 ± 0	11.10 ± 0.14	11.16 ± 0.16
RANKALA												
A	9.88 ± 0.04	10.11± 0.16	9.50 ± 0.16	8.87± 0.14	9.92±0.30	10.8 ± 0.15	11.37 ± 0.01	8.36 ± 0.18	10.6 ± 0.29	11.27 ± 0.02	8.11 ± 0.28	9.11± 0.014
B	9.66 ± 0.04	10.27±0.03	9.37 ± 0.43	8.68±0.12	10.0 ± 0	10.9 ±0.10	11.00 ±0.01	3.20 ±0.20	10.2 ±0.16	11.0 ±0.04	8.02 ±0.14	9.02 ±0.10
C	9.91 ± 0.01	10.12± 0.28	9.28 ±0.24	8.77±0.14	9.81±0.32	10.5 ± 0.12	11.22 ±0.02	8.67 ±0.20	9.45 ± 0.20	11.44 ± 0.01	8.0 ±0	9.08 ±0.014
D	9.82 ± 0.03	10.27 ±0.14	9.57 ±0.22	8.57± 0.20	9.90 ±0.22	10.6 ± 0.10	11.30 ±0.04	8.20 ± 0.22	9.22 ± 0.20	11.08 ± 0.02	8.27 ± 0.14	8.79 ±0.17

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

FIG. 18 : VARIATION IN THE NO_3–N DURING YEAR 2001-2003



Nitrate :

Nitrate represents the highest oxidized form of nitrogen. Only a few mineral sources of nitrate such as soda niter deposits in chile, exist in nature and most of the surface waters are, therefore, deficient in nitrate. The most important source of the nitrate is biological oxidation of organic nitrogenous substances which come in sewage and industrial wastes or produced indigenously in the waters. Domestic sewage contains very high amounts of nitrogenous compounds. Run-off from agricultural fields is also high in nitrate.

Present study reveals that nitrate ranges from 6 to 13.8 mg/l in both the years (Table 30 and 31). High values of Nitrate (13.8 mg/l at site D, May 2003) are found in summer season, while low values were found in rainy season in all the three lakes (Fig. 18).

Nitrate nitrogen has been given particular importance in freshwater pollution. Ried (1961) found that world average of nitrates in unpolluted waters in 0.3 mg/l. Our values are quite high from this value. It may be because of pollutants mixing in all sites of the lakes. Nitrate is one of the most important nutrients in an aquatic ecosystem. Generally water bodies polluted by organic matter exhibit higher values of nitrate (Kodarkar, 1995).

In the present study water samples of the lakes showed high concentration. this may be due to sewage and high concentration of nutrients owing to the evaporation of lake water.

TABLE 32 : SEASONAL VARIATION IN THE SODIUM (Na) CONTENT DURING 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	4.40 ± 0.15	6.10 ± 0.30	8.90 ± 0.035	5.50 ± 1	3.06 ± 0.14	4.16 ± 1.50	5.10 ±0.32	8.16 ± 1.20	12.10 ± 1	17.12 ±2.21	9.20 ±1.34
B	5.10 ± 0.14	6.70 ± 0.12	8.10 ±0.11	5.10 ± 0	3.00 ±0.12	4.00 ± 0.12	5.00 ±0.28	8.10 ± 1.12	14.90 ± 0	9.10 ±1.16	9.00 ± 1.60
C	5.40 ±1.10	7.15 ±0.37	6.05 ± 0.56	5.00 ± 0.10	3.60 ± 0.12	3.90 ± 1.10	5.70 ± 0.42	9.16 ± 0.26	15.16±1.28	15.10 ±0.28	9.30 ±1.12
D	5.60 ± 1.15	6.40 ±0.18	6.86 ± 0.18	5.20 ±0.10	3.50 ±0.12	4.16 ± 1.07	5.16 ±0.30	10.20 ± 0	15.00±0.10	18.10 ±0.50	8.90 ± 1.08
KOTITIRTH											
A	28.10 ±1.10	20 ±1.61	12.00±1.16	14.00±1.10	16.00±1.71	19.20 ± 0	16.17±0.01	20.16 ± 0	25.26 ± 0	21.00 ± 2	18.20±1.71
B	30.00 ± 1.27	18.10 ±1.42	14.40 ±2.12	14.28 ±2.21	16.90 ± 1.62	15.20 ±2	16.00± 0.80	18.12 ± 1	26.00 ±1.17	22.20 ±1.12	16.10 ±0.90
C	22.70 ±1.18	22.00± 2.60	15.60 ±0	12.26 ±1.16	15.20 ± 0	20.2 ± 0	16.40 ±0.27	19.18 ±0.12	22.22± 1.161	23.10 ±1.01	16.00 ± 0.14
D	31.2 ± 1.20	23.20 ±1.71	15.00 ±1	14.20± 1.10	17.40 ± 1	25.50 ± 0	15.00± 0.18	21.22± 0.10	20.00 ±1	23.0 ± 1.09	15.90 ±0.12
RANKALA											
A	13.26 ± 1.81	22.20 ±1.71	23.26 ±1.12	32.00 ±1	20.00 ±1.12	20.26 ±0	45.60± 1.16	38.20 ± 0	20.20 ± 1.12	17.20 ±0	7.6 ± 0.82
B	22.24 ± 1.20	20.48 ± 0	10.08 ±1.02	12.48± 1.12	26.20±1.10	10.02 ± 0	12.48 ± 0	36.50 ±1	22.20±0.85	25.20±1.07	18.20±1.08
C	16.10 ±1.61	21.12 ± 1	25.50 ±3.12	12.50± 0.80	12.00 ±0.20	11.50 ±0.12	20.60± 1.12	32.26 ± 0	30.6 ±2	36.20 ±1.16	10.20 ±0
D	42.50 ± 1.17	45.00 ± 0	46.50 ±0	38.20 ± 0	36.20 ±0.18	30.00 ± 0.17	53.20 ±1.10	50.20 ±1.17	52.34 ± 1.12	20.00± 1.61	17.28 ± 0.17

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

TABLE 33 : SEASONAL VARIATION IN THE SODIUM (Na) CONTENT DURING YEAR 2002-2003

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	10.14± 0.21	6.67 ± 0.12	8.90 ±0.36	10 ± 0	6.68 ± 0.34	4.68 ± 0.21	5.22 ± 0.20	5.33 ±0.36	18.5 ±1.15	22.5 ± 0	26.5 ±1.34	11.46 ± 0.28
B	10.0 ± 0.24	6.90 ± 0.20	7.45 ±1.18	9.25 ±2.16	6.71 ±0.20	4.77 ±0.06	6.90 ± 0.30	5.74 ±1.18	30.5 ± 1.62	20.5 ±0.01	14.5 ± 0.30	11.04±0.008
C	11.0 ±0.39	6.71 ± 0.14	8.30 ± 2.21	7.64 ± 0.32	6.88 ±1.32	4.55 ± 0.08	6.71 ± 0.14	5.88 ±0.30	15.0 ±0.32	18.0 ±0.02	20.5 ±0.54	11.18 ±0.10
D	10.4 ± 0.12	6.88 ± 0.14	7.60 ±0.12	8 ±2.10	7 ± 1.42	4.50 ±0.32	5.87 ±0.36	5.74 ± 0.12	12.5 ± 0.20	19.5 ±0.32	25.0 ±0	10.0 ± 0
KOTITIRTH												
A	74.7 ± 1.64	40.4 ± 0.30	25.1 ± 1.62	18 ±0.22	18.4 ±1.51	19.0 ±1.312	25.5 ± 1.18	15.41 ±3.31	284.5 ± 0	148 ±0.02	165.5 ± 0	84. 08± 2.35
B	69.64 ±0.58	38.0 ± 0.22	26 ± 1.22	19.1 ±0.30	18.3 ± 1.08	19.1 ±1.21	30.0 ± 3.32	15.35 ± 2.12	279.0 ± 0	142.5 ± 0.01	176.0 ± 0.42	81.0 ±1.41
C	65.3 ± 0.44	32.0 ±0.20	26.5 ± 1.20	19 ±0.12	17.5 ±0.40	19.4± 1.09	32.5 ±0.40	15.36 ± 0.53	282.0 ±0.50	145 ± 0	155.0 ±0.54	82.6 ±2.19
D	68.2 ±1.09	35.5 ± 0.10	25.0 ± 1.12	19.2 ±0.14	18.1 ± 0.54	20.0 ±1.81	28.0 ± 1.09	15.45 ± 040	280.0 ±0.42	142 ± 0.60	170.0 ±0.26	81.2 ± 4.43
RANKALA												
A	17.42 ± 0.51	16.2 ± 1.14	28.5 ±0.18	29 ±2.20	45 ±1.21	22.0 ±1.16	20.0 ±0.004	62.5 ±0.36	53.0 ±0.26	24.8 ±1.16	20.2 ±1.32	8.7 ±0.57
B	27.84 ± 0.08	26.0 ±1.09	25.8 ± 1.26	12.21±1.81	15.1 ±0.26	45.0 ±2.14	12.2 ± 0	18.5 ±0.15	52.0 ±1.26	32. 8 ± 2.30	30.0 ±2.14	29.5 ±0.27
C	22.4 ±0.26	22.0 ± 0.36	24.5 ± 0.15	30 ±0.34	18.5 ±0.10	18.0 ±1.12	17.5 ±0.25	26.0 ± 0.30	54.5 ± 0	50.5 ± 0.04	52.0 ±0.20	15.46 ±0.28
D	49.9 ±0.54	52.5 ± 0.21	53.0 ±0.44	54. 6 ±0.17	45.2 ± 3.56	39.5 ± 2.64	35.4 ±0.26	60.0 ±1.41	58.0 ±4.47	57.4 ±0.22	22.58 ± 0.34	22.4 ±1.81

A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

When the concentration of nitrates exceeds 40 mg/l, methamoglobinemia disease occurs. In this disease the skin becomes blue due to decreased efficiency of haemoglobin to combine with oxygen.

In the waste treatment systems, high amounts of nitrate denote the aerobic conditions and high stability of the wastes. Although high concentrations are useful in irrigation but their entry into the water resources increase the growth of nuisance algae and trigger eutrophication.

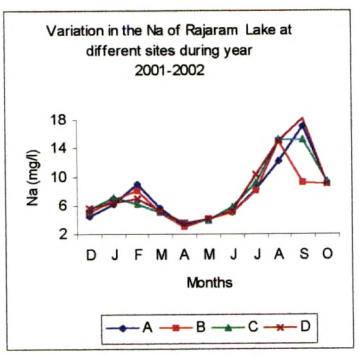
- Sodium

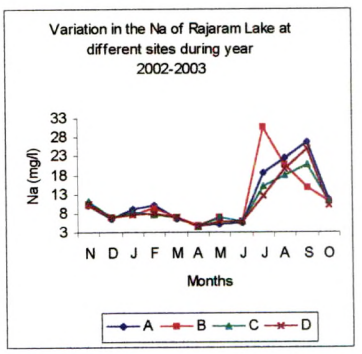
Sodium is present in all natural waters and it's salts impart water with softness. This element plays a minor role in aquatic systems and it's importance to all organisms has not been fully understood, except for the role it plays in on exchange and transport. Sodium when present in high concentrations (e.g. in saline and brackish waters) limits the biological diversity due to osmotic stress.

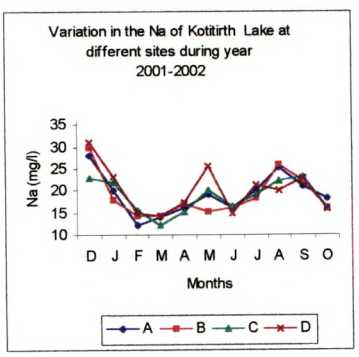
Sodium enters in freshwater due to weathering of various rocks, industrial wastes and domestic sewage (Trivedy and Goel, 1984).

