Environment Conservation Journal 8 (3) 117-126, 2007
(ISSN 0972-3099)

A study of biotic and abiotic factors of Song River at Dehradun, Uttarakhand

D.R. Khanna, Vikas Singh, R. Bhutiani, Kumar Satish Chandra, Gagan Matta and Dheeraj Kumar
Deptt of Zoology & Environmental Science, Gurukula Kangri Vishwavidyalaya,Haridwar

Abstract

The present study deals with the analysis of physico-chemical parameters of the Song river at Dehradun, Uttarakhand during the pre-autumn, autumn and post-autumn months of 2007. In the present study of the Song river its physico-chemical characteristics viz temperature, velocity, total solids, total suspended solids, total dissolved solids, turbidity, pH, dissolved oxygen, free CO_2, BOD, COD, alkalinity, chlorides, sulphate and identification of fishes were done. The data revealed that 36 species of fishes are present in the Song river of Dehradun, Uttarakhand.

Keywords- *Physico-chemical, abiotic, biotic, Song river, Dehradun.*

Introduction

Through out history water has been considered a natural resource critical to human survival. Human history can infact be written in terms of interactions and interrelations between human and water (Biswas, 1970). Rivers are the most important resources in the world and in India in particular. Unfortunately, the same rivers are being polluted by indiscriminate disposal of sewage and industrial wastes as a plethora of human activities. Even piped water which is available in big cities becomes also mixed with number of impurities causing jaundice, cholera, typhoid and gastroenteritis (Kudesia, 1988). Pollution of a river first affects its chemical quality and then systematically destroys the community disrupting the delicate food web. River pollution has several dimensions; and effective monitoring, and control of river pollution requires the expertise from various disciplines (Trivedy, 1990).

Song River is a spring fed river originated from different small rivulets of the mountainous range of Dhanolti, crossing with Sahastradhara streams flow downward towards Doon valley basins and finally it assimilates into river Ganga at Raiwala. The river Song is located at 30°28' latitude and 78°8' longitude, with which peoples of Raiwala, Doiwala, Chiddarwala, and Lacchiwala are very much attached because this river is the only ultimate source of water for them travelling a total distance of approximately 42.5 Km. It merges into river Ganga at 78°48'27" longitude and 30°2' latitude after crossing Satyanarayana area. Therefore, in the present study of the Song river its physico-chemical characteristics viz- temperature, velocity, total solids, total suspended solids, total dissolved solids, turbidity, pH, dissolved oxygen, free CO_2, BOD, COD, alkalinity, chlorides, sulphate and identification of fishes were done.

Accurate assessment of water quality, whether in relation to the requirements of intended water uses or in order to determine the impacts of an activity on the water resource depends on the results generated by specific monitoring activities which define the physical, chemical and/or biological condition of the resource. Many workers from India and abroad discussed the different aspects of water quality time to time. Khanna (1993) made a study on ecology and pollution of River Ganga at Hardwar. Pandey *et al*. (1993) studied on the physico-chemical quality of water of river Kosi at Purnia. Khanna *et al*. (1999) studied fishes and their

ecology of the river Suswa at Raiwala, Dehradun. Khanna and Singh (2002) published a book on pond fish ecology and economics. Khanna *et al.* (2003) described a study of assessment of water quality of river Ganga in district Bulandshahar of Uttar Pradesh. Kaur and Joshi (2003) described seasonal variation in some physico-chemical parameters of river Ganga. Khanna and Bhutiani (2003) worked on limnological status of Satikund pond at Hardwar. Semwal and Akolkar (2006) had done the water quality assessment of sacred Himalayan Rivers of Uttarakhand. Bhutiani and Khanna (2007) have done ecological study of Suswa River with main reference to BOD and DO modelling.

