ANTHROPOGENIC IMPACT ON THE VARADA RIVER PHYTOPLANKTONS

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ABSTRACTS

The aquatic ecosystem is enormously polluting day by day due to the human interference and environmental pollutants, this is directly effecting on the aquatic organisms. The present investigation was undertaken to study the physico-chemical analysis of the Varada river water. It shows seasonal fluctuation in the alkalinity, calcium, magnesium and hardness contents, due to the small scale industries, environmental degradation on the bank of the river and also ecological factors impact on the growth and healthy development of aquatic organisms especially on phytoplankton's are studied.

Key word: Ecology, Varada River, Phytoplankton's, Physico-chemical factors, Water quality.

INTRODUCTION

Rivers of the nation are the major sources of our water supply to the towns and cities. If availability of water is less due to failure of monsoons as it happens in south often, it gives rise to sever scarcity. Today most of the rivers of world receive millions of liters of sewage, domestic waste, industrial and agricultural effluents containing substances varying in characteristic from simple nutrients to highly toxic substances. Increasing industrialization and consequent urbanizations are the most significant causes of pollution of aquatic ecosystem due to a diverse kind of wastes produced by them

. Population growth, rapid industrialization, urbanization, technological development, injudicious planning without due regard to the sustainable development have induced numerous changes in the environment. Water is a main concern as billions of people worldwide have no access to safe drinking water. Water is basic to life and health of all living beings. Adequate drinking water quality is essential for the well being of all humans who use water not only for drinking but also at home, in industry, agriculture, recreation etc.

Rivers are dynamic systems that receive minerals and nutrients through sedimentation, rain, surface and ground water and human generated pollution. Chemical analysis of river water quality and indications of nutrient dynamics in the surrounding landscapes.

In the present study, the analysis of the physico-chemical status of Varada River water with special reference to the anthropogenic impact on Phytoplankton's

1. To understand the distribution of phytoplankton and their inter relationship with physico-chemical parameters.
2. To assess water quality and its effects on phytoplanktons.
3. Micro flora of Varada river.
4. Pollution assessment in the river

MATERIALS AND METHODS

Monthly surface water samples were collected in two different sites, from Jun 2013 to May 2014. The reading is recorded for physico-chemical and Biological factors described in APHA (2005).

Haveri District at a Glance:

Haveri district was formed in the year 2001 by earlier Dharwad district into Dharwad, Haveri, and Gadag districs. Haveri district is located in the northern part of Karnataka State with geographical area of 4851 sq.km. The district is bounded by Davangere district on eastern and southeastern side, Gadag and Dharwad district on northside, Uttara Kannada district on western side and Shimoga district on the southwestern side. It lies between 14^0 16' to 15^0 10' North Latitude and 75^0 01' to 75^0 50'East Longitude.

As per the 2001 census, Haveri district has a population around 14.39 lakhs. The total number of villages/ habitations in the district is 630. Haveri district has 7 taluks viz, Byadagi, Hanagal, Haveri, Hirekerur, Ranibennur, Savannur and Shiggaon. Haveri district forms part of the maidan area and receives an annual rainfall between 450-700 mm. The rainfall is confined to the monsoon period with most of the precipation occurring between June and September. Tungabhadra and Varada rivers drain the district and Tungabhadra forms the boundary between Haveri and Bellary districts. Haveri district has subtropical climate with temperature ranging in between 18^0c to 40^0c. The major part of the soil is red sandy soil, followed by the medium black soil and deep black soil, the major crop is Maize, Jawar and Cotton etc.

Rain fall: The Haveri taluk total rainfall is received 806.19 mm during the study period of June 2013 to May 2014, usually an excess of rain has received, as a result, there has been huge overflow of the river (Table 1).