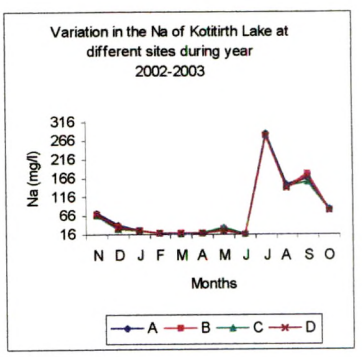
In the present study, sodium concentration is quite low in summer season and increases in monsoon season (Table 32 and 33). Highest values of sodium observed in Kotitirth lake in July 2003, ranges from (279 to 284.5 mg/l). It may be due to mixing of industrial

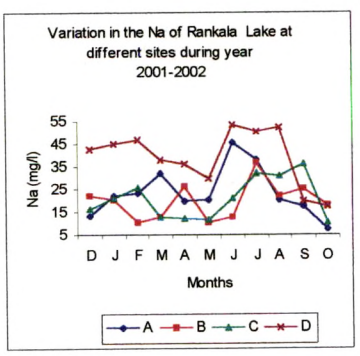
FIG. 19 : VARIATION IN THE Na DURING YEAR 2001-2003











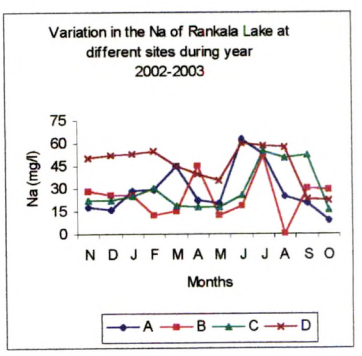


TABLE 34 : SEASONAL VARIATION IN THE POTASSIUM (K) CONTENT DURING 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	5.56 ± 0.19	6.71 ± 0.12	8.71 ± 0.30	7.71 ± 0.16	6.21 ±0.05	5.11 ± 0.11	6.12 ±0.12	5.21 ± 0	6.10 ±0.24	4.11 ± 0.10	4.60 ± 0.04
B	4.90 ± 0.85	7.72 ± 0.01	8.82 ±0.19	8.90 ±0.10	6.30 ± 0.03	4.10 ±0.02	5.20 ± 0.36	7.72 ± 2	6.00 ±0.38	5.20 ±0.04	4.12 ± 0.14
C	5.72 ± 1.17	6.88 ± 0.04	7.90 ±0.21	9.00 ±0.03	6.10 ±0.10	4.0 ± 0	5.80 ±0.17	8.81 ± 0.40	15.00 ±1.17	12.20 ±0.30	5.57 ±0.02
D	5.10± 1.04	7.80 ± 0.42	8.02 ±0.02	7.61 ±0.026	6.00 ±0.18	5.62 ±0.04	5.72 ±0.25	5.10 ±0.27	6.7 ±0.20	5.00 ±0.43	5.60 ±0.34
KOTITIRTH											
A	12.27± 0	8.87 ± 0.16	8.87 ±0.02	10.15 ±0.18	11.70 ±0.10	12.00± 0.18	10.12 ±0.32	15.30 ±0	14.16 ±0.19	10.12 ±0.22	8.81 ±1.12
B	13.26 ± 0.02	12.66± 0.15	13.26± 1.20	12.70 ± 0.02	11.30± 0.11	12.70 ±0.14	10.00 ±0.06	15 ±1.12	14 ± 0.03	10.26±10.08	8.22 ± 0.20
C	13.00 ± 0.06	13.76 ±0.35	14.20 ±0.32	12.00 ±0	11.02 ± 0	11.90 ±0.14	9.21 ±0.03	12 ±0.20	14.16 ±0.12	9.12 ±0.20	9.91 ±0.10
D	12.10 ±0.12	12.20 ±0.19	11.80 ±0.20	10.30 ±0.24	12.0 ± 0	12.10 ±0.14	8.21 ± 0.04	12.26 ±0.10	14.11 ±0.01	9.02 ± 0.18	8.02 ±0
RANKALA											
A	16.90 ± 0	24.16 ±0.20	32.1 ±0.38	20.20 ±0.04	16.10 ±0.05	17.2 ±0.02	21.2 ±0.42	32.10 ±0.03	22.10 ±0.008	30.00 ±1.12	9.92 ±0.80
B	22.10 ± 0.10	25.10 ±0.04	40.20 ±0.02	22.10 ±0.40	15.06 ±0.27	16.6 ± 0.04	13.10 ±0.18	33.00 ±0.10	20.10 ±0.06	32.00 ± 0.65	9.10 ±0.25
C	20.12 ± 0.23	25 ±0.12	40.10± 1.02	20.10 ± 0.22	16.0 ±0.02	16.0 ± 0	10.40 ±0.40	34.00± 0.12	21.22 ± 0.10	31.00 ±0.28	9.00 ±0.34
D	17.10± 0.009	22.20 ±0	30.2 ±0.32	23.40 ± 0.10	16.10 ±0.33	17.2 ± 0	7.62 ± 0.14	30.10 ±0.06	22.10 ±0.20	29.00 ±0	11.2 ±0

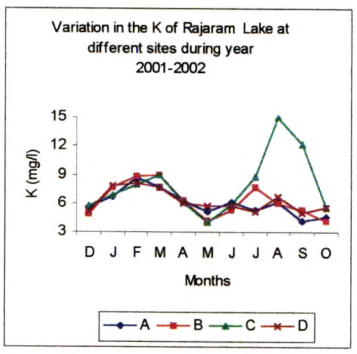
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

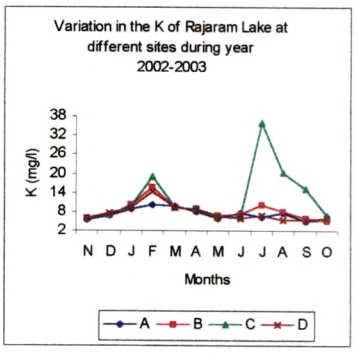
TABLE 35 : SEASONAL VARIATION IN THE POTASSIUM (K) CONTENT DURING YEAR 2002-2003

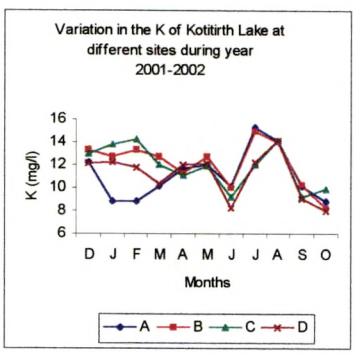
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	5.57 ± 0.03	6.61 ±0.20	8.81 ± 0.01	10.2 ± 0.44	9.81 ± 0.03	8.0 ±0.20	6 ±0.006	7.43 ±0.50	6.4 ±0.04	7.71 ±0.22	5.11 ± 0.08	5.18 ± 0.20
B	5.73 ±0.01	6.71 ±0.10	9.92 ±0.30	15.5 ± 0.26	9.17 ± 0.20	8.71 ±0.31	6.7 ±0.08	6.93 ±0.20	9.9 ±0.44	7.82 ±0.12	5.71 ± 0.06	5.12 ± 0.06
C	5.82 ±0.01	7.0 ± 0.14	9.70 ±0.22	18.8 ± 0.40	9.22 ±0.02	8.82 ±0.34	6.4 ±0.02	6.34 ±0.42	35.7 ±0	20.2 ± 0.10	15.0 ± 0	6.65 ± 0.03
D	5.80 ±0.01	7.71 ±0.20	9.0 ± 0	14.4 ±0.01	9.30 ±0.12	8.55±0.006	6.25 ±0.12	5.97 ± 0.14	6.7 ± 0.12	5.6 ±0.10	5.5 ±0.02	6.02 ±0.10
KOTITIRTH												
A	10.12±0.01	15.5 ±0.16	10.05 ±0.04	11.52±0.36	12.3 ± 0.05	13.0 ±0.22	14.4 ± 0	12.3 ±0.03	102 ± 0.40	145. 5 ± 0	56.7 ± 0.22	6.75 ± 0.03
B	11.8 ± 1.01	15.0 ± 0	14.5 ± 0.22	14.0 ±0.06	14.0 ±0.32	13.5 ± 0.30	13.0 ± 0.16	11.2 ±0.12	100.5±0.04	148.0 ± 0	60.5 ± 0.20	5.98 ± 0.04
C	10.18±0.02	16.5 ± 0.04	15.5 ± 0.30	15.0 ±0.40	14.2 ±0.04	13.2 ± 0.12	14.0 ± 0.06	10.2 ±0.20	90.7 ±0.35	142.0± 0.02	54.5 ±0.12	7.70 ±0.004
D	10.0 ± 0.35	15.7 ±0.30	13.5 ± 0.12	13 ± 0.26	12.8 ±0.22	13.0 ± 0.14	14.6 ±0.20	9.42 ± 0.06	83.0 ±0.24	145.0±0.006	55.0 ± 0.10	6.63 ±0.004
RANKALA												
A	40.14±0.21	25.4 ± 0.30	34.5 ± 0.14	50.4 ±0.32	25.8 ± 0.18	20.4 ±0.06	19.2 ±0.12	26.4 ±0.10	67.5 ± 0	28.5 ±0.04	39.1 ±0.03	12.4 ± 0.22
B	41.6 ±0.89	23.4 ±0.06	35.5 ± 0.02	50.0± 0.220	25.0 ±0.12	20.7 ±0.04	18.2 ±0.10	15.8 ±0.35	62.5 ±0.30	22.4 ± 0	36.0 ±0.20	11.9 ± 0.22
C	44.0 ± 122	22.0 ±0.02	34.0 ± 0.06	47.7 ± 0.24	24.7 ±0.06	20.0 ±0.12	18.0 ± 0.04	10.4 ± 0.15	60.0 ± 0.22	25.6 ± 0.30	37.1 ±0.02	10.5 ±0.31
D	41.5 ±1.06	21.5 ± 0.30	34.9 ± 0.46	45.8 ±0.04	24.0 ±0.30	21.2 ±0.20	20.5 ± 0.06	9.8 ± 0.22	53.5 ±0	24.0 ±0.42	38.5 ±0.22	12.5 ±0.34

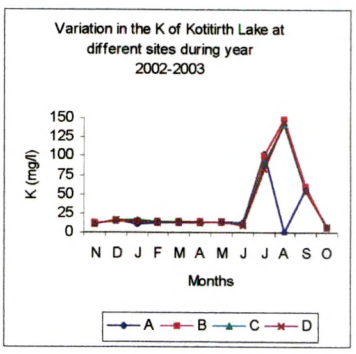
A - Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

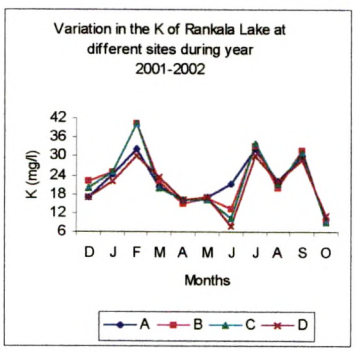
FIG. 20 : VARIATION IN THE K (POTASSIUM) DURING YEAR 2001-2003

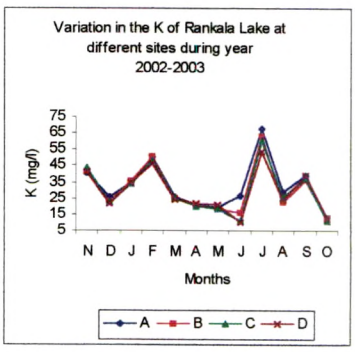












sewage and domestic waste. Because of this heavy pollution aquatic weed *Salvinia molesta* Mitchell might be appeared at that time in Kotitirth lake. Lowest values (3 mg/l) were found in Rajaram lake at site B, April 2002 (Fig. 19).

In Rankala sample 145.0 mg/l and 146 mg/l in Kotitirth sample was measured by Kadam (1990).

- **Potassium**

Potassium is an important element present in water and plays a vital role in the metabolism of freshwater environments. It is found in smaller amounts than sodium but due to it's importance as enzyme activator, cell membranes continuously pump in potassium and pump out sodium, consuming large amount of energy.

The major source in natural freshwaters is weathering of the rocks but the quantities increase in the polluted waters due to disposal of waste waters.

In present study it ranges from 3.24 mg/l to 148 mg/l in both the years (Table 34 and 35). High amount of potassium content (102 and 148 mg/l) were found in month of July and August 2003 in Kotitirth lake. This may be due to heavy load of sewage in rainy season. There is great seasonal variation in Rajaram, Rankala and Kotitirth lake (Fig. 20).

TABLE 36 : SEASONAL VARIATION IN THE LEVEL OF CALCIUM (CA) DURING YEAR 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2002
RAJARAM											
A	30.70±0.18	60.42±0	40.2 ±0.20	52.2 ± 0.32	53.69 ± 0.12	68 ± 0.26	65.29 ± 0.12	40.26 ± 0	50.6 ± 0	52.67 ± 0	48.26 ± 0
B	26.40± 0.26	65.12 ± 0.22	42.0 ± 0.31	50.60 ± 0.40	54.67 ± 0	62.67 ± 2	73.26 ± 0	52.16 ±1.16	52.2 ±0.10	50.28 ± 0.28	42.16 ± 0.26
C	36.20± 1.12	64.70 ± 0.12	40.2 ± 0.12	55.67 ± 0	52.28 ±0.26	60.00 ± 0	70.10 ± 0.12	36.28 ± 0	58.20 ± 0	52.36 ± 2.12	40.28 ± 0
D	32.00± 0	72.12 ± 0.15	52.10 ± 0	53.20 ± 0.10	58.29 ± 0.12	72.62±0.10	69.67 ± 0.32	40.28 ± 0	72.60 ± 10	53.28 ± 0	42.67 ± 1
KOTITIRTH											
A	130.00± 0.22	130 .00± 0.16	120.00 ± 0.12	115.20 ± 0	105.20 ± 0.28	132..60±0.22	120.00 ±0.25	122.20 ±0.14	127.00 ± 0.32	157.20 ± 0.16	142.60±0.20
B	142.50± 0.10	140.20± 0.37	125.20 ± 0.22	122.60± 0.22	90.20 ± 1.12	132.60±0.36	115.20 ± 0.22	112.00 ±0.12	115.00 ±0.35	110.00 ± 0.45	132.00 ± 0
C	152.20± 0.12	151.20± 0.18	132.60 ± 0.15	125.30 ± 0	132.20 ± 0.14	142.20± 0.15	120.00 ± 1.09	62.20 ±0.10	72.00 ± 0.70	80.00 ±0.32	100.20 ± 0
D	147.10± 0.14	60.20 ± 0.20	180.00 ± 0.26	60.60 ±0.28	70.00 ± 0.16	82.00 ± 0.17	115.20 ± 1.10	72.60 ± 0.17	60.20 ±0.17	48.00 ± 0.72	52.20 ± 0
RANKALA											
A	26.10 ± 0.12	32.50 ±0.16	67.60 ± 0.26	74.10 ± 0.19	80.20 ±0.30	86.20 + 0.11	92.70 ± 0.16	62.20 ± 0	50.20 ±0.16	22.70 ± 0	38.60 ± 1
B	24.20 ± 1.10	44.10 ± 1.06	64.20 ± 0.18	32.20 ± 0.30	84.00 ± 0.22	87.00± 0.26	70.20 ± 0.18	71.20 ± 0.10	52.60 ± 0.12	23.00 ± 0	32.20 ± 0
C	17.20 ±0.12	34.60 ±0.26	38.00 ± 0.40	42.60 ± 014	82.00 ± 0.32	89.00± 0.17	64.10 ± 0.16	74.70 ± 0.10	54.20 ±0	20.00 ±1	33.60 ± 2
D	35.60 ±1.18	62.60 ±0.20	74.10 ±0.21	86.00 ± 0.10	78.20 ± 1	92.00 ± 1	90.20 ± 0	96.20 ± 1.10	49.20 ± 0	21.20 ±1.16	32.20 ± 1.12