Methodology

The water samples were collected from three sampling stations "A"- Raiwala, "B"- Chiddarwala and "C"- Lacchiwala in morning hours (From 8:00 A.M. to 10:00 A.M.). The samples were taken in Borosil glass bottles of 300 ml capacity and plastic containers. Fishes were collected in plastic jars and polythenes.The procedure, which was applied to analyse the sample for different physico-chemical parameters, were taken from APHA (1998), Trivedi and Goel (1986), Khanna and Bhutiani (2004), Santra (2004).

Results and Discussion

The physico-chemical parameter and fish species obtained during the study period are tabulated in table 1 to 15. In the Song River at Dehradun a difference in the fluctuation of water temperature was observed maximum (23.38^{o}C) in post-autumn month and minimum (18.36^{O}C) in pre-autumn month. The water temperature showed an upward trend from winter season to summer season. A more or less similar trend has been observed in the river Yamuna by Chakrabarty *et al.* (1959). Badola and Singh (1981) reported similar trend in river Alakhnanda.

The velocity started increasing after winter season. The maximum (0.95 m/sec) velocity was recorded in post-autumn month and minimum (0.82 m/sec) in pre-autumn month. In the present study it has been observed that the velocity and the total solids showed positive relationship. Maximum concentration (380 mg/l) of total solid was found during the post-autumn month which may be due to soil erosion or side cutting caused by the main stream and the minimum (300 mg/l) during the pre-autumn month as also observed by Joshi and Bisht (1993) in Ganga canal at Jwalapur, Haridwar.

During the study T.D.S. was found minimum (290 mg/l) in pre-autumn month and maximum (335 mg/l) in post-autumn month and increased value were probably due to heavy rain causing soil erosion and adding more suspended or dissolved solids from the nearby area as also observed by Khanna (1993) in the river Ganga at Haridwar, Logankumar *et al.* (1989) in the river Bhavani at Sirumugai, Tamil Nadu. During the study total suspended solid was found maximum (45 mg/l) in post-autumn month and minimum (15 mg/l) in pre-autumn and autumn month and increased value was probably due to heavy rain causing soil erosion and adding more suspended or dissolved solids from the nearby area as also observed by Khanna (1993) in the river Ganga at Haridwar.

During this study it was found that turbidity was higher (26.66 J.T.U.) during postautumn month which may be due to heavy soil erosion and lower (15.33 J.T.U.) during preautumn month as also reported by Khanna(1993) in the river Ganga, Joshi and Bisht(1993) in Ganga canal at Jwalapur, Haridwar. The turbidity

and total solids were closely interrelated with one another and cause common effect upon the river and aquatic life as also stated by Verma *et al.*(1984). The maximum (8.5) pH was recorded in post-autumn month, which might be due to increased chemical load in the river or due to increased photosynthetic activities and low dilution capacity of water. The minimum pH was recorded (6.9) in pre-autumn month which was due to decreased photosynthetic activities which was due to increase in turbidity affecting the penetration of light as also reported by Badola and Singh (1981) reported similar trend in river Alakhnanda river of Garhwal Himalaya. Similar observations were reported by Sangu and Sharma (1985) in river Yamuna. Khanna (1993) in the river Ganga, Joshi and Bisht (1993) in Ganga canal at Jwalapur, Haridwar. Dissolved oxygen is usually related to ambient temperature, current velocity, rainfall and turbulence besides some biological components:-viz. planktonic blooms. Higher value (9.25 mg/l) of D.O. was observed during pre-autumn month, which permit retention of higher amount of air at lower temperature. Thus low temperature has high turbulence usually cause rise in oxygen level. Lower value (8.38 mg/l) of D.O. was observed during post-autumn month due to low O_2 retention capacity of water with the rise in temperature and higher TDS status as also observed by Badola and Singh (1981) reported similar trend in river Alakhnanda river of Garhwal Himalaya. Similar observations were reported by Sangu and Sharma (1985) in river Yamuna. Khanna (1993) in the river Ganga and Kataria *et al.* (1995) in Kubza River at Hoshangabad. The BOD was observed maximum (3.25 mg/l) in post-autumn month and minimum (2.3 mg/l) in pre-autumn month. A similar pattern has been reported by Khanna(1993) in the river Ganga, Chugh (2000) in the river Ganga at Haridwar and Kataria *et al.*(1995) in Kubza River at Hoshangabad.