STUDY AREA:

Topography of the Varada River:

The Varada river originates in Vardamoola in sagar taluk (6 kms from Sagara in Shimoga district) and enters Banavasi through the Western Ghats.Later it enters the central districts of Karnataka (Haveri and Ballary). The place is remote and is picturesque. The place is also called as Theertha grama (Holy water village). Many temples are situated in this place along with two Kalyani / Holy water tank from where the Varada river bubbles out. Varada river joins the Tungabhadra river near Galaganath village in Haveri district. The river flows as miniature stream through small valleys of Western Ghats, and widens in Haveri district near Sangur village. The gradient of the water flow of the Varada in general is not steep..

The Varada river water plays a vital role in supply of drinking, domestic and also for agriculture for the people living on the banks. Varada river is the major drinking water source for the people of Haveri town and nearby villages, it is the only source of water for Sagar town in Shimoga district. Check dams have been constructed along the Varada River's course to provide water for minor irrigation and domestic purposes during the summer months. Wild plants and a few beautiful coloured flowers create a natural landscape without much forest cover. (detail information of the river shows Table-1 and Photographic view of the river shows Plate: 1a-b).

METEOROLOGY:

The information pertaining to various climatic factors such as Annual and average rainfall required for the study was obtained from Thahasildar office Haveri from June 2013 to May 2014 and the same has been referred in the present study.

FIELD STUDY:

Collection of water sample: The water samples were collected on 1st of every month from two different stations and monthly reading were taken from Jun 2013 to May 2014. The data of sample collections were collecting in a clean sample bottles for the study of various physico-chemical parameters.

The collection and observation of water samples from two different stations were made between 9.00 AM to 10.00 AM hours throughout the study period. A vehicle was used to maintain accuracy in reaching the stations on time from G H College, Haveri to Varada river approximately 18 KMS.

RESULTS AND DISCUSSIONS

The physico-chemical factors play significant role on the growth of micro-organisms in the lotic ecosystem. This has been studied by several investigators. Some of the factors may independently promote the phytoplankton growth individually. However, combined effect of these factors with reference to the anthropogenic impact on ecosystem is also equally important.

In the present study large number of phytoplanktons belonging to Chlorophyceae, Bacillariophyceae Cyanophyceae,and Euglenophyceae were recorded. They have shown fluctuation in their periodicity depending upon the availability of various nutrients.

Chlorophyceae:

The Physico-chemical parameters, distribution and periodicity of chlorophyceae members recorded from Varada river is given in Table No. 2 to 4 & Fig 1.

Munawar 1970 states that the low nitrate, phosphate and high dissolved oxygen are the factors responsible for maximum occurrence of green algae, Pearsall (1924), Singh (1960), Seenayya 1971, have also made a similar observation and concluded that temperature, pH, phosphate, nitrate and dissolved oxygen play an important role in the growth of Chlorophyceae members. The highest numbers of organisms were recorded during north east monsoon followed by the summer and south west monsoon. The variation in periodicity may be because of fluctuation in physico-chemical factors.

In present study the Chlorophyceae is mainly represented by 9 species, *Chlorella fusca, Chlorella vulgaris (Beyerinck), Haematococcus lacusta (Girod), Euastrum spinulosum, Pediastrum bonyanum, Cosmarium subtumidium, Sphaerozosma wallichii, Spirogyra sabsalsa Keutezing, Chlosterium acerosum.* The occurrences of Desmides, the member of zygnematales of this group are very sensitive to pollution, which shows the water quality. *Chlorella fusca* and *Chlorella vulgaris, Euastrum quadratum, Spirogyra* have occurred at all sites during the peak at north east monsoon, and summer season. The fluctuation in distribution pattern of chlorophyceae can be attributed to high alkalinity, and pH. The similar observations were also made by Philipose (1959) and Prescott (1982).

Bacillariophyceae:

The Physico-chemical parameters, distribution and periodicity of diatoms are given in the Table No. 2 to 4 & Fig 1. In the present study it was observed that the diatoms recorded high in number during south west monsoon followed by north east monsoon and summer during study period.