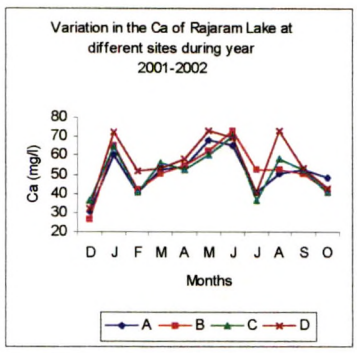
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

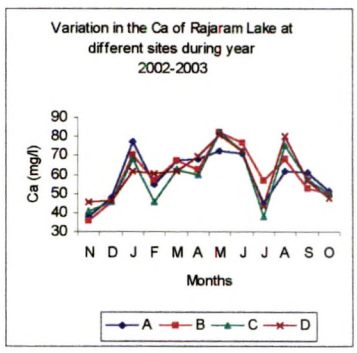
TABLE 37 : SEASONAL VARIATION IN THE LEVEL OF CALCIUM DURING YEAR 2002-03

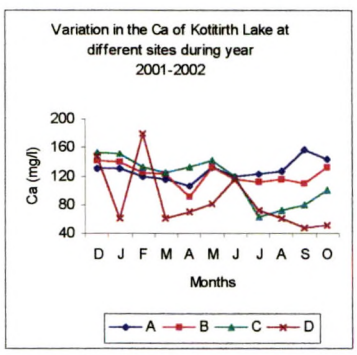
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	37.70 ± 0.14	47.80 ± 0.22	77.40 ± 0.26	55.00 ± 0	67.50 ± 0.36	67.80 ± 0.4	72.50 ± 0.30	70.87± 0.14	45.10 ± 0	62.00 ± 0.12	61.00 ±0.30	51.20 ± 0.14
B	35.80 ± 0.20	45.20 ± 0.40	70.10 ±0.32	57.00 ± 0	67.10± 0.042	62.70 ± 0.26	82.00 ± 0	76.61 ±0.12	56.50 ± 0	68.00 ± 0	52.50 ± 0	50.00 ± 0
C	40.50±0.12	45.50 ± 0.23	67.80 ±0.14	45.80 ± 0.12	62.50 ± 0.20	60.00 ±0.14	82.22 ±0.28	72.12 ± 0.14	37.50 ± 0	75.50 ±0.22	57.80 ± 0.18	49.50 ± 0.20
D	45.70 ± 0.30	46.00 ± 0.12	62.00 ± 0	60.70 ± 0.36	62.00 ± 0.30	69.80 ± 0.14	80.80± 0.14	72.10 ± 0.12	43.50 ± 0	80.10 ± 0.14	56.50 ± 0.20	48.00 ± 0.30
KOTITIRTH												
A	155.40± 0.22	168.20 ± 0	140.00 ±0	130.70±0.30	92.10 ± 0.40	109.80±0.22	152.50± 0.12	127.90 ± 0.16	175.50± 0.14	170.00 ± 0.20	177.00 ± 0.32	150.60 ± 2.60
B	150.00± 0	162.80 ± 0.3	145.70 ± 0.30	150.80± 0.20	67.70 ± 0.14	102.70 ± 0.26	151.20± 0.014	126.16± 0.30	125.80±0.12	117.50 ± 0.20	150.50 ± 0	147.30 ± 0.26
C	145.20 ± 0.30	160.00 ± 0.15	120.80±0.23	135.50± 0.17	140.00 ± 0	115.50±0.20	155.50±0.14	126.00 ±0	67.80 ± 0.16	80.20 ± 0.30	100.20 ± 0	120.20 ± 0
D	145.00± 0.12	161.10±0.14	75.50 ± 0.15	62.80 ± 0.24	65.00 ± 0	125.20 ± 0.14	132.50 ± 0.14	124.30 ±0	69.00 ± 0.20	55.00 ± 0.12	60.00 ± 0	58.50 ± 0
RANKALA												
A	35.70 ± 0.14	40.20 ±0.15	45.50 ± 0.14	80.00 ± 0	82.70 ± 0.14	90.00±0.12	92.70 ± 0	97.50 ± 0.14	68.50 ± 0.22	62.60 ± 0.34	11.50±0.21	22.56± 0.31
B	35.00± 0.14	47.50 ± 0.20	55.50 ± 0.12	70.20 ± 0.17	35.50 ± 0.14	92.70 ± 0.10	90.00 ± 0.17	94.50 ± 0.22	75.40±0.32	60.70 ± 0.26	10.20 ± 0.16	20.00 ± 0.30
C	40.00± 0	20.20 ± 0.10	47.50 ± 0.11	45.10±0.32	52.50 ± 0.27	15.00 ± 0.12	90.20 ± 0.30	71.00±0.12	82.80 ± 0.12	58.00 ± 0.32	10.00 ±0	21.60 ± 0.14
D	48.80 ± 1.16	55.80 ± 0.21	85.50 ± 0.14	97.70 ± 0.24	80.00±0.14	90.20 ± 0.12	100.70 ± 0.20	95.50 ± 0.10	110.50 ± 0.14	59.50±0.24	10.70 ± 0	21.00 ±0.14

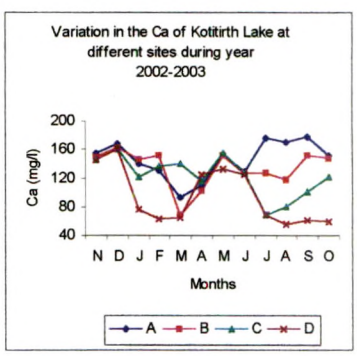
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l

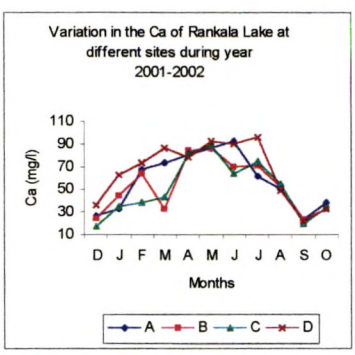
FIG. 21 : VARIATION IN THE Ca (CALCIUM) DURING YEAR 2001-2003

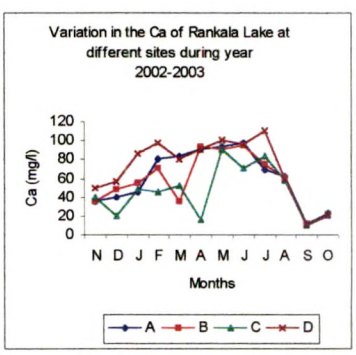












In Rankala 70 mg/l and Kotitirth 97 mg/l was observed by Kadam (1990).

- **Calcium**

Calcium is the fifth most abundant alkaline earth element in the earth crust, which is derived from the natural source like carbonate, silicate, sulphates and fluoride and phosphate.

The minimum calcium concentration is 20 mg/l in the Rankala at site C in the month September 2002. While maximum is 177 mg/l in the Kotitirth site A in the month of September 2003. The variation was recorded in the Rajaram, Rankala and Kotitirth samples in different months during year 2001-2003 shown in table 36 and 37 Calcium concentration varies from 26.4 to 82.22 mg/l in Rajaram lake in both the years (Fig. 21) Desirable limit of calcium by ISI was 75 mg/l and permissible 200 mg/l (Pandey et al., 2002).

Calcium is influencing the flora of ecosystem, which plays potential role in metabolism and growth. The presence of Ca and Mg alongwith their carbonates, sulphates and chlorides make the water hard. According to Ohle (1934), any value above 25 mg/l indicates calcium rich water.

- **Magnesium**

Magnesium is a necessary constituent of chlorophyll without which no ecosystem could operated. It's high content reduces the

TABLE 38 : SEASONAL VARIATION IN THE MAGNESIUM (Mg) DURING YEAR 2001-2002

Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nove.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	12.6 ± 0.10	16.7 ± 0.12	22.0 ± 0.12	25.7 ±0.14	21.7 ±0.10	16.6 ±0.10	13.7 ± 0.10	14.6 ± 0.10	27.2 ± 0.02	18.6 ± 0.10	15.2 ± 0.10	14.6 ± 0.06
B	12.2 ± 0.01	15.0 ± 0.10	24.2 ± 0.10	26.2 ± 0.12	21.0 ± 0.12	16.0 ± 0.12	12.2 ± 0.10	15.2 ±0.02	28.2 ±0.01	19.2 ±0.02	15.0 ± 0.12	13.2 ± 0.08
C	12.0 ±0.10	16.0 ± 0.10	23.5 ±0.12	27.5 ±0.12	22.6 ±0.10	17.6 ± 0.10	12.8 ± 0.12	16.4 ±0.04	26.6 ±0.04	17.2 ±0.04	16.2 ± 0.04	14.0 ± 0.10
D	12.5 ±0.02	16.2 ±0.10	22.7 ± 0.12	25.2 ± 0.10	21.2 ±0.12	17.2 ± 0.12	13.9 ± 0.10	15.7 ± 0.06	25.2 ±0.02	18.2 ±0.06	16.0 ± 0.02	14.2 ±0.02
KOTITIRTH												
A	42.6 ± 0.04	62.0± 0.04	65.6± 0.12	66.6 ± 0.12	65.6± 0.22	90.6± 0.12	100.2± 0.014	106.2± 0.14	140.2± 0.10	135.2± 0.20	90.0 ± 0.12	56.2± 0.10
B	45.2 ± 0.02	60.5± 0.10	66.2 ± 0.14	66.0± 0.20	66.2± 0.10	92.6± 0.14	94.2± 0.16	112.2± 0.20	145.2± 0.24	132.2± 0.12	192.6± 0.10	50.2± 0.16
C	40.0 ± 0.04	68.2± 0.14	67.2 ± 0.12	66.2± 0.14	64.6± 0.20	94.7± 0.12	96.2± 0.20	110.6 ± 0.16	143.7± 0.20	130.0± 0.20	90.0± 0.20	52.6± 0.12
D	43.5 ± 0.10	64.6± 0.10	67.6± 0.10	66.0± 0.10	66.0± 0.18	90.2± 0.10	94.6± 0.22	108.2± 0.20	14.2± 0.22	136.2± 0.14	96.2± 0.12	54.2± 0.14
RANKALA												
A	17.2 ±0.18	22.6 ± 0.12	36.2 ± 0.16	25.2 ± 0.12	42.0 ± 0.10	34.2 ± 0.12	49.2 ± 0.10	54.2 ±0.14	55.2 ± 0.12	47.2 ± 0.10	20.2 ±0.10	10.6 ± 0.04
B	18.7 ± 0.10	25.2 ±0.14	34.6 ±0.10	26.2 ± 0.12	40.2 ± 0.12	32.2 ± 0.04	46.2 ±0.06	42.2 ±0.10	55.0 ±0.12	48.2 ± 0.10	22.6 ± 0.12	10.0 ± 0.06
C	17.0 ± 0.04	26.0 ± 0.10	30.2 ± 0.16	26.0 ± 0.20	44.2 ± 0.12	30.0 ±0.10	50.2 ± 0.04	45.2 ± 0.06	52.2 ± 0.10	48.0 ± 0.12	22.6 ± 0.04	12.6 ± 0
D	18.6 ± 0.10	26.5 ± 0.20	32.0 ± 0.10	24.2± 0.12	47.2 ±0.12	34.2 ±	52.2 ± 0.02	42.2 ± 0.10	50.0 ±0.12	47.5 ± 0.10	21.4 ±0.12	12.0 ± 0.10

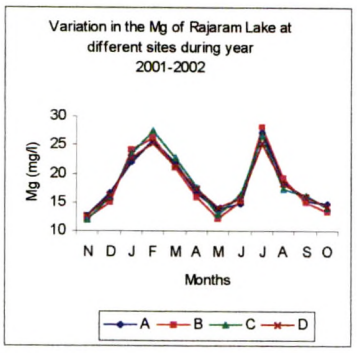
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in Mg/l

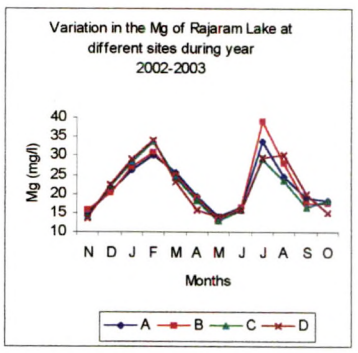
TABLE 39 : SEASONAL VARIATION IN THE MAGNESIUM (Mg) DURING YEAR 2002-2003