The maximum value (3.16 mg/l) of COD observed during post-autumn month and minimum (2.3 mg/l) in pre-autumn month. A positive relationship has been observed between COD and water temperature Free Carbon Dioxide was observed maximum (3.31 mg/l) in post-autumn month due to high temperature, and minimum (2.56 mg/l) in pre-autumn month when temperature was low and turbidity was found lowest. Pahwa and Mehrotra (1966) have reported that the Ganga River contains maximum free carbon dioxide in rainy season at Allahabad. Charakbarty *et al.* (1959) also observed the maximum free CO2 in Yamuna during Monsoon at Allahabad.

Sulphate concentration was found to be minimum (1.65 mg/l) in pre-autumn month and maximum (2.76 mg/l) during post-autumn, also observed by Kataria(1966) in borewellsof Bhopal city. Maximum value (23.38 mg/l) of chlorides was observed in Post-autumnmonth and minimum (18.36 mg/l) in Pre-autumn month.The term alkalinity is defined as the quality if ions in water, which react to neutralize hydrogen ions. The maximum value of alkalinity was found in pre-autumn month and minimum in post-autumn month. The cause of increasing alkalinity was the decomposition of the organic water.

A total number of 36 fish species were observed in river Song while Badola and Singh (1981) observed 31 species of fish in river Alakhnanda of Garhwal Himalaya. Bhatt *et al*. (1984) reported 26 fish species in river Kosi of Kumaon Himalayas. Khanna and Badola (1991) observed 30 species of fish fauna in the river Ganga at Hardwar.

SYSTEMATIC LIST OF FISHES

Present scientific names and classification

Sub- phylum	Craniata
Super-class	Gnathostomata
Phylum	Vertibrate
Series	Pisces
Class	Teleostomi
Order	Cyprini-formes
Family	Cyprinidae
Division	Cyprini
Name of Species	**Local name**
Labeo rohita	Rohu
Labeo dero	Aragi
Labeo calbasu	Rohu
Labeo gonious	Rohu
Punitus sarena	Darahi
Punitus ticto	Shidhari
Punitus chola	Shidhari
Punitus sophore	Shidhari
Punitus conchonius	Darahi
Rasbora daniconius	Dandwa
Barilius bola	Bola
Barilius bendelisis	Bola
Barilius vagra	Bola
Danio devario	Fatukari
Brachydanio reria	-
Crossocheilus	-
Garra gotyla gotyla	-
Schizothorax sinatus	-
Schizothorax richardsoni	-
Tor putitora	Mahsheer

Tor tor	Mahsheer
Family : Cobitidae	
Botia dario	
Lepidocephalus guntea	Hakati
Neomacheilus botia	Natwa
Neomacheilus rupicala	Natwa
Family : Bagridae	
Mystus seenghala	Tengar
Mystus tengara	Tengar
Mystus vittatus	Tengar
Family : Saccobranchidae	
Heteropneustes fossils	Singhi
Family : Clariidae	
Clarius batarachus	Mangur
Order : Beloniformes	
Family : Belonidae	
Xenentodon cancila	Kauwa
Family: Channidae	
Channa striatus	Saur
Channa gachuo	Girae
Family: Anabantidae	
Colisa fasciatus	Khosti
Family: Mastacembelidae	
Mastacembelus armatus	Baam
Mastacembelus pancalus	Patya

Table-1 : Seasonal variations of different parameters of Song River at Dehradun.