The Diatoms have been studied by many workers. The important contributions were made by Pearsell (1923), Philipose (1959), more recently by Yin Zin Wel (2002), Oliveira *et. al.,* (2001), Kalchev *et. al.,* (2000), Cronborg (1999). Hosmani and Bharati (1988), states that high concentration of phosphates, and nitrates are factors favored the growth and development of diatoms. Similarly Zafar (1986) and Munavar (1970) have opined that high phosphate and nitrate are favorable for the

luxurient growth diatoms. Cronborg (1999) have observed the pH favored the high number of diatoms. Oliveira *et. al.,* (2001) have opened that the BOD and phosphate concentration play an important role.

The Varada river is represented by 8 species of baciliariophyceae, they are: *Navicula rhomboidis, Cyamatopleura tumida, Synedra ulna, Mastolgloia smithii, Meridion Sps., Pinnularia viridis Ehrimb, Surirella robusta, Anomoneis sphacerophora. Surirella robosta* was more common than *Navicula rhomobidis.* All other species shows a seasonal trend *Surirella robosta* along with all other diatoms were recorded maximum during south west monsoon where as *Anomoneis sphacerophora* were recorded at minimum at all stations. In the present study it was observed that high temperature, pH, dissolved oxygen, calcium, magnesium, total hardness, along with these factors, the most important was biochemical oxygen demand which favors the luxuriant growth of the diatoms. The observation made during the present study was in conformity with the above workers.

Cyanophyceae:

In the present study, the Physico-chemical parameters, distribution and periodicity of cyanophyceae members in the Varada river is represented in Table 2 to 4 & Fig 1.

It was observed that the blue green algal population was in lesser number and had shown a steady increase from summer season to south west monsoon. A maximum during south west monsoon followed by north east monsoon and minimum during the summer. While during the south west monsoon the maximum number of the cyanophyceae and during north east where as the minimum species of the cyanophyceae were recorded during the year 2014. Totally six species have been recorded from the class cyanophyceae. *Chrococcus varius A. Br, Gloeocapsa granosa, Lyngbya semiplena Gomont,, Lyngbya hieronymusii Lemm, Aphenocapsa endophytica G. M. Smith, Stichosiphon sansibariens (Hieron)*.

The higher number of blue green algal population during south west Monsoon can be attributed to the high values of pH. dissolved oxygen and BOD, as the presence of these factors favors the maximum growth of cynaophyceae. The observation made in the present study is the conformity by the observations made by Desikachary (1955), and Prescott (1982). It was also being observed that sunshine and temperature played an important role in increased number of blue greens, as it is the fact in tropical belt that a bright sunshine and high temperature is the characteristic feature (Desikachary, 1955).

Euglenophyceae:

The Physico-chemical parameters, distribution and periodicity of euglenophyceae is given in Table 2 to 4 & Fig 1. In the present study, it was observed that seasonal variation of euglenophyceae population was low, however a slight more in summer. Totally Five species represents the euglenophyceae, that are: *Phacus caudate var ovalis Drejepolski, Phacus arbicularis Var caudatus skvortzon, Euglena acus, Euglena polymorpha Dangeard, Lepocinchis fusiformis var major.*

Several workers have discussed on the distribution of euglenophyeae in various types of freshwater environment. Most important contributions came from Davis (1962) and Chandler (1937) and Munawar (1970) have attributed that the high percentage of euglenophyceae to the high concentration of free carbon dioxide, Davis (1962), Seenayya (1971) and Sedamkar (2008) opined that, the high temperature favors the growth of euglenophyceae. Hegde and Bharathi (1985) observed that the high pH favored the growth of euglenophyceae.

In the present study it was observed that the presences of all species constant throughout the year, but maximum were recorded in the summer season and minimum in the south west monsoon. The high pH, CO_2, BOD, Mg played a significant role on growth of euglenophyceae members. The result and observation made are in confirmity with the workers as mentioned above.

CONCLUSION

The present investigation was undertaken to study the ecological characteristics of Varada river. The study was carried out for a period of two years from June 2013 to May 2014. From two selected sites (mean reading was taken) at Kunimellihalli, near Haveri Belt.