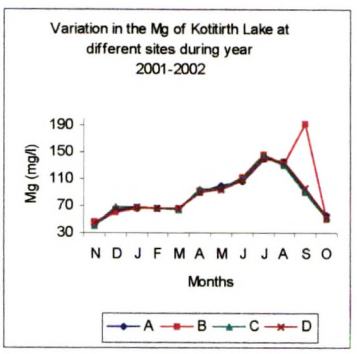
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nove.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2003
RAJARAM												
A	15.0 ± 0.10	20.5± 0.12	26.2± 0.20	30.2± 0.12	25.5± 0.20	19.2 ± 0.14	14.04± 0.10	16.26± 0.12	33.5± 0.16	24.5± 0.20	19.0± 0.22	18.0±0.20
B	15.5 ± 0.12	20.2± 0.12	27.0± 0.14	31.0± 0.14	25.0± 0.22	19.0± 0.12	13.26± 0.32	16.47± 0.14	39.0± 0.20	28.0±0.16	17.5± 0.12	17.5± 0.24
C	14.0±0.14	22.0 ± 0.12	28.5 ±0.22	33.6± 0.24	24.0± 0.16	18.0± 0.40	13.00 ± 0.20	15.66± 0.16	29.2± 0.22	23.5 ± 0.22	16.2 ± 0.10	18.0 ± 0.20
D	13.5 ± 0.14	22.2 ±0.12	29.0 ± 0.20	34.0 ± 0.20	23.1 ± 0.14	15.5 ± 0.26	14.00 ± 0.12	15.60 ±0.18	29.5 ±0.14	30.0 ± 0.20	20.0 ±0.14	15.0 ± 0.22
KOTITIRTH												
A	52.5 ± 0.20	77.0 ±0.14	79.0± 0.16	80.0 ±0.22	67.0 ± 0.14	137.5±0.22	122.2± 0.14	127.95±0.16	164.5±0.22	156.5± 0.14	99.0± 0.12	63.5 ± 0.10
B	50.0 ± 0.12	75.5 ±0.12	82.0± 0.24	92.5 ±0.14	68.5± 0.12	130.2±0.20	122.0 ±0.22	126.16±0.14	155.0±0.10	152.6 ±0.12	100.2 ±0.12	50.2 ±0.16
C	45.2 ± 0.24	70.0 ± 0.10	80.0± 0.20	93.5 ±0.16	63.2± 0.20	135.2±0.20	130.0 ± 0.14	126.00±0.16	144.0± 0.22	150.0± 0.20	92.0 ± 0.12	57.2 ± 0.10
D	49.0 ± 0.10	72.5 ± 0.12	83.4 ± 0.22	95.0± 0.18	63.0± 0.10	135.0± 0.16	145.5±0.20	124.34±0.22	132.0± 0.20	154.2± 0.22	105.3±0.20	60.5±0.22
RANKALA												
A	22.5± 0.12	30.2± 0.14	42.2± 0.30	26.6± 0.20	52.2± 0.12	42.2 ± 0.14	59.5± 0.10	62.0 ± 0.22	63.5±0.20	57.2± 0.16	22.0± 0.12	12.0± 0.10
B	27.2 ± 0.20	25.2± 0.22	37.2± 0.22	27.2± 0.16	42.5± 0.20	37.2 ± 0.12	52.2 ± 0.10	46.0± 0.20	60.2±0.16	54.5± 0.10	27.5± 0.12	10.5 ± 0.20
C	29.3±0.14	33.2± 0.40	35.5± 0.12	28.0 ± 0.10	50.2 ± 0.10	24.2± 0.16	53.0± 0.14	49.0 ± 0.10	58.0 ±0.12	53.0 ± 0.20	24.0 ± 0.32	17.2± 0.30
D	37.5 ± 0.14	27.2 ± 0.32	33.0± 0.14	25.5± 0.16	53.0± 0.12	40.2± 0.14	54.5 ± 0.20	47.0± 0.25	59.5±0.14	58.0± 0.15	25.0± 0.12	15.5± 0.10

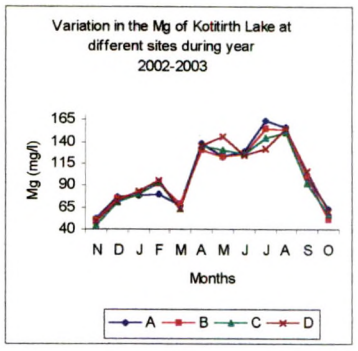
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/l

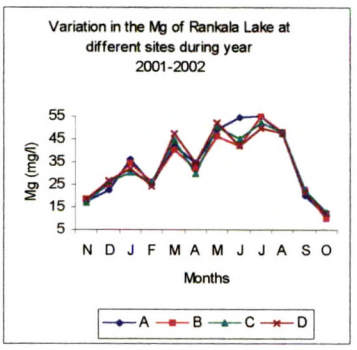
FIG. 22 : VARIATION IN THE Mg (MAGNESIUM) DURING YEAR 2001-2003

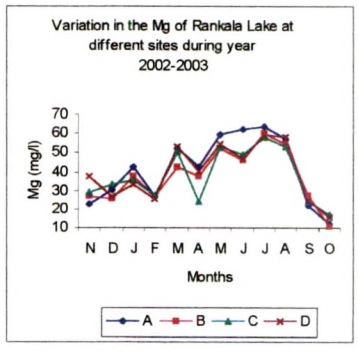












utility of water for domestic use, while the concentration above 500 mg/l, imparts water an unpleasant taste and renders it unfit for drinking purpose. High concentration of magnesium also proves to be diuretic and laxative. It is generally in low concentration than calcium (Trivedy and Goel, 1984).

The minimum magnesium concentration is 10.6 mg/l in the Rankala site A, and maximum is 164.5 mg/l in the Kotitirth site A during year 2001 to 2003. The magnesium concentration level varies in the Kotitirth, Rankala and Rajaram samples in both the years shown in table 38 and 39. In Rajaram lake concentration varies from 12.0 to 34.0 mg/l in the both years (Fig. 22). The magnesium concentration 9.2 to 12.1 mg/l in Kalamba sample was measured by Khatavakar et al. (1989). While studying impact of marble slurry on subsurface water Pandey et al. (2002) observed Mg concentration 36.54 to 1754.2 mg/l.

3. TRACE ELEMENTS :

The presence of trace elements in aquatic environment is dependent upon a wide range of chemical, biological and environmental factors. In the present study trace elements like Iron (Fe), Copper (Cu), Nickel (Ni), Manganese (Mn), Cadmium (Cd) and zinc (Zn) were analysed. the values are depicted in Table 40 to 51.

TABLE 40 : SEASONAL VARIATION IN THE IRON (Fe) CONTENT DURING 2001-2002

Months / Site	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	0.172 ±0.002	0.072 ± 0.0002	0.058 ± 0.0003	0.090 ± 0.002	0.160 ± 0.010	0.182 ± 0.18	0.176 ± 0.10	0.030 ±0.0002	0.022 ± 0.0002	0.016 ± 0.002	0.162 ± 0.14
B	0.168 ± 0.003	0.062 ± 0.002	0.070 ± 0.004	0.078 ± 0.001	0.0161 ± 0.028	0.182 ± 0.40	0.180 ± 0.18	0.022 ± 0.0006	0.016 ± 0.0002	0.112 ± 0.16	Ab
C	0.173 ± 0.001	Ab	0.068 ± 0.0001	0.110 ± 0.21	0.148 ± 0.32	0.160 ± 0.12	0.043 ± 0.001	0.030 ± 0.002	0.010 ± 0.0004	Ab	0.142 ± 0.12
D	0.180 ± 0.002	0.080 ± 0.0002	0.069 ± 0.0004	0.126 ± 0.25	0.132 ± 0.14	0.160 ± 0.16	0.155 ± 0.22	0.042 ± 0.0002	0.025 ± 0.0002	0.012 ± 0.002	0.157 ± 0.002
KOTITIRTH											
A	0.042 ± 0.0002	0.125 ± 0.32	0.110 ± 0.20	0.120 ± 0.42	0.132 ± 0.25	0.142 ± 0.38	0.138 ± 0.25	0.130 ± 0.40	0.122 ± 0.32	Ab	0.120 ± 0.28
B	Ab	0.080 ± 0.004	Ab	0.120 ± 0.12	0.128 ± 0.14	0.144 ± 0.16	0.028 ± 0.0004	0.128 ± 0.050	Ab	Ab	Ab
C	0.070 ± 0.002	0.120 ± 0.38	0.132 ± 0.42	0.140 ± 0.12	0.102 ± 0.20	0.126 ±0.40	0.012 ± 0.0002	0.102 ± 0.50	Ab	Ab	0.106 ± 0.12
D	Ab	0.120 ± 0.20	0.090 ± 0.16	0.100 ± 0.12	0.122 ± 0.16	0.142 ± 0.32	Ab	0.100	Ab	Ab	0.126 ± 0.15
RANKALA											
A	0.062 ± 0.0004	0.064 ± 0.0002	0.092 ± 0.53	0.094 ± 0.30	0.110 ±0.43	0.132 ±0.22	0.128 ± 0.18	0.050 ± 0.0002	Ab	0.100 ±0.10	0.092 ± 0.18
B	0.055 ± 0.0004	0.062 ± 0.0002	Ab	0.094 ± 0.14	0.102 ± 0.12	0.146 ± 0.10	0.132 ±0.16	0.045 ±0.002	Ab	0.110 ±0.12	0.082 ± 0.0002
C	Ab	0.043 ± 0.0004	0.100 ±0.20	0.120 ±0.12	0.140 ± 0.16	0.153 ± 0.12	0.122 ± 0.0004	0.060 ±0.0004	Ab	0.067 ±0.0004	0.090 ± 0.0004
D	Ab	0.032 ± 0.0003	Ab	0.120 ± 0.30	0.126 ± 0.14	0.162 ± 0.10	0.125 ± 0.10	0.052 ± 0.002	0.094 ± 0.002	0.094 ± 0.012	0.096 ± 0.0006

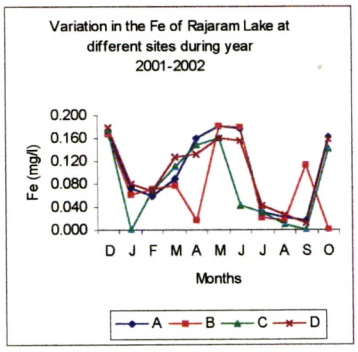
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/l Ab - Absent

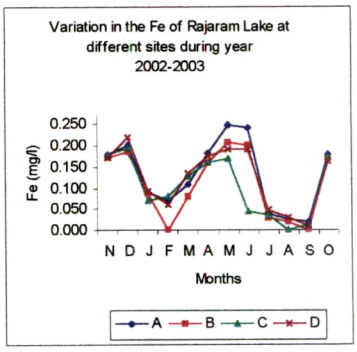
TABLE 41 : SEASONAL VARIATION IN THE IRON (Ee) CONTENT DURING YEAR 2002-2003

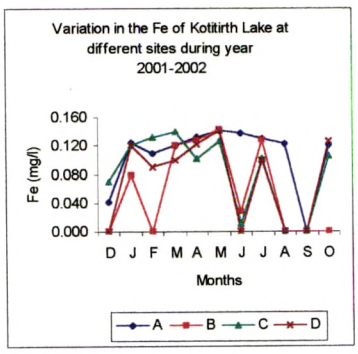
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
RAJARAM												
A	0.179 ±0.001	0.200 ±0.004	0.090 ±0.0004	0.070 0.002	0.107 ± 0.003	0.180 ±0.012	0.247 ±0.16	0.240 ± 0.12	0.037 ±0.0002	0.027 ±0.0002	0.018 ±0.0001	0.177 ±0.20
B	0.172 ± 0.002	0.183 ±0.002	0.085 ±0.002	Ab	0.080 ± 0.002	0.159 ±0.027	0.205 ± 0.60	0.200 ± 0.20	0.030 ±0.0004	0.020 ±0.004	Ab	0.168 ±0.12
C	0.177 ±0.001	0.193 ±0.001	0.070 ±0.001	0.080 ±0.0002	0.126 ±0.20	0.160 ±0.30	0.167 ± 0.004	0.045 ±0.002	0.034 ±0.002	Ab	0.012 ±0.002	0.170 ± 0.10
D	0.170 ±0.002	0.220 ±0.002	0.092 ±0.004	0.060 ±0.004	0.135 ±0.28	0.174 ±0.52	0.192 ± 0.22	0.190 ±0.002	0.047 ±0.0002	0.030 ±0.002	0.010 ±0.004	0.162 ± 0.10
KOTITIRTH												
A	0.069 ± 0.006	0.070 ± 0.002	0.130 ± 0.36	0.110 ± 0.23	0.125 ±0.43	0.145 ±0.26	0.153 ± 0.60	0.149 ± 0.26	0.127 ± 0.42	Ab	Ab	0.133 ± 0.30
B	0.065 ±0.002	0.060 ±0.004	Ab	0.090 ± 0.002	0.130 ±0.52	0.140 ±0.40	0.156 ± 0.73	0.031 ± 0.002	0.117 ± 0.26	Ab	Ab	0.116 ± 0.18
C	0.067±0.0 001	0.090 ±0.002	0.128 ±0.40	Ab	0.138 ± 0.14	0.132 ± 0.14	0.150 ± 0.043	0.015 ±0.004	0.100 ± 0.56	Ab	Ab	0.109 ±0.14
D	Ab	Ab	0.125 ⊥0.25	0.100 ±0.16	0.120 ±0.14	0.140 ±0.10	0.160 ⊥ 0.37	0.116 ± 0.16	0.130 ± 0.60	Ab	Ab	0.127 ⊥ 0.16
RANKALA												
A	0.117 ±0.20	0.070 ± 0.0002	0.067 ±0.004	0.100 ±0.62	0.101 ±0.26	0.120 ±0.60	0.190 ±0.0006	0.136 ±0.002	0.055 ±0.0004	Ab	0.103 ± 0.12	0.101 ±0.20
B	0.120 ±0.32	0.060 ±0.0002	Ab	0.090 ±0.004	0.107 ±0.15	0.126 ±0.72	0.175 ±0.0004	0.142 ±0.0004	0.060 ±0.004	Ab	0.117 ±0.14	0.097 ±0.0003
C	0.112 ±0.12	Ab	0.050 ±0.002	0.105 ±0.26	0.100 ±0.10	0.135 ±0.14	0.180 ±0.0002	0.135 ± 0.0002	±0.067 ± 0.0002	Ab	0.090 ±0.006	0.100 ±0.002
D	0.126 ±0.26	Ab	0.040 ±0.0004	Ab	0.110 ±0.35	0.130 ±0.12	0.178 ±0.0002	0.127 ±0.0004	0.059 ±0.0004	Ab	0.101 ±0.10	0.105 ±0.17

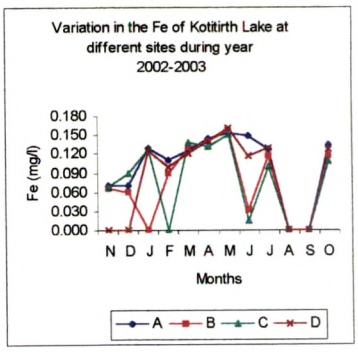
A – Site A B - Site B C - Site C D - Site D All values are in mg/ l ± - Standard deviation Ab – Absent