Para meter	Pre-autumn	Autumn	Post-autumn	Average
Temperature ($_{o}$C)	19.50	22.83	23.16	21.16±2.02
Velocity (m/sec)	0.82	0.87	0.95	0.88±0.07
Total Solid (mg/l)	300.00	330.00	380.00	336.66±40.41
T.D.S (mg/l)	290.00	315.00	335.00	313.30±22.55
T.S.S (mg/l)	17.33	15.33	35.33	22.66±11.02
Turbidity (J.T.U.)	15.33	20.00	26.66	20.66±5.69
pH	6.90	6.90	8.56	7.45±0.96
DO (mg/l)	9.25	8.90	8.38	8.85±0.44
Free CO_2(mg/l)	2.56	2.76	3.31	2.88±0.39
BOD (mg/l)	2.30	2.80	3.25	2.78±0.47
COD (mg/l)	2.30	2.68	3.16	2.71±0.43
Sulphate (mg/l)	1.65	2.27	2.76	2.22±0.56
Alkalinity (mg/l)	180.80	158.16	141.50	160.15±19.73
Chlorides (mg/l)	18.36	22.90	23.38	21.54±2.78

References

APHA, AWWA, WPCF, 1998. *Standard methods for examination of water and waste water*, 20th Eds. American Public Health Association; 1015, Fifteen Street, New Washington., 15: 1-1134.

Badola, S.P. and Singh, H.R., 1981. Hydrobiology of the river Alakhnanda of Garhwal Himalaya*,* ***Ind. J. Eco.***, 8(2):269-276.

Bhatt, S.D., Bisht, Y.and Negi, U., 1984. Ecology of Limnoflora in river Koshi of the Kumaon Himalaya (U.P.). ***Proc. Ind. Natu.,*** S.C, 50(4).

Bhutiani, R. and Khanna, D.R., 2007. Ecological study of Suswa River: modeling DO and BOD, ***Environ. Monit. and Assesment,*** 125:1-3.

Biswas, J., 1970. Interactions and interrelations between human and water. ***Indian Journal Environ. Health.,*** 14: 297-309.

Chakrabarty, R.D., Ray, P. and Singh, S.B., 1959. A quantitative survey of Plankton and physiological conditions of the river Yamuna at Allahabad. ***Indian. J. Fish.,*** 6(1):186-203.

Chugh, Tarun, 2000. *Seasonal variation in the microbial ecology of river Ganga at Hardwar*, Ph.D Thesis, Gurukula Kangri University.

Joshi, B.D. and Bisht, R.C.S, 1993. Some aspects of physico-chemical characteristics of western Ganga canal near Jwalapur at Haridwar. ***Him. J. Env. Zool.***, 7(1):76-82.

Kataria, H.C., 1966. Sulphate content in bore well water of Bhopal city. ***Ultra. Scientist. Phyl. Sci.***, 8(1):97-100.

Kataria, H.C., Jain, O.P., Gupta, S.S., Srivastava, R.M. and Shandilya, A.K., 1995. Physicochemical analysis of water of Kubza river of Hoshangabad. ***Oriental. J. Chem.,*** 11(2):157-159.

Kaur, Surendra and Joshi, B.D., 2003. Describes seasonal variation in some physicochemical parameters of Ganga. ***Him, J. Env & Zoo.***, 17(1):45-55.

Khanna, D.R., 1993. *Ecology and Pollution of Ganga River*, Ashish publication House, Delhi:1-241.

Khanna, D.R. and Badola, S.P., 1991, *Fish fauna of the river Ganga at Hardwar. Aquatic Environment,* Ashish Publishing House. 8/81, Punjabi Bagh, New Delhi, 90-93.

Khanna, D.R. and Bhutiani, R., 2003.Worked on limnological status of Satikund pond at Hardwar, ***Indian J. Env. Sc.,*** 7(2):131-136.

Khanna, D.R. and Bhutiani, R., 2004. *Water analysis at a glance*, ASEA Publications, 1- 115.

Khanna, D.R. and Singh, S., 2002. *Published a book on pond fish ecology and economics*. Daya publishing House, Delhi: 1-81.