The water samples and phytoplankton were collected on first day of every month on a regular monthly basis. The findings of the study summarized as follows.

The physico-chemical charecters of Varada river water are within the desirable limit set by WHO except, Turbidity, Alkalinity, and Iron. As water moves across the surface of a landscape and through the ground, nutrients and minerals can dissolve in the water and get carried into the rivers The water of Varada river was alkaline throughout the study period. The hardness of the river water is moderately high throughout the study period. The low value of dissolved oxygen in both sites indicates the presence of poor development of organisms. The phytoplanktons of Varada river shows the dominance order of chlorophyceae followed by bacillariophyceae, cynophyceae and euglenophyceae. It has been recorded that the chlorophyceae population and their composition was more and dominant during the study period. Among the chlorophyceae *Chlorella fusca. C. vulgaris, Euastrum spinolosum,* and *Spirogyra subsalsa* were recoded more in number during the south west monsoon, remaining species showed a seasonal trend.

Bacillariophyceae members are the second dominant group occurred in the Varada river, occurrence of *Surriella robusta, Navicula rhombodis* and *Mastogloia smithi* showed maximum during north east monsoon and remaining species showed a seasonal trend. The third dominant group was the cyanophyceae members, recorded 6 species showed a seasonal trend and euglenophyceae members are the last in the dominancy, 5 species have been recorded from this group and showed a seasonal trend. During the present study period totally 28 species of phytoplankton belonging to 4 major classes of algae were recorded from the collection samples.

There is an urgent need to discourage the formers using excess of chemical fertilizers for their fields, pollution from the small scale industries on the bank of the river and human interruption in the name of religious programmes. The concern authorities need to adopt indigenous technologies to minimize the pollution level and make water fit for drinking, domestic and agriculture use.

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TABLE-1: MONTHLY TOTAL VALUE OF RAINFALL IN HAVERI TALUK, DURING THE STUDY PERIOD JUNE-2013 TO MAY-2014

Months	Rain fall in mm
JUNE	113.88
JULY	183.37
AUG	86.9
SEPT	135.13
OCT	54.98
NOV	---
DEC	---
JAN	---
FEB	---
MAR	3.36
APR	66.42
MAY	162.15

---- = No Rainfall

Total rainfall during the period of study is **806.19** mm

Total monthly average Rainfall during the study period is **67.18** mm

TABLE-2: MONTHLY AVERAGE VALUES OF PHYSICO-CHEMICAL PARAMETERS OF VARADA RIVER

NEAR HAVERI BELT, KARNATAKA, DURING JUNE- 2013 TO MAY-2014.

MONTHS	TEMP.		pH	DO	CONDUC-TIVITY	TURBIDITY	FREE Co2	DS	ALKA-LINITY	HARD-NESS	CHLO-RIDE	CAL-CIUM	MAGNE-SIUM	PHOS-PHATE	NO_3	NO_2	SO_4	IRON	FLORIDE	BOD
	WATER	AIR																		
JUNE	30.0	30.8	8.0	72	128	5	1.8	95	52	48	32	13.0	3.2	0.04	0.82	0.4	5.2	0.42	0.2	2.00
JULY	28.2	29.0	7.8	80	110	6	1.2	80	36	28	18	5.6	2.4	ND	0.12	ND	7.6	0.80	ND	1.60
AUG	26.6	27.4	8.2	86	98	3	0.8	60	26	36	16	8.8	3.4	0.02	1.8	0.9	8.0	0.48	0.2	2.40
SEPT	27.4	28.2	7.9	88	164	6	0.6	100	56	70	24	18.4	5.6	0.60	1.9	0.8	10.4	0.14	0.2	6.20
OCT	27.0	27.8	8.4	82	178	2	1.2	120	48	54	28	13.6	4.9	0.14	0.71	ND	6.0	0.33	0.4	3.80
NOV	26,8	27.4	7.8	76	180	2	1.6	140	64	74	24	16	6.0	0.16	1.06	ND	5.6	ND	0.2	2.25
DEC	27.2	27.8	7.8	70	520	2	2.0	380	110	164	58	42.2	13.6	0.02	1.1	ND	4.8	0.80	0.4	2.20
JAN	28.2	29.6	7.4	64	500	2	1.6	190	90	122	62	44.0	12.6	ND	1.5	0.6	14.4	0.62	0.2	2.0
FEB	30.0	30.8	7.8	60	270	8	1.4	120	32	49	19	8.0	2.18	ND	1.4	0.9	11.8	0.56	0.4	2.10
MAR	29.4	31.6	8.0	58	180	6	1.0	90	40	36	14	9.6	2.91	ND	3.2	0.1	7.0	0.22	0.2	1.80
APRL	30.0	31.2	7.8	62	122	5	1.6	86	28	30	10	6.4	1.94	0.06	4.0	ND	4.0	0.36	0.3	2.50
MAY	30.0	30.8	8.0	68	98	8	2.2	68	30	28	12	7.6	2.18	0.04	3.0	ND	6.0	0.50	0.2	2.60