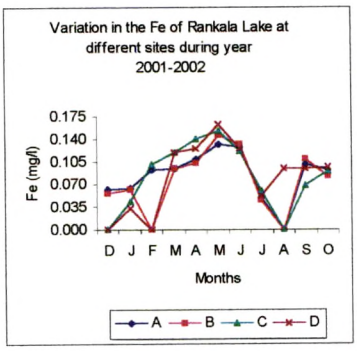
FIG. 23 : VARIATION IN THE IRON (Fe) DURING YEAR 2001-2003











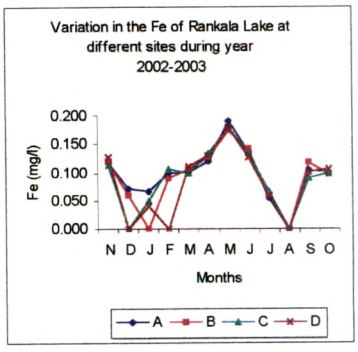


TABLE 42 : SEASONAL VARIATION IN THE COPPER (Cu) CONTENT DURING 2001-2002

Months / Site	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
RAJARAM											
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	0.006 ±0.001	Ab	0.010 ±0.002
B	Ab	0.009 ±0.002	0.010 ± 0.004	Ab	0.004 ± 0.002	0.005 ± 0.001	Ab	Ab	0.005 ±0.001	Ab	0.009 ±0.003
C	Ab	Ab	Ab	0.014 ±0.002	0.006 ± 0.004	0.008 ±0.004	0.010 ±0.001	Ab	0.010 ±0.002	Ab	0.011 ±0.002
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	0.012 ±0.004	Ab	0.010 ±0.002
KOTITIRTH											
A	0.015 ± 0.004	0.012 ± 0.001	0.020 ±0.002	0.022 ±0.002	0.023 ± 0.001	0.020 ±0.002	0.026 ±0.001	0.018 ± 0.001	Ab	Ab	Ab
B	0.016 ± 0.002	0.016 ±0.003	0.026 ±0.002	0.020 ±0.001	0.018 ±0.002	Ab	0.021 ± 0.004	0.017 ± 0.003	Ab	Ab	Ab
C	0.010 ±0.001	0.020 ±0.003	0.021 ± 0.001	Ab	Ab	0.030 ±0.004	0.019 ±0.001	Ab	Ab	Ab	Ab
D	0.014 ± 0.010	0.015 ±0.003	0.014 ± 0.002	0.018 ±0.004	0.020 ±0.004	Ab	Ab	Ab	Ab	Ab	Ab
RANKALA											
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	0.006 ±0.002	Ab	Ab	Ab	Ab	Ab
C	Ab	0.004 ±0.002	Ab	0.002 ± 0.001	Ab	Ab	Ab	0.004 ± 0.004	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

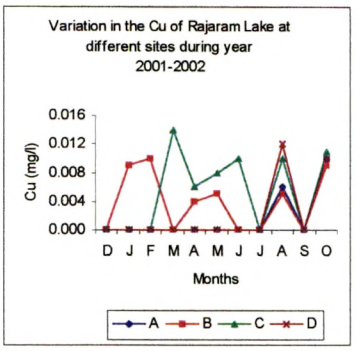
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab - Absent

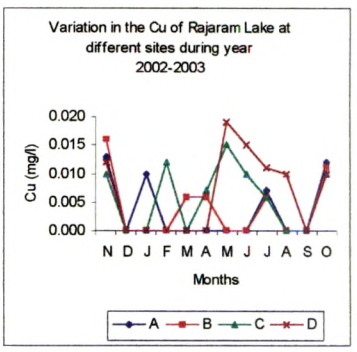
TABLE 43 : SEASONAL VARIATION IN THE COPPER (Cu) CONTENT DURING 2002-2003

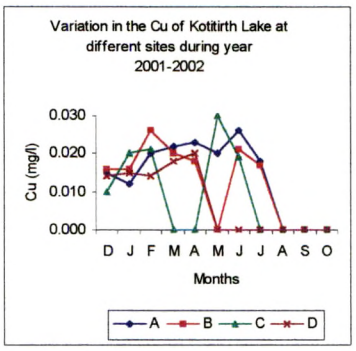
Months / Site	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2002
RAJARAM												
A	0.013 ± 0.001	Ab	0.010 ± 0.002	Ab	Ab	Ab	Ab	Ab	0.007 ± 0.001	Ab	Ab	0.012 ±0.003
B	0.016 ±0.001	Ab	Ab	Ab	0.006 ±0.002	0.006 ±0.001	Ab	Ab	0.006 ±0 .001	Ab	Ab	0.011 ± 0.003
C	0.010 ± 0.002	Ab	Ab	0.012 ± 0.004	Ab	0.007 ±0.003	0.015 ±0.002	0.010 ±0.001	0.006 ± 0.001	Ab	Ab	0.010 ±0.002
D	0.012 ± 0.001	Ab	Ab	Ab	Ab	Ab	0.019 ± 0.004	0.015 ±0.003	0.011 ±0.004	0.010 ±0.006	Ab	0.010 ±0.002
KOTITIRTH												
A	0.020 ± 0.001	0.018 ± 0.003	0.020 ±0.001	0.025 ±0.002	0.026 ± 0.001	0.025 ±0.002	0.022 ±0 004	0.029 ±0.001	0.020 ±0.003	Ab	Ab	Ab
B	0.021 ± 0.004	0.017 ± 0.002	0.021 ± 0.003	0.028 ± 0.002	0.024 ±0.001	0.028 ±0.00	0.020 ± 0. 0020	0.030 ± 0.002	0.020 ±0.001	Ab	Ab	Ab
C	0.023 ± 0.003	0.015 ± 0.001	0.023 ±0.003	0.025 ± 0.001	0.021 ± 0.001	0.023 ± 0.003	0.022 ± 0.006	0.024 ± 0.002	0.019 ± 0.001	Ab	Ab	Ab
D	0.020 ± 0.001	0.016 ± 0.001	0.020 ±0.003	0.017 ±0.002	0.020 ± 0.001	0.020 ±0.001	0.021 ± 0.002	0.020 ± 0.002	0.010 ±0.001	Ab	0.010 ±0.001	Ab
RANKALA												
A	0.004 ± 0.002	Ab	Ab	Ab	0.004 ±0.001	Ab	Ab	0.002 ± 0.001	Ab	Ab	Ab	Ab
B	Ab	Ab	0.003 ± 0.002	Ab	Ab	0.005 ± 0.001	Ab	Ab	Ab	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	0.002 ± 0.001	Ab	0.004 ± 0.003	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

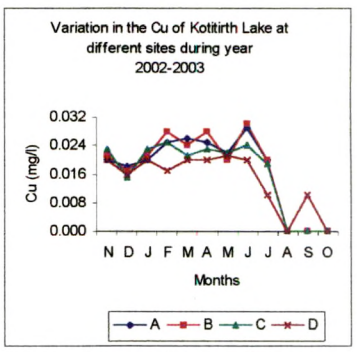
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

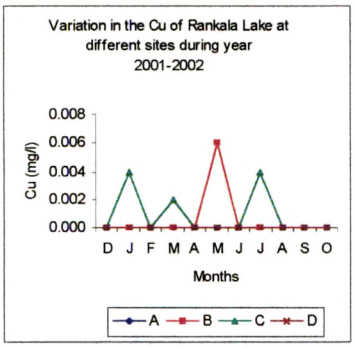
FIG. 24 : VARIATION IN THE COPPER (Cu) DURING YEAR 2001-2003











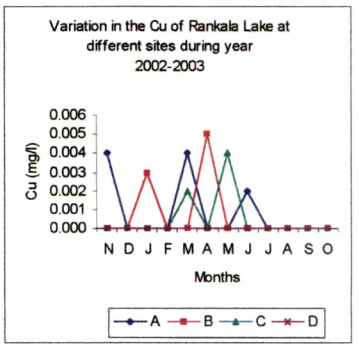


TABLE 44 : SEASONAL VARIATION IN THE NICKEL (Ni) CONTENT DURING 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.2002
RAJARAM											
A	0.002 ±0.001	0.004± 0.001	0.020± 0.004	0.060± 0.0002	0.162 ± 0.80	0.210 ± 0.70	0.160 ± 0.60	Ab	Ab	Ab	Ab
B	0.001 ±0.001	Ab	0.032±0.0002	0.090 ± 0.10	0.92 ± 0.12	0.167 ± 0.10	0.160 ± 0.12	0.155 ± 0.10	Ab	Ab	Ab
C	0.002 ± 0.002	0.030± 0.004	0.026±0.0002	0.080±0.0004	0.087± 0.0002	0.212 ± 0.30	0.200 ± 0.14	0.162 ± 0.12	0.140 ± 0.10	Ab	Ab
D	0.006± 0.0002	0.030± 0.0004	0.022± 0.0002	0.062± 0.0004	0.045± 0.0002	0.242 ± 0.14	0.235 ±0.15	0.230 ± 0.36	Ab	Ab	Ab
KOTITIRTH											
A	0.050±0.002	0.004± 0.004	0.082 ± 0.002	0.122 ± 0.14	0.144 ± 0.16	0.212 ± 0.12	0.205 ± 0.20	0.006±0.0002	Ab	Ab	Ab
B	Ab	0.006± 0.002	0.080 ± 0.004	0.140 ±0.12	0.148 ± 0.10	0.220 ±0.14	0.215 ± 0.16	Ab	Ab	Ab	Ab
C	0.026± 0.0002	Ab	0.060 ±0.006	0.132 ± 0.10	0.200 ± 0.12	0.262 ± 0.28	0.258 ± 0.26	Ab	Ab	Ab	Ab
D	Ab	Ab	0.082 ± 0.002	Ab	0.218 ± 0.10	0.248 ± 0.16	0.240 ± 0.22	Ab	Ab	Ab	Ab
RANKALA											
A	Ab	0.007± 0.0004	Ab	0.004 ± 0.0002	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	0.002 ± 0.0002	Ab	0.002± 0.0001	0.006± 0.0002	Ab	0.004± 0.0001	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	0.004± 0.0002	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

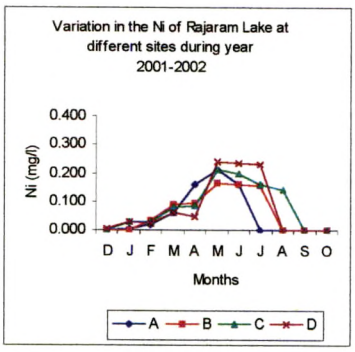
A – Site A B - Site B C - Site C D - Site D All values are in mg/ l ± - Standard deviation Ab - Absent

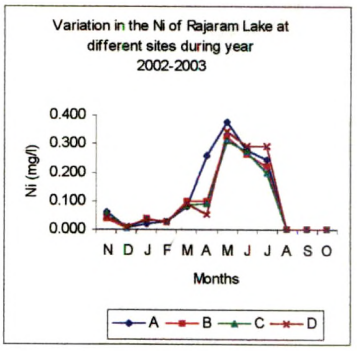
TABLE 45 : SEASONAL VARIATION IN THE NICKEL (Ni) CONTENT DURING YEAR 2002-2003

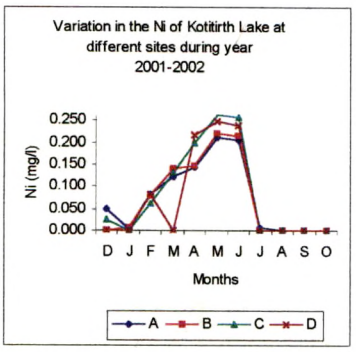
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
RAJARAM												
A	0.060 ± 0.0004	0.006 ± 0.001	0.020 ±0.002	0.030 ±0.0004	0.080 ±0.0002	0.260 ±0.36	0.377 ±0.27	0.279 ± 0.12	0.247 ±0.30	Ab	Ab	Ab
B	0.040 ±0.0002	0.003 ± 0.001	0.040 ±0.0002	0.022 ±0.0005	0.100 ±0.12	0.100 ±0.14	0.325 ±0.12	0.263 ±0.26	0.220 ±0.12	Ab	Ab	Ab
C	0.055 ± 0.0002	0.005 ± 0.002	0.035 ±0.0002	0.030 ±0.0003	0.087 ±0.0004	0.090 ±0.0002	0.310 ±0.42	0.271 ±0.10	0.200 ±0.10	Ab	Ab	Ab
D	0.042 ±0.0002	0.008 ±0.002	0.032 ±0.002	0.029 ±0.0002	0.090 ±0.0002	0.050 ±0.0004	0.345 ±0.12	0.290 ±0.32	0.293 ± 0.40	Ab	Ab	Ab
KOTITIRTH												
A	0.090 ±0.002	0.060 ±0.0002	0.006 ±0.002	0.111 ±0.007	0.130 ±0.26	0.165 ±0.32	0.267 ±0.12	0.213 ±0.22	0.008 ±0.0002	Ab	Ab	Ab
B	0.075 ±0.0004	0.030 ±0.002	Ab	0.090 ± 0.004	0.125 ±0.12	0.230 ±0.20	0.320 ± 0.10	0.216 ±6.30	0.005 ±0.0002	Ab	Ab	Ab
C	0.077 ±0.0002	Ab	0.004 ±0.001	0.070 ± 0.006	0.145 ±0.14	0.220 ±0.20	0.300 ±0.10	0.254 ±0.27	0.004 ±0.004	Ab	Ab	Ab
D	0.066 ±0.0002	0.020 ±0.0004	Ab	0.088 ±0.004	0.140 ±0.12	0.210 ± 0.12	0.273 ±0.14	0.253 ±0.37	0.002 ± 0.0001	Ab	Ab	Ab
RANKALA												
A	Ab	Ab	0.005 ±0.0001	Ab	0.006 ±0.002	Ab	Ab	0.003 ± 0.0002	Ab	Ab	Ab	Ab
B	0.004 ± 0.0002	Ab	Ab	Ab	Ab	0.004 ± 0.002	Ab	Ab	0.002 ±0.0001	Ab	Ab	Ab
C	Ab	0.007 ±0.0004	Ab	0.004 ±0.0002	Ab	Ab	0.002 ±0.0001	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	0.002 ±0.0001	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