Khanna, D.R., Seth, T.R., Malik, D.S. and Singh, R.K.,1999. Fishes and their ecology of river Suswa at Raiwala (Dehradun), ***Sw. Eco. Sys. and Env.,*** Ed. by D.R. Khanna, A. Gautam,105-110.

Khanna, D.R., Singh, S., Gautam, A. and Singh, J.P., 2003. Study of assessment of water quality of river Ganga in distt. Bulandshahar (U.P.). ***J. Nat. Con.,*** 15(1):167-175.

Kudesia, P.R., 1988. Studied the diseases caused because of polluted water in New Delhi.***Indian J. Ecol.,*** 12(4):236-254.

Logankumar, K., Sivakumar,A.A., Logasamy, S. and Aruchami, M., 1989. Seasonal variation in the nutrients of the river Bhavani at Sirumugai, Coimbatore district, Tamil Nadu., ***Ind. J. Ecol***. 16(1): 60-63.

Pahwa, D.V. and Mehrotra, S.M., 1966. Observation on fluctuations in abundance of plankton in relation to certain hydrological conditions of river Ganga. ***Proc. Nat. Acad. Sci***., 36B(2):157-159.

Pandey, B.N., Kumar, K., Lala, A. and Das, P.K.L., 1993. A prelimary study on the physico-chemical quality of water of the river Kosi, ***J. Ecobiol.,*** 5: 237-339.

Sangu, R.R.S. and Sharma, K.D., 1985. Studies on water pollution on Yamuna river at Agra, ***Indian J. Env. Hlth.,***27(3): 257-261.

Santra, S.C., 2004. *Environmental Science*. New Central Book Agency (P) Ltd. 1-944.

Semwal, N. and Akolkar, P., 2006. Water quality assessment of sacred Himalayan Rivers of Uttarakhand. ***Current Science.,*** 91(4).

Trivedi, R.K. and Goel, P.K.,1986. *Chemical and Biological method for water pollution studies*. Karad: Environmental Publications, 1-251

Trivedy, P.K., 1990. Studied the monitoring and control of river pollution. *Water pollution and management*., 245-265.

Verma, S.R., Sharma, P., Rani. A., Gupta, A.K. and Dalela, R.G., 1984. Pollution and saprobic status of eastern Kalinadi. ***Limnologica (Berlin)*** 15(1):69-133.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	19.0	21.0	23.5	21.16± 2.25
Chiddarwala	20.0	22.0	24.0	22.00± 2.00
Lacchiwala	19.5	19.5	22.0	20.33 ±1.44

Table - 2 The value of temperature (oC) found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	0.90	0.95	1.00	0.95± 0.05
Chiddarwala	0.85	0.85	1.00	0.90 ±0.087
Lacchiwala	0.73	0.82	0.85	0.80 ±0.062

Table - 3 The velocity (m/sec) of water found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	305	345	385	345±40.00
Chiddarwala	310	335	375	340±32.79
Lacchiwala	300	310	380	330±43.59

Table -4 The value of total solids (mg/) found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	285	320	340	315±27.84
Chiddarwala	300	325	335	320±18.03
Lacchiwala	285	300	330	305±22.91

Table -5 The value of total dissolved solids (mg/l) found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	20	25	45	30±3.61
Chiddarwala	10	10	40	20±9.17
Lacchiwala	15	10	50	24±21.79

Table -6 The value of total suspended solids (mg/l) found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	16	20	30	22±7.21
Chiddarwala	20	25	30	25±5.00
Lacchiwala	10	15	20	15±5.00

Table -7 The value of turbidity (J.T.U.) found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	17.60	24.23	27.65	23.16± 5.11
Chiddarwala	19.50	24.50	23.50	22.50 ±2.65
Lacchiwala	18.00	20.00	19.00	19.00 ±1.00

Table -8 The value of Chlorides (mg/l) found at different sampling stations of Song River