*All the values expressed in mg/L, except temperature and pH. Conductivity=U mohs, Turbidity=NTU.

Table-3: List of Phytoplanktons found in the Varada River, DURING JUNE 2013 TO MAY 2014

CHLOROPHYCEAE
Chiorella fusca
Chlorella vulgaris (Beyerinck)
Haematococcus lacusta (Girod)
Euastrum Spinulosum
Pediastrum bonyanum
Cosmarium subtumidium
Sphaerozosma Wallichii
Spirogyra Sabsalsa Keutezing
Chlosterium acerosum

BACILLARIPHYCEAE
Navicula rhomboidis
Cymatopleura tumida
Synedra ulna
Mastolgloia Smithii
Meridion Sps.
Pinnularia viridis Ehrimb
Surirella robusta
Anomoneis sphacerophora,

CYANOPHYCEAE
Chrococcus varius A. Br.,
Gloeocapsa granosa
Lyngbya semiplena Gomont
Lyngbya hieronysii Lemm
Abhenocapsa endophytica G.M.Smith
Stichosiphon sansibariens (Hieron)

EUGLENOPHYCEAE
Phacus caudate var ovalis Drejepolski
Phacus arbicularis Var caudatus skvortzon
Euglena acus
Euglena polymorpha Dangeard
Lepocinchis fusiformis var major