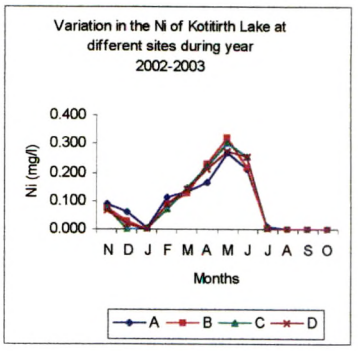
A – Site A B - Site B C - Site C D - Site D All values are in mg/ l ± - Standard deviation Ab- Absent

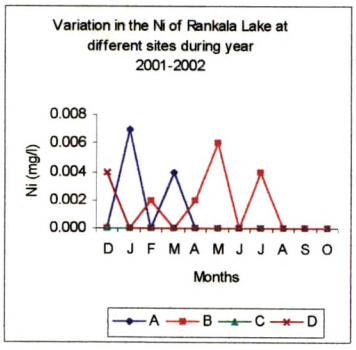
FIG. 25 : VARIATION IN THE NICKEL (Ni) DURING YEAR 2001-2003

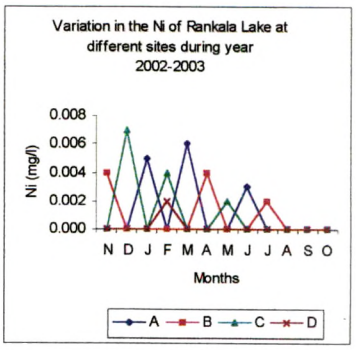












Higher concentration of iron (0.240 mg/l) was found at site A of Rajaram lake in the month of June 2003. In the year 2001-02 values are less than 2003. While very much low concentration (0.012 mg/l) at site 'C' in Kotitirth lake in the month of June 2002 (Table 40 and 41). In the Rankala lake values of iron were ranging from 0.055 to 0.190 mg/l (Fig. 23). Iron in excess of 0.3 mg/l causes staining of clothes and utensils (Trivedy and Goel, 1984). But our values are found within limit.

Lower concentrations of copper was found in all the three lakes at different sites (Table 42 and 43). Slight higher value (0.030 mg/l) was found in site B of Kotitirth lake in monsoon season, June 2003. But this value is within the limit of WHO 1973. Very low amount of nil concentration is observed in Rankala lake in the both years. In Rajaram lake values were ranging from 0.004 to 0.019 mg/l in both the years (Fig. 24).

Nickel was present in high amounts in Kotitirth lake, ranging from 0.463 to 0.490 mg/l in the month of June 2003 at all the sites. In Rajaram lake also high concentration (0.377 mg/l) at site A and in May 2003. But these values are within WHO standards (Table 44 and 45). But less or nil amount of concentrations were found in Rankala lake (Fig.. 25).

TABLE 46 : SEASONAL VARIATION IN THE MANGANESE (Mn) CONTENT DURING 2001-2002

Months / Site	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	0.005 ± 0.0001	Ab	0.032 ± 0.004	0.028 ± 0.002	0.004 ±0.0001	0.040 ± 0.006	0.070 ± 0.004	0.052 ± 0.04	0.050 ±0.007	Ab	0.018 ± 0.0004
B	0.012 ± 0.002	Ab	Ab	Ab	Ab	0.032 ± 0.004	0.082 ± 0.002	0.050 ± 0.002	0.040 ± 0.009	Ab	Ab
C	Ab	0.020 ± 0.004	Ab	0.004 ± 0.0	Ab	Ab	0.053 ± 0.002	Ab	0.022 ±0.004	Ab	Ab
D	0.022 ± 0.003	Ab	Ab	Ab	0.018 ± 0.004	Ab	0.060 ± 0.0002	Ab	0.025 ± 0.0002	Ab	Ab
KOTITIRTH											
A	0.052 ± 0.004	0.440 ± 0.002	Ab	Ab	Ab	0.020 ± 0.002	0.460 ± 0.002	Ab	Ab	Ab	0.004 ± 0.001
B	Ab	Ab	Ab	0.020 ± 0.16	0.025 ± 0.12	0.025 ± 0.001	0.040 ± 0.004	Ab	Ab	Ab	Ab
C	0.030 ± 0.002	0.400 ± 0.10	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	0.026 ± 0.004	Ab	0.040 ± 0	0.040 ± 0.004	0.63 ± 0.16	0.60 ± 0.17	Ab	0.012 ± 0.004	0.010 ±0.002	Ab	Ab
RANKALA											
A	Ab	Ab	Ab	Ab	0.010 ± 0.002	Ab	0.004 ± 0.004	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	0.004 ± 0.0001	Ab	Ab	Ab	Ab	Ab	Ab	Ab
C	Ab	0.004 ± 0.0002	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

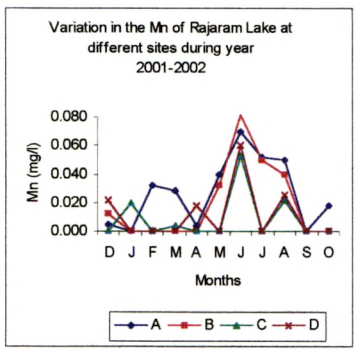
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

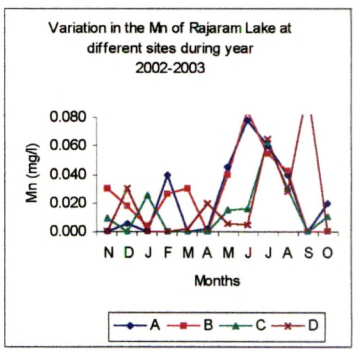
TABLE 47 : SEASONAL VARIATION IN THE MANGANESE (MN) CONTENT DURING YEAR 2002-2003

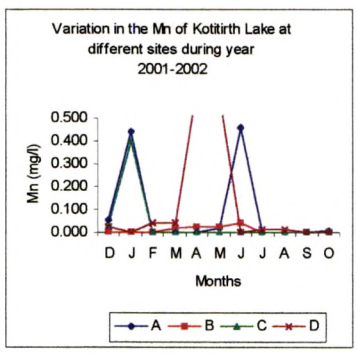
Months / Site	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
RAJARAM												
A	Ab	0.006 ± 0.002	Ab	0.040 ±0.006	Ab	0.002 ±0.0001	0.045 ±0.006	0.078 ±0.004	0.060 ±0.04	0.040 ±0.007	Ab	0.02 ± 0.0002
B	0.030 ± 0.004	0.018 ±.004	0.004 ± 0.0002	0.026 ±0.004	0.030 ±0.008	Ab	0.040 ±0.004	0.085 ±0.002	0.055 ±0.006	0.042 ±0.009	Ab	Ab
C	0.009 ±0.0002	Ab	0.025 ±0.004	Ab	Ab	Ab	0.015 ± 0.002	0.016 ±0.004	0.062 ±0.004	0.030 ± 0.002	Ab	0.010 ±0.0001
D	Ab	0.030 ±0.006	Ab	Ab	0.002 ± 0.0001	0.020 ±0.0002	0.006 ±0.0002	0.05 ±0.0002	0.065 ±0.0002	0.028 ± 0.0004	0.10 ± 0. 0002	Ab
KOTITIRTH												
A	Ab	Ab	0.472 ±0.004	Ab	Ab	0.564 ± 0.12	Ab	0.674 ±0.20	Ab	Ab	Ab	0.002 ± 0.0001
B	Ab	0.057 ±0.002	Ab	Ab	0.303 ± 0.16	Ab	0.027 ± 0.10	0.042 ± 0.004	Ab	Ab	Ab	Ab
C	0.052 ±0.004	Ab	0.403 ±0.12	0.023 ± 0.002	Ab	0.023 ±0.17	Ab	0.033 ± 0.006	Ab	Ab	Ab	0.004 ± 0.0002
D	Ab	0.032 ± 0.004	Ab	0.307 ±0.14	0.283 ±0.020	0.045 ± 0.004	0.65 ±0.12	0.85 ± 0.17	0.010 ±0.006	0.011 ± 0.004	Ab	Ab
RANKALA												
A	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	0.009 ±0.0002	Ab	Ab	Ab	Ab	Ab	Ab	0.012 ± 0.0004	Ab	Ab
C	0.012 ±0.0002	Ab	Ab	0.002 ±0.0002	Ab	0.010 ±0.0004	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	0.002 ±0.0001	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

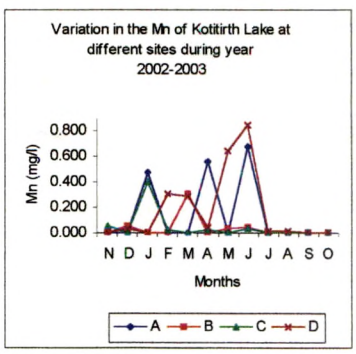
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

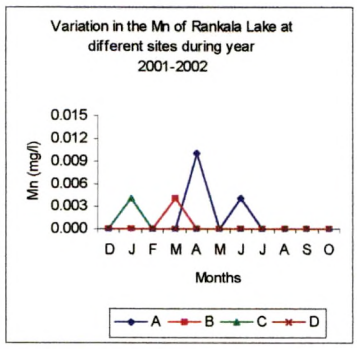
FIG. 26 : VARIATION IN THE MANGANESE (Mn) DURING YEAR 2001-2003











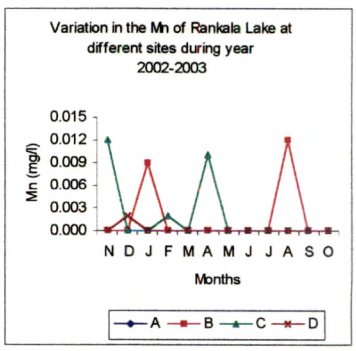


TABLE 48 : SEASONAL VARIATION IN THE CADMIUM (Cd) CONTENT DURING 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	0.004 ± 0..001	Ab	0.004 ± 0.001	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	0.002 ± 0.001	Ab	Ab	Ab	Ab	Ab
C	0.003 ± 0.004	Ab	Ab	0.018 ± 0.001	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	0.020 ±0.001	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
KOTITIRTH											
A	Ab	Ab	0.012 ± 0.001	Ab	Ab	0.018 ± 0.004	Ab	Ab	0.012 ± 0.002	Ab	Ab
B	0.007 ± 0.002	Ab	Ab	0.012 + 0.004	0.016 ± 0.004	Ab	Ab	Ab	0.020 ± 0.002	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	0.022 ± 0.001	0.016 ± 0.002	Ab	Ab	Ab	Ab
D	Ab	Ab	0.020 ± 0.002	Ab	0.016 ± 0.004	0.020 ± 0.001	Ab	Ab	Ab	Ab	Ab
RANKALA											
A	Ab	Ab	0.004 ± 0.002	0.010 ± 0.002	0.008 ± 0.003	0.020 ± 0.002	Ab	0.030 ±0.001	Ab	Ab	Ab
B	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
C	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

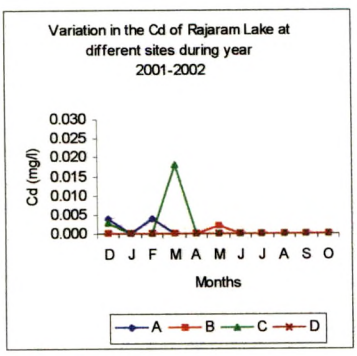
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

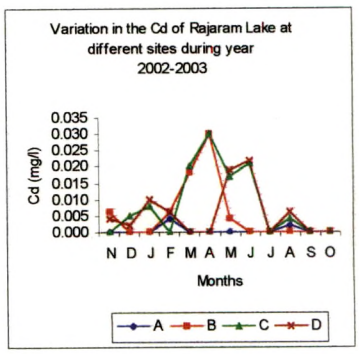
TABLE 49 : SEASONAL VARIATION IN THE CADMIUM (CD) CONTENT DURING YEAR 2002-03

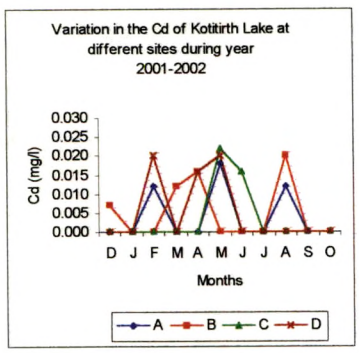
Months / Sites	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2003
RAJARAM												
A	Ab	Ab	Ab	0.004 ± 0.001	Ab	Ab	Ab	Ab	Ab	0.002 ±0.001	Ab	Ab
B	0.006 ± 0.001	Ab	Ab	0.006 ± 0.003	0.018 ±0.001	0.030 ±0.002	0.004 ± 0.002	Ab	Ab	Ab	Ab	Ab
C	Ab	0.005 ± 0.001	0.008 ±0.002	Ab	0.020 ± 0.001	Ab	0.017 ± 0.001	0.021 ±0.003	Ab	0.004 ± 0.002	Ab	Ab
D	0.004 ± 0.002	Ab	0.010 ± 0.002	0.006 ±0.002	Ab	Ab	0.019 ±0.001	0.22 ±0.001	Ab	0.006 ± 0.001	Ab	Ab
KOTITIRTH												
A	0.012 ±0.001	Ab	Ab	Ab	Ab	0.010 ±0.001	Ab	0.011 ±0.001	0.012 ±0.003	0.018 ±0.006	Ab	Ab
B	0.010 ±0.001	0.009 ±0.002	0.012 ±0.003	Ab	0.002 ± 0.001	0.004 ±0.001	0.014 ± 0.002	0.017 ± 0.001	0.010 ±0.004	0.022 ±0.004	Ab	Ab
C	0.004 ± 0.002	Ab	Ab	Ab	0.016 ± 0.002	Ab	Ab	0.019 ± 0.001	0.022 ± 0.002	0.027 ±0.002	Ab	Ab
D	Ab	0.007 ± 0.001	0.020 ± 0.003	0.040 ± 0.001	Ab	0.006 ± 0	0.020 ± 0.002	0.025 ± 002	0.29 ±0.002	Ab	Ab	Ab
RANKALA												
A	Ab	0.020 ±0.001	Ab	Ab	Ab	Ab	0.040 ± 0.001	Ab	0.043 ± 0.002	0.026 ±0.006	Ab	Ab
B	0.060 ± 0.001	0.004 ± 0.002	Ab	0.010 ± 0.001	0.010 ±0.002	0.020 ±0.001	Ab	Ab	0.050 ± 0.006	0.020 ±0.02	Ab	Ab
C	Ab	0.025 ± 0.002	Ab	Ab	0.015 ± 0	Ab	0.030 ± 0.002	Ab	0.062 ± 0.004	0.025 ±0.006	Ab	Ab
D	0.030 ± 0.002	Ab	0.004 ± 0	0.022 ± 0.002	0.010 ±0	0.045 ±0.004	0.020 ±0.001	Ab	0.065 ±0.002	0.027 ±0.007	Ab	Ab