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	7.25	6.75	8.20	7.40±0.74
Chiddarwala	7.00	6.50	9.00	7.50 ±1.32
Lacchiwala	6.50	7.50	8.50	7.50± 1.00

Table -9 The value of pH found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	9.25	8.75	8.40	8.80 ±0.43
Chiddarwala	9.50	9.00	8.50	9.00 ±0.50
Lacchiwala	9.00	9.00	8.50	8.83 ±0.29

Table -10 The value of Dissolved oxygen (mg/l)found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	2.95	3.05	3.45	3.15± 0.265
Chiddarwala	2.75	2.75	3.50	3.00± 0.433
Lacchiwala	2.00	2.50	3.00	2.50 ±0.50

Table -11 The value of free carbon dioxide (mg/l) found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	2.65	2.95	3.55	3.05± 0.46
Chiddarwala	2.25	2.95	3.50	2.90± 0.63
Lacchiwala	2.00	2.50	2.70	2.50± 0.50

Table -12 The value of biochemical oxygen demand (mg/l) found at different sampling stations of Song River.

Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	2.20	2.90	3.15	2.75± 0.49
Chiddarwala	2.45	2.65	2.85	2.65± 0.20
Lacchiwala	2.25	2.50	3.50	2.75± 0.66

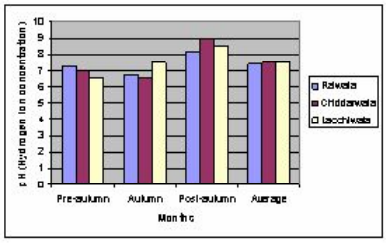
Table -13 The value of chemical oxygen demand (mg/l) found at different sampling stations of Song River.

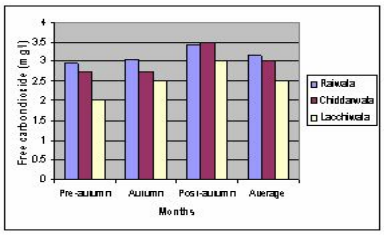
Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	1.85	2.42	2.73	2.32± 0.45
Chiddarwala	1.60	2.15	2.85	2.20± 0.63
Lacchiwala	1.50	2.25	2.70	2.15± 0.61

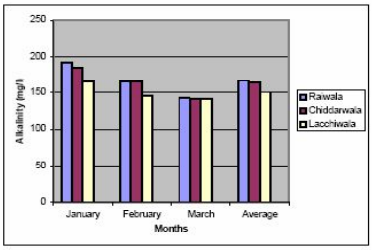
Table -14 The value of Sulphate (mg/l) found at different sampling stations of Song River.

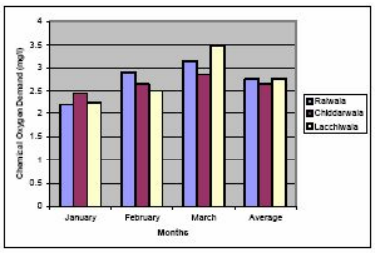
Sampling Site	Pre-autumn	Autumn	Post-autumn	Avarage
Raiwala	192.50	164.50	142.26	166.42± 25.18
Chiddarwala	185.00	165.00	140.75	163.58±22.16
Lacchiwala	165.00	145.00	141.50	150.50± 12.68

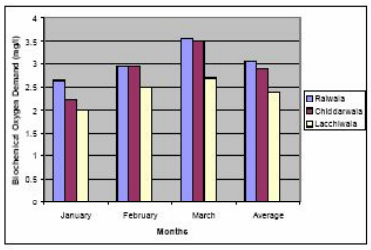
Table -15 The value of alkalinity (mg/l) found at different sampling stations of Song River