FIG 1: MONTH WISE DISTRIBUTION AND PERIODICITY OF PHYTOPLANKTONS OF VARADA RIVER, DURING JUNE TO 2013 TO MAY 2014

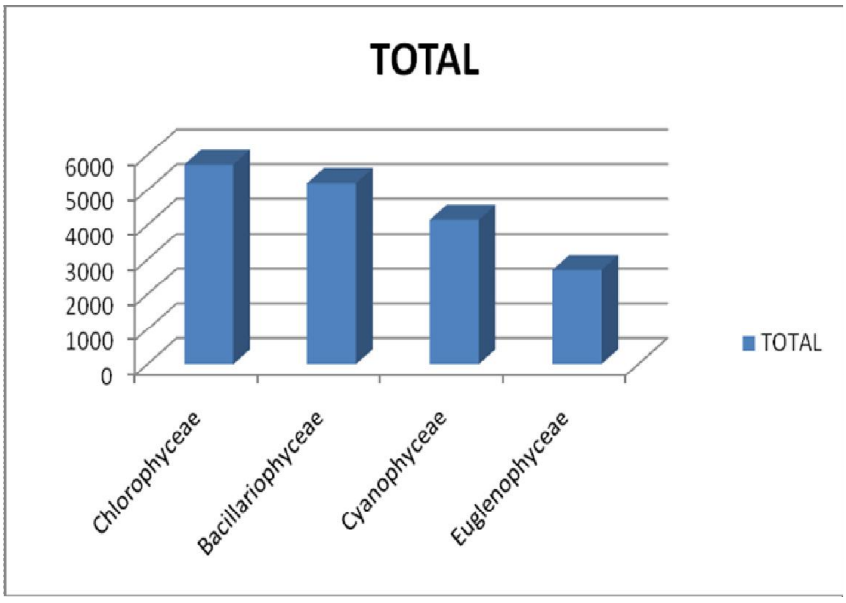


TABLE-4: MONTH WISE DISTRIBUTION AND PERIODICITY OF PHYTOPLANKTONS OF VARADA RIVER, DURING JUNE TO 2013 TO MAY 2014

Month	Chlorophyceae	Bacillariophyceae	Cyanophyceae	Euglenophyceae	Total
JUNE	438	512	426	206	1582
JULY	512	454	382	196	1564
AUG	406	439	306	152	1303
SEPT	451	408	219	201	1139
OCT	609	383	362	263	1417
NOV	585	284	444	292	1505
DEC	655	302	386	333	1576
JAN	593	286	478	201	1558
FEB	472	383	318	262	1735
MAR	381	606	272	184	1443
APRL	301	582	250	218	1471
MAY	326	564	302	196	1488
TOTAL	5729	5203	4145	2704	17781
%	32.22 %	29.26 %	23.32 %	15.20 %	100 %

Fig: - 2. Monthly average values of Atmospheric and Water temperature

Fig: - 3. Monthly average values of Hydrogen ion conc.

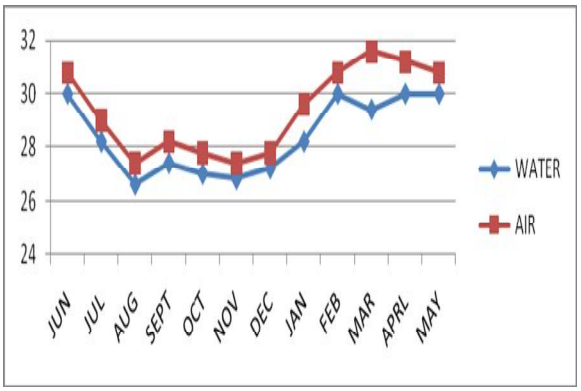


Fig: - 4. Monthly average values of Dissolved oxygen and Alkalinity.

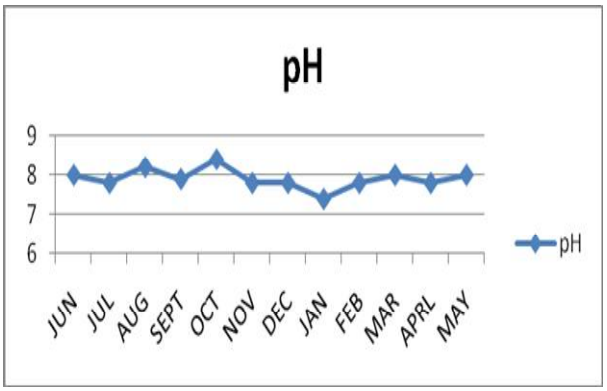


Fig: - 5. Monthly average values of Conductivity and DS

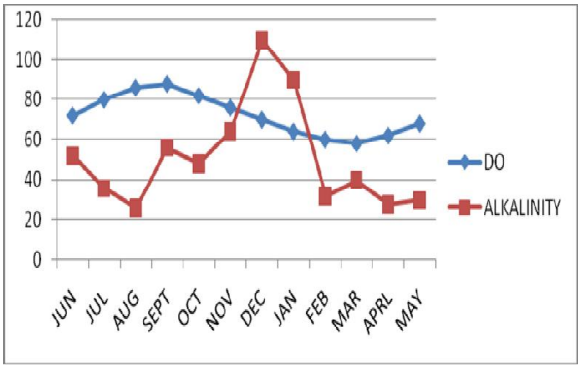


Fig: - 6. Monthly average values of Turbidity.