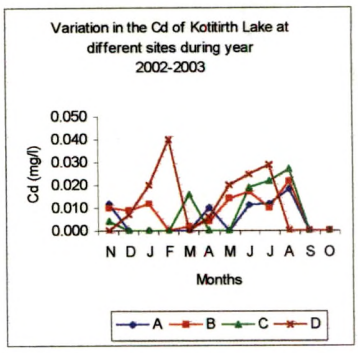
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

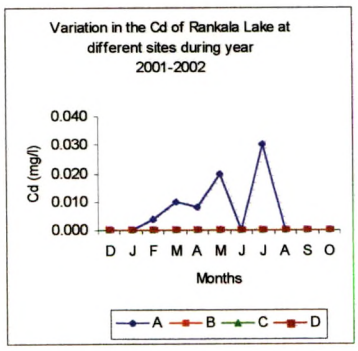
FIG. 27 : VARIATION IN THE CADMIUM (Cd) DURING YEAR 2001-2003











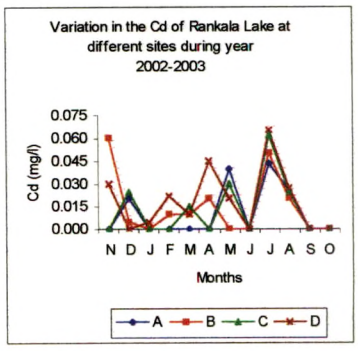


TABLE 50 : SEASONAL VARIATION IN THE ZINC (Zn) CONTENT DURING 2001-2002

Months / Sites	WINTER		SUMMER				MONSOON				WINTER
	Dec. 2001	Jan. 2002	Feb.	March	April	May	June	July	Aug.	Sept.	Oct. 2002
RAJARAM											
A	Ab	0.004± 0.001	0.012 ± 0.002	0.010 ± 0.001	0.004 ± 0.001	0.016 ±0.001	0.010 ± 0.002	0.009 ±0.001	Ab	Ab	Ab
B	0.004 ± 0.001	0.010 ± 0.002	0.014± 0.003	0.010 ± 0.001	0.006 ± 0.002	0.014 ± 0.002	0.012 ± 0.002	0.010 ±0.002	Ab	Ab	Ab
C	0.005 ± 0.002	0.012 ± 0.003	0.016 ±0.002	Ab	0.006 ± 0.002	0.016 ± 0.002	0.020 ± 0.001	0.002 ± 0.0001	Ab	Ab	Ab
D	0.006 ± 0.001	0.01 ± 0.002	0.011 ± 0.001	Ab	0.004 ± 0.001	0.004 ± 0.001	0.014 ± 0.002	0.006 ± 0.002	Ab	Ab	Ab
KOTITIRTH											
A	0.003 ± 0.0002	0.004± 0.001	0.030 ±0.004	0.020 ±0.002	0.032 ± 0.001	0.052 ±0.002	0.050 ± 0.001	0.028 ±0.002	Ab	Ab	Ab
B	0.005 ± 0.001	0.006±0.002	0.032 ± 0.002	0.030 ±0.004	0.036 ±0.002	0.060 ±0.004	0.052 ±0.002	0.042 ± 0.004	Ab	Ab	Ab
C	Ab	0.00 ±0.001	0.026 ±0.004	0.020 ±0.002	0.030 ±0.002	0.072 ± 0.003	0.068 ± 0.001	Ab	Ab	Ab	Ab
D	0.008 ± 0.003	0.00 ±0.002	Ab	0.020 ±0.003	0.028 ±0.004	0.045 ± 0.002	Ab	Ab	0.010±0.002	0.014± 0.004	Ab
RANKALA											
A	0.002 ± 0.001	0.004 ± 0	Ab	0.007 ±0.002	0.004 ±0.001	0.006 ± 0.002	Ab	Ab	0.010 ± 0.002	Ab	Ab
B	0.002 ± 0.002	0.002± 0.001	Ab	Ab	Ab	Ab	Ab	Ab	0.012 ±0.004	0.002± 0.002	Ab
C	0.003 ± 0.001	Ab	Ab	Ab	Ab	Ab	Ab	Ab	0.010 ± 0.002	Ab	Ab
D	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab

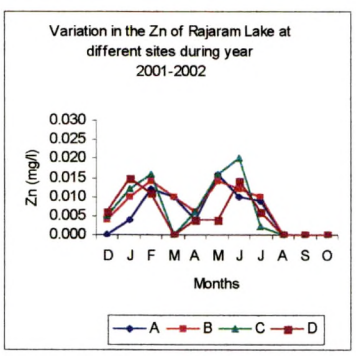
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

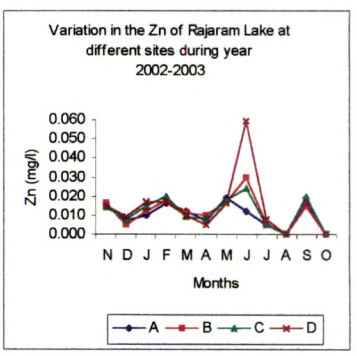
TABLE 51 : SEASONAL VARIATION IN THE ZINC (Zn) CONTENT DURING YEAR 2002-2003

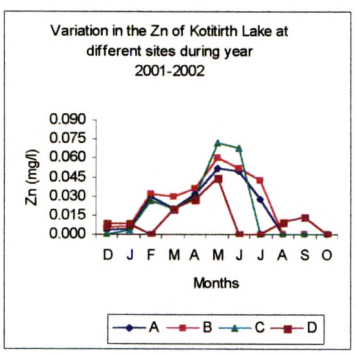
Months / Site	WINTER			SUMMER				MONSOON				WINTER
	Nov.2002	Dec.2002	Jan. 2003	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.03
RAJARAM												
A	0.015 ±0.003	0.007 ±0.001	0.010 ±0.001	0.016 ± 0.002	0.012 ± 0.001	0.007 ±0.001	0.019 ±0.001	0.012 ±0.002	0.005 ±0.001	Ab	0.019 ±0.003	Ab
B	0.016 ±0.001	0.005 ±0.001	0.012 ±0.003	0.;018 ±0.004	0.011 ±0.001	0.010 ±0.002	0.017 ±0.001	0.030 ±0.002	0.006 ±0.003	Ab	0.015 ±0.003	Ab
C	0.014 ±0.002	0.008 ±0.001	0.015 ±0.002	0.020 ±0.003	0.009 ±0.001	0.008 ±0.002	0.018 ±0.001	0.024 ±0.002	0.005 ±0.002	Ab	0.020 ±0.002	Ab
D	0.015 ±0.001	0.009 ±0.001	0.017 ±0.002	0.017 ±0.001	0.010 ± 0.001	0.005 ±0.002	0.016 ± 0.001	0.059 ±0.002	0.008 ±0.004	Ab	0.016 ±0.001	Ab
KOTITIRTH												
A	0.012 ±0.002	0.005 ±0.002	0.007 ±0	0.032 ± 0.006	0.022 ±0.004	0.043 ±0.001	0.060 ±0.003	0.035 ±0.001	0.030 ±0.001	Ab	0.018 ±.0001	Ab
B	0.010 ±0.006	Ab	0.008 ±0.001	0.040 ±0.002	Ab	0.040 ±0.002	0.077 ±0.006	0.066 ± 0.001	0.045 ±0.002	Ab	0.020 ±0.002	Ab
C	0.013 ±0.001	0.010 ±0.001	0.005 ± 0.002	0.030 ±0.006	0.025 ±0.002	0.035 ±0.002	0.088 ±0.003	0.077 ±0.001	0.035 ± 0.001	Ab	0.015 ± 0.002	Ab
D	0.015 ± 0.001	0.009 ±0.005	Ab	0.026 ±0.004	0.030 ± 0.001	0.030 ±0.002	0.073 ± 0.002	Ab	Ab	Ab	0.012 ±0.002	Ab
RANKALA												
A	0.002 ±0.001	Ab	Ab	0.009 ± 0.002	0.008 ± 0.003	Ab	0.006 ±0.002	Ab	Ab	0.012 ±0.004	Ab	Ab
B	0.003 ± 0.001	Ab	Ab	0.006 ± 0.001	0.010 ±0.004	Ab	0.005 ±0.001	Ab	Ab	0.010 ±0.006	Ab	Ab
C	0.005 ± 0.002	Ab	0.012 ± 0.001	Ab	Ab	Ab	0.003 ±0.001	Ab	Ab	0.010 ± 0.001	Ab	Ab
D	Ab	0.010 ±0.001	Ab	Ab	Ab	0.007 ± 0.004	Ab	Ab	Ab	0.010 ±0.001	Ab	Ab

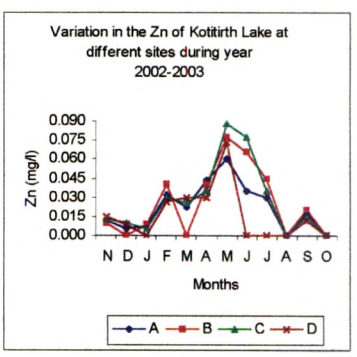
A – Site A B - Site B C - Site C D - Site D ± - Standard deviation All values are in mg/ l Ab – Absent

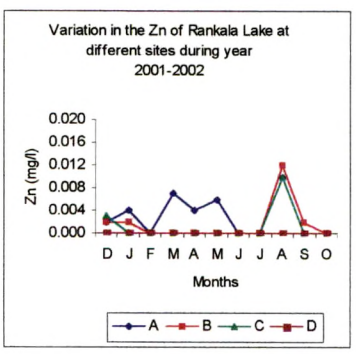
FIG. 28 : VARIATION IN THE ZINC (Zn) DURING YEAR 2001-2003

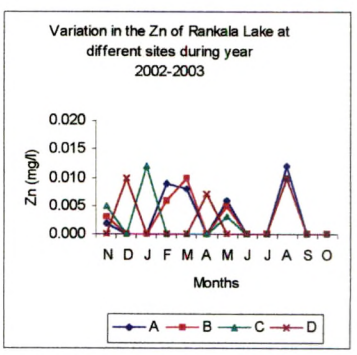












Manganese was found absent throughout in Rankala lake, except in trace amounts (0.002 to 0.012 mg/l) at some sites in both the years (Table 46 and 47). Higher concentration (0.674 mg/l) was observed at site A in Kotitirth lake in June 2003 but below WHO limit. In Rajaram lake values were ranging of from 0.002 to 0.065 mg/l in both the years (Fig. 26).

Lower concentrations of cadmium were observed in both the years in all the three lakes (Table 48 and 49). Although it is absent in many times in all three lakes, but it is slight higher (0.065 mg/l) at site D in Rankala lake in the month of July 2003 (Fig. 27). But this value is below the WHO limit. Cadmium is added to aquatic ecosystem by number of industries and may be due to manmade activities like mining, smelting and other industrial operation or pesticide use (Smith, 1973).

Zinc is present in very little quantity or absent in all the three lakes in different sites during both the years (Table 50 and 51). In Rajaram lake values ranging from 0.002 to 0.059 mg/l, Kotitirth 0.003 to 0.077 mg/l and Rankala 0.002 to 0.012 mg/l in both the years (Fig. 28). It is an essential and beneficial element in human metabolism, in small quantity does not appear to have a serious effect on health (Salgare and Singh, 2001).

4. SOCIOECONOMIC IMPACTS (A Special Study) :

In Kolhapur city Rajaram, Rankala and Kotitirth lakes have more importance for their historical, aesthetical and traditional features. Earlier these lakes had good quality of water and free from pollutional activities of human beings. Additional to the previous activities, since last 10 years, there has been tremendous increase in the traditional activities like cloth washing and Ganesh idol immersions have been pointed out, alongwith this, in year 2003 sudden invasion of an new aquatic weed *Salvinia molesta* Mitchell has been observed in Kotitirth lake. Keeping in mind, the impact of these activities on the pollution level, was undertaken. The pollution status was studied for their physicochemical characteristics.

The following impacts have been studied :

- **Ganesh Idol Immersion**

Lord Ganapati worshipped since the birth of the Indian civilization and Hindu religion in particular, as Vighnaharta i.e. troubleshooter God.