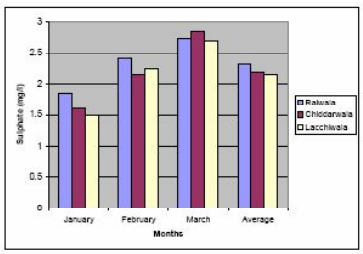

pH (Hydrogen ion concentration)
Pre-autumn
Autumn
Post-autumn
Average
Months
Raiwala
Chiddarwala
Lacchiwala

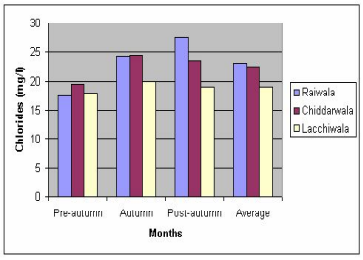

Free carbondioxide (mg/l)
Pre-autumn
Autumn
Post-autumn
Average
Months
Raiwala
Chiddarwala
Lacchiwala

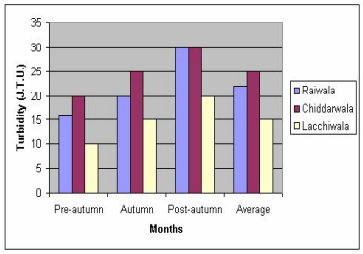

Alkalinity (mg/l)
January
February
March
Average
Months
Raiwala
Chiddarwala
Lacchiwala

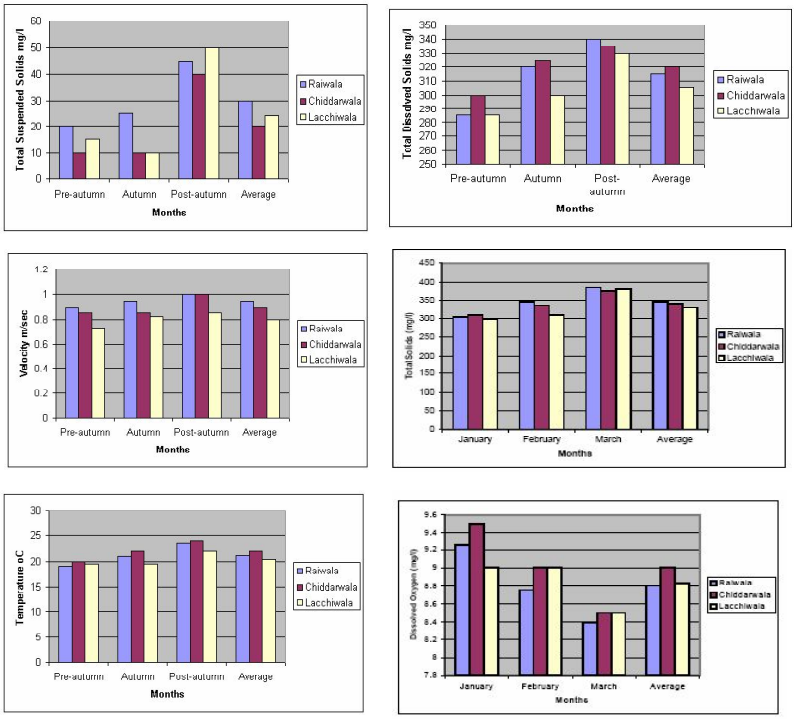

Chemical Oxygen Demand (mg/l)
January
February
March
Average
Months
Raiwala
Chiddarwala
Lacchiwala


Biochemical Oxygen Demand (mg/l)
January
February
March
Average
Months
Raiwala
Chiddarwala
Lacchiwala


Sulphate (mg/l)
January
February
March
Average
Months
Raiwala
Chiddarwala
Lacchiwala


Chlorides (mg/l)
Pre-autumn
Autumn
Post-autumn
Average
Months
Raiwala
Chiddarwala
Lacchiwala


Turbidity (J.T.U)
Pre-autumn
Autumn
Post-autumn
Average
Months
Raiwala
Chiddarwala
Lacchiwala



Graphs showing fluctuation in parameters in different seasons