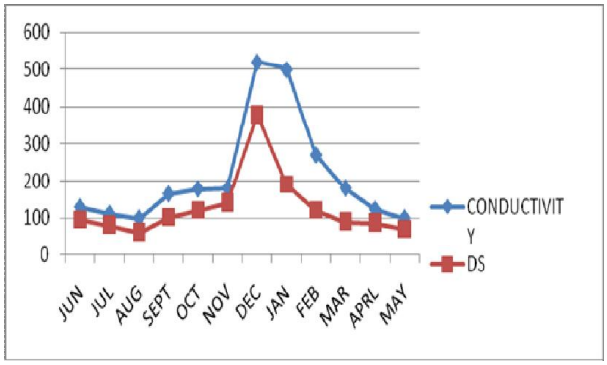


Fig: - 7. Monthly average values of Free carbon dioxide.

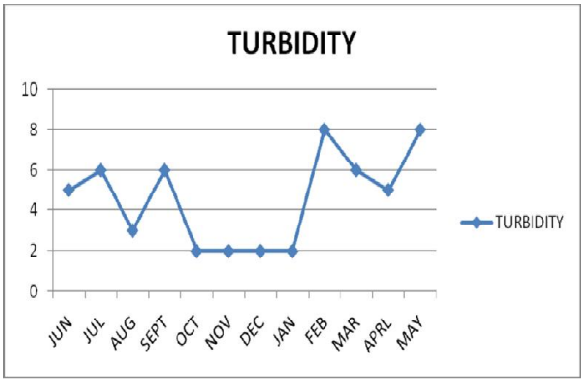


Fig: - 8. Monthly average values of Hardness and Chloride content.

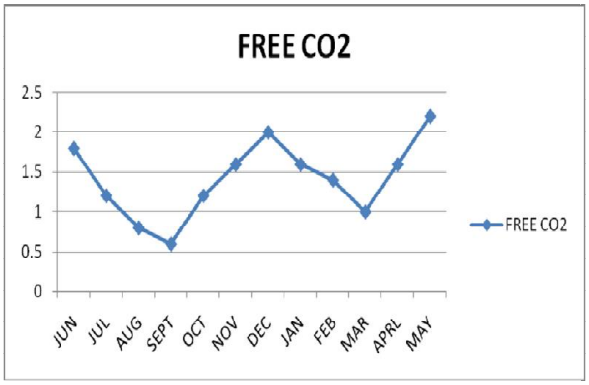


Fig: - 9. Monthly average values of Calcium and Magnesium content.

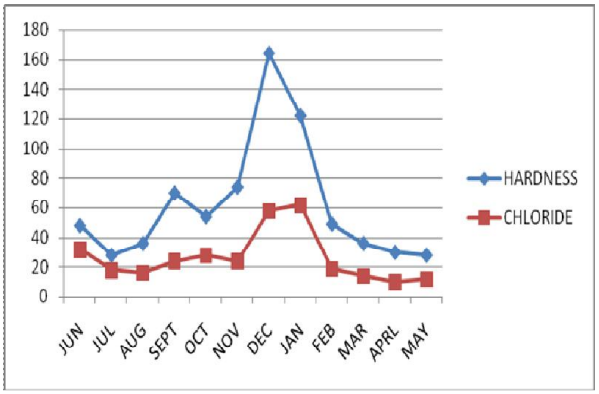


Fig: - 10. Monthly average values of NO3 and NO2.