As a part of the final ritual of Ganesh Chaturthi celebrations, the clay and plaster of Paris idols of Ganesha along with flowers, banana leaves, coconuts, etc. are immersed in various water bodies, resulting in alarming increase in pollution levels in the water bodies. In Kolhapur, the idols are immersed in lakes, subsequently

PLATE – 8

a. Ganesh Idol Immersion in Rajaram Lake

b. Ganesh Idol Immersion in Kotitirth Lake

PLATE –8

a

b

TABLE 52 : PHYSIOCHEMICAL PARAMETERS BEFORE AND AFTER IMMERSION OF GANESH IDOLS

Parameter	RAJARAM LAKE		KOTITIRTH LAKE	
	Before	After	Before	After
Temp.(^{0}C)	29	30	29	30
pH	7.9	8.4	8.15	8.55
EC (mMhos/cm)	0.54	0.69	1.3	1.4
DO	11.2	8.4	14.2	11.27
Free CO_2	Ab	Ab	Ab	Ab
Alkali	170	220	180	250
Hardness	80	120	160	220
Chloride	88.75	142	145	225
PO_4-P	4.59	5.9	2.27	5.78
NO_3-N	9.49	13.5	10.8	18.39
Na	14.5	26.5	14.5	26.5
Ca	49.5	82	170	271
Mg	19	24.5	56.5	99
Mn	Ab	Ab	Ab	Ab
Fe	0.018	0.027	Ab	Ab
Zn	0.012	0.019	0.018	0.020
Cd	Ab	Ab	Ab	Ab
Ni	Ab	Ab	Ab	Ab
Cu	Ab	Ab	Ab	Ab

All values are in mg/l except mentioned. Ab - Absent

endangering the aquatic flora and fauna. According to officials of civic body like Kolhapur Mahanagar Palika, for a month following the festival day, nearly 1000 to 1500 idols of various sizes are immersed in each lake (Plate 8 and 9)

To assess the alarming rise in pollution due to immersion, a study was initiated, wherein the pollution levels in two lakes of the city namely, Rajaram and Kotitirth lake were recorded before the immersion and after the immersion. The values of physicochemical parameters are depicted in table – 52.

pH were more alkaline in both the lakes ranging from 7.9 to 8.4 in Rajaram and 8.15 to 8.45 in Kotitirth lake. In the lakes of Bangalore pH increased from an average of 7.3 to an average of 7.6, hence the immersion of excessive idols alongwith wooden planks and decorative items made up of iron, led to acidification of the waters (cpcb annual report 1999-2000).

Electrical conductivity were ranging from 0.54 – 0.69 mMhos/ cm in Rajaram and 1.3 – 1.4 mMhos/ cm in Kotitirth lake.

There is slight decrease in the values of dissolved oxygen from 11.2 to 8.4 mg/l in Rajaram and 14.2 to 11.7 mg/l in Kotitirth lake. It was observed that the DO content increased in few places and it decreased at other places in Bangalore (loc.cite).

Alkalinity increased from 170 – 220 mg/l in Rajaram lake and 180- 250 mg/l in Kotitirth lake.

Hardness increased from 80-120 mg/l in Rajaram lake and 160-220 mg/l in Kotitirth lake.

Free carbon dioxide were absent in both the lakes throughout.

Chloride values increased from 88.75 – 142 mg/l in Rajaram lake and 145-225 mg/l in Kotitirth lake.

Increase in the levels of phosphorus from 4.59 – 5.9 mg/l in Rajaram lake and 2.27 – 5.78 mg/l in Kotitirth lake. Plaster of Paris contains hazardous chemicals like zinc oxide, calcium oxide, mercury, lead etc. It shows high amounts of phosphate (EPB : No. 3 Sept. 1998).

Increase in the level of sodium from 14.5 – 26.5 mg/l in Rajaram lake and 14.5 – 26.5 mg/l in Kotitirth lake were found. Values of magnesium from 19 –-24.5 mg/l in Rajaram and 56.5 – 99 mg/l in Kotitirth lake.

Calcium shows higher values ranging from 49.5 to 82 mg/l and 170 to 271 mg/l in Kotitirth lake. Calcium has got a high affinity to adsorb on the soil particles, therefore, the cation exchange equilibria and presence of other cations greatly influence it's concentration in waters (Trivedy and Goel, 1984).

TABLE 53 : PHYSIOCHEMICAL CHARACTER BEFORE AND AFTER CLOTH WASHING

Parameter	RAJARAM LAKE		KOTITIRTH LAKE	
	Before	After	Before	After
Temp. (^{0}C)	28	3.07	28	3.02
PH	8	8.36	8.1	8.31
EC (mMhos/cm)	0.70	1.2	1.4	3.1
Hardness	220	240	224	240
Free CO_2	Ab	Ab	Ab	Ab
Alkalinity	245	260	220	250
Chloride	140	186.5	210	226
PO_4-P	5.3	8.07	3.67	5.44
NO_3-N	10.5	12.12	7.9	8.42
Do	12.5	8.07	8.25	4.02
Na	9.42	11.5	62.3	85
K	4.17	5.12	4.28	6.77
Ca	42.8	61	270	377
Mg	12.7	18	42.7	63.5
Mn	Ab	0.020	Ab	0.002
Pb	Ab	Ab	Ab	Ab
Cd	Ab	Ab	Ab	Ab
Ni	Ab	Ab	Ab	Ab
Fe	0.120	0.177	0.118	0.133
Zn	0.020	Ab	0.012	Ab

All values are in mg/l except mentioned. Ab - Absent

PLATE – 9

a. Traditional Cloth Washing in Rajaram Lake.

b. Traditional Cloth Washing in Kotitirth Lake.

PLATE –9

a

b

Manganese, Nickel and copper are absent in both the lakes before and after immersion of idols. But slight increase in concentrations of zinc and iron were found in both the lakes.

Increase in values of EC, pH and temperature after the immersion of idols can hamper the quality of the water. Liberation of calcium in the water, from plaster of Paris might be increasing the values of it, which may also be harmful and results into increase in hardness of water. As more idols have been found to be immersed in Kotitirth lake, the water quality has also been declined. So it is feared troubleshooter God may turn out to be the troublemaking God.

- **Traditional Cloth Washings**

In the month of October before the 'Navratra Festival' people wash their matresses in the lakes of Kolhapur city, like Rajaram and Kotitirth. In both the lakes washings were done tremendously. People from nearby area like Tembalaiwadi, Uchgaon etc. came to Rajaram lake to wash these cloths. In Kotitirth lake people from nearby area also come to wash these types of cloths (Plate - 9).

It is thought worthwhile, to study the impact of this activity on the quality of the water by analysing certain physicochemical characteristics.

The physicochemical analysis of both the water bodies has been depicted in table 53.

pH of lake water more alkaline (8-8.36) in Rajaram and Kotitirth (8.1 – 8.31). Temperature increased from 28 – 30^{0}C and electrical conductivity from 0.70 – 1.2 mMhos/ cm and 1.4 – 3.1 mMhos/ cm in both the lakes respectively.

Increase in values of hardness were found from 220 – 240 mg/l and 224- 240 mg/l in Rajaram and Kotitirth lake respectively. It may be due to high load of carbonates and bicarbonate in water by cloth washing (Agarkar, 1998).

There is also increase in alkalinity from 245 – 260 mg/l in Rajaram and 220-250 mg/l in Kotitirth lake. Various types of soaps, detergents and other washable drugs might be helping to increase the alkalinity in lake water (Kadam, 1990).

Free carbon dioxide is absent throughout and increase in chloride from 140 – 186.5 mg/l and 210-226 mg/l in Rajaram and Kotitirth lake respectively.

There is decrease in dissolved oxygen from 12.5 to 8.07 mg/l in Rajaram lake. While in Kotitirth lake due to heavy load of cloth washings, dissolved oxygen level decreases tremendously from 6.77 to 4.28 mg/l.

Increase in the level of phosphate due to washing and detergents from 5.3 to 8.07 mg/l and 3.67 to 5.44 in Rajaram and Kotitirth lake respectively. There is slight increase in the values of

nitrate from 10.5 to 12.12 mg/l in Rajaram and 7.9 – 8.42 m in Kotitirth lake.

There is increase in level of calcium from 42.8 – 61 mg/l and 270 – 377 mg/l in both the lakes respectively. Whereas sodium, potassium shows values (9.42 – 11.5 mg/l, 62.3 – 85 mg/l and 4.17 – 5.12 mg/l, 4.28 – 6.77 mg/l in both the lakes respectively).

Among the heavy metals Mn, Pb, Cd and Ni were absent in both the lakes. But iron shows much increase from 0.120 – 0.177 mg/l in Rajaram and 0.118 – 0.133 mg/l in Kotitirth lake.

Mn was found in trace amount in both the lakes after cloth washing 0.02 mg/l in Rajaram and 0.002 mg/l in Kotitirth lake.

While studying polluted waterbody at Mysore, high values of total hardness, alkalinity, chloride and other parameters reported by Raghavendra et al. (2002).

5. Invasion of An Aquatic Weed :

In the year 2003, sudden tremendous growth of an noxious aquatic weed *Salvinia molesta* Mitchell has been noticed in Kotitirth lake. In view of this, to establish a status report, characterisation and analysis of certain physical and chemical properties have been undertaken.

PLATE – 10

Invasion of an aquatic weed.

PLATE –10

TABLE 54 : PHYSICOCHEMICAL SITES OF KOTITIRTH LAKE WITH APPEARANCE AND DISAPPEARANCE OF *Salvinia*

	PH	EC (Mm hos/ cm)	Temp °C	Colour	Hard-ness (mg/l)	Alka-linity (mg/l)	Free CO_2 (mg/l)	D.O. (mg/l)	Chlo-ride (mg/l)	Salinity (mg/l)	Phos-phate	Nitrate	Na	K	Ca	Mg	Mn	Pb	Zn	Fe	Cu	Cd	Ni
Appearance																							
Initially	7.9	1.1	25	Yellow	210	390	42.8	7.9	400.2	0.752	2.13	8.72	132.5	82.7	97.5	67	0.702	0.019	0.082	0.135	0.040	0.020	0.572
Partly	8.45	1.7	24	Yellow	220	380	50.6	10.08	532.5	0.991	1.69	7.88	270.6	12.30	27.95	26.05	0.674	0.017	0.075	0.149	0.020	0.025	0.479
Fully :	9.1	1.5	26	Yellow	180	370	4.4	0.00	426	0.798	1.40	10.03	284.5	102	175.5	164.5	Ab	Ab	0.086	0.107	0.030	0.029	Ab
Disappearance																							
Initially	8.2	1.4	28	Yellow	240	400	0.00	2.21	362.1	0683	1.50	8.90	148	145.5	491	77	Ab	Ab	Ab	Ab	Ab	0.018	Ab
Partly	8.3	1.3	29	Yellow	360	400	0.00	6.8	454.4	0.850	2.71	11.0	140.5	95.5	209.5	79	Ab	Ab	Ab	Ab	Ab	0.022	Ab
Fully	8.55	1.5	28	Yellow	200	450.	0.00	9.66	411.8	0.77	4.83	11.5	128	61	86	54	Ab	Ab	Ab	Ab	Ab	0.027	Ab

All values are in mg/l except mentioned

Water samples were collected at the 50 cm depth, corresponding to the changes in the growth of *Salvinia molesta* i.e. after appearance and disappearance of it (Plate-10). These physicochemical parameters are depicted in Table 54.

In the present study, pH is found alkaline ranging from 7.9 to 9.1. According to Gaur and Khan (1995) while studying physico-chemical characteristics of an eutrophic lentic environment, more alkaline pH (8.71 – 9.94) has been recorded. Electrical conductivity ranges from 1.1 to 1.7 m mhos/cm. Increase in the temperature is also observed from $24^0C = 29^0C$.

Hardness of water is mainly due to cations of calcium and magnesium (Harrison and deMora, 1992). But there are no significant changes found in hardness and alkalinity during the present study. But the values of alkalinity (370-450 mg/l) and hardness (200-360) are quite high. The studies on aquatic macrophytes in relation to environmental factors were conducted by Kanii (1991). The observations revealed that high content of alkalinity, conductivity and high pH of water were significant for growth of macrophytes.

Free carbon is found to be very high (50.6 mg/l) during partly occupance of *Salvinia* but with the development / appearance of *Salvinia*, it dropped down 4.4 to 0.0 mg/l.

Prokrovskaya (1983) suggested that macrophyte overgrown lakes show important indication of eutrophication such as drop in

oxygen content of water. Similar observation was made during the present study, because dissolved oxygen drops down to zero with full growth of *Salvinia*.

The chlorides are maximum during full growth of *Salvinia* (532 to 426 mg/l) and minimum when initial disappearance of *Salvinia*. But it doesn't show any significant change along with salinity.

The aquatic weeds are known to absorb nutrients from water, about 5-7 times higher than required by the plant for maximum production and thus have luxuriant consumption of major nutrients than phytoplankton (Padmavathi and Durga Prasad, 1997). This was observed during the present study as the lower value of phosphate (1.40 mg/l) coincides with fully developed carpet of *Salvinia* and higher (4.82) value with disappearance of *Salvinia*.

The highest value of nitrates (11.5 mg/l) are also observed after fully disappearance of *Salvinia*, but the lowest value (10.03 mg/l) donot show direct relation with full appearance of *Salvinia*.

High values of sodium potassium and calcium were observed with the appearance of *Salvinia*. But values of them get reduced after complete disappearance of *Salvinia*.

The values of heavy metals like iron and copper (0.107 ppm and 0.030 ppm) coincides with fully developed carpet of *Salvinia*. After disappearance of *Salvinia* it is seen that heavy metals like

manganese, iron, lead, copper, nickel, zinc are absent. These might be absorbed by *Salvinia*.

Shallow water bodies are specifically engineered using macrophytes for water quality treatment, which is the low cost technology suggested by Billore (1998).
study

The growth of *Salvinia* is found to be beneficial for eutrophic lake, as it removes heavy metals as well as phosphates from the water and thus the lake can be revived back to mesotrophic.