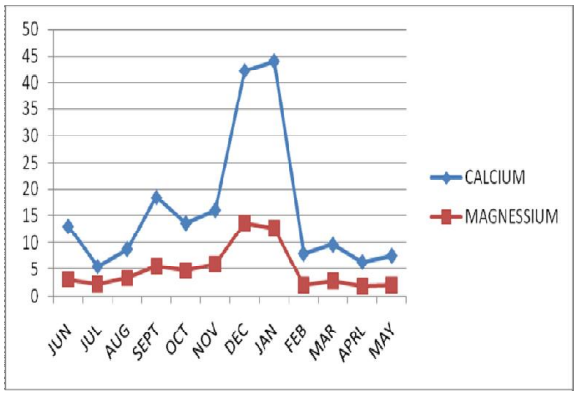


Fig: - 11. Monthly average values of PO4 and SO4

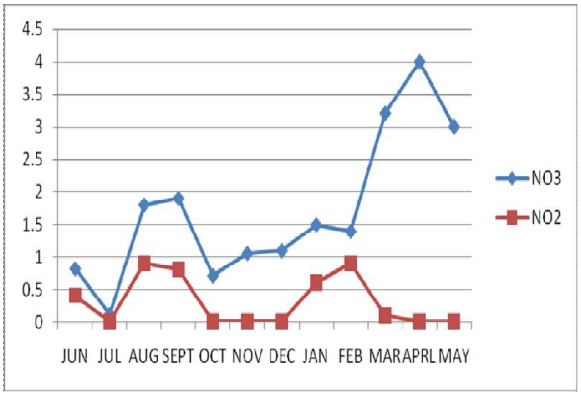


Fig: -12. Monthly average values of Iron and Florida content.

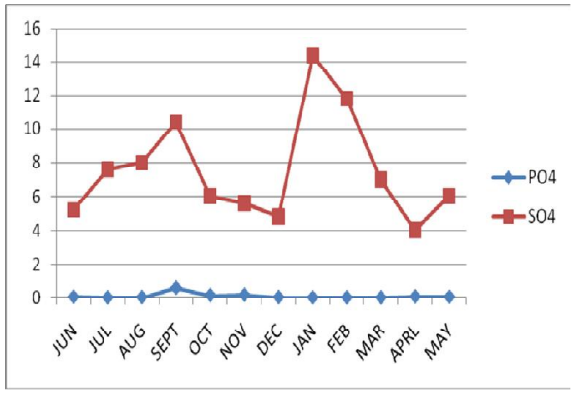
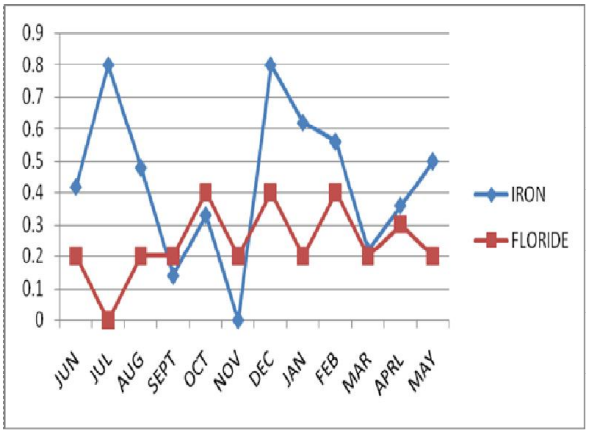


Fig: - 13. Monthly average values of Biologycal oxygen demand.



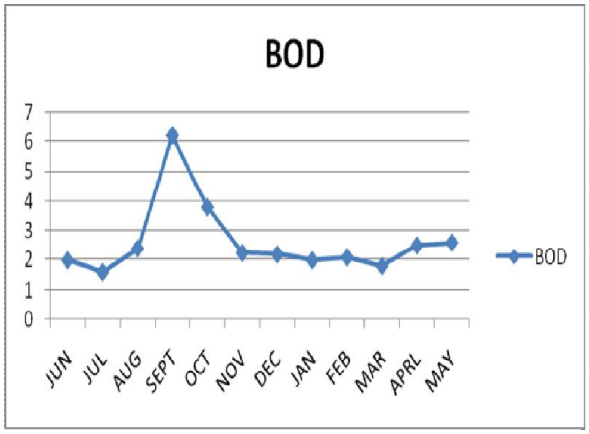


FIG -14(a) Photographic views of varada river during rainy season

FIG -14(b) Photographic views of varada river during normal season