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Impact of Touristic Activities on Water Quality of Sahashtradhara Stream, Dehradun

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Abstract: Present study was conducted to find out the impact of touristic activities on the water quality of Sahashtradhara Stream round the year. Some selected physico-chemical parameters viz. temperature, pH, transparency, turbidity, total solids, total dissolved solids, dissolved oxygen, biochemical oxygen demand and chlorides monitored during study period. Three study sites viz. Site-I (reference site), Site-II (main attraction of tourist) and site-III (dilution zone) were selected for the sampling. The relative differences for temperature was 8.05% higher, pH 1.06% higher, turbidity 52.24 higher, transparency 22.81% lower, total solids 18.31 higher, TDS 28.64% higher, DO 6.54% lower, BOD 21.78% higher, chlorides 22.29% higher at Site-II as compared to reference Site-I. The pH showed minimum (1.06%) relative difference while turbidity showed maximum (52.24%) relative difference at site-I as compared to reference site (site-I). It was found that significant change in water quality of Sahashtradhara stream due to different touristic activities.
Key words: Physico-chemical parameters, touristic activities.

Introduction

Tourism is one of the world's fastest growing industries as well as the major source of foreign exchange earnings and employment for many developing countries. It has the potential to contribute in a positive manner to socio-economic achievements but, at the same time, its fast and sometimes uncontrolled growth can be the major cause of degradation of the environment and loss of biodiversity. Biological and physical resources are in fact the assets that attract tourists. Dwelling the remote areas in and around the touristic places people have shifted for the unproductive agricultural and pastoral practices to small business related to tourism e.g. small huts stalls have been opened at places where no one could have imagined these facilities[1].

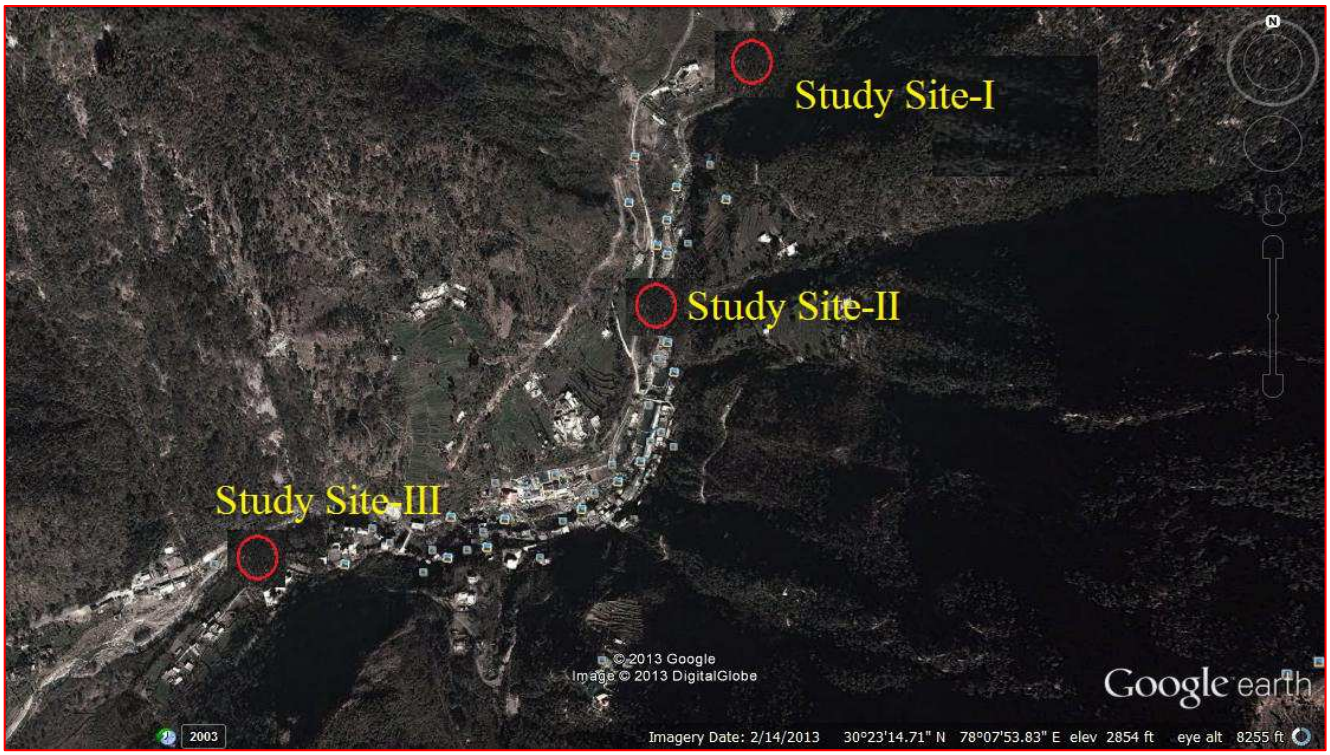
World Tourism Office statistics show that in the countries where tourism is firmly established the sector dealing with accommodation alone can provide 3-5 % of the total number of jobs available for the whole tourism sector[2]. The harmful impacts are even more important than the useful ones. Plants are the direct sufferers of the road construction as they are liable to cutting and felling where a road is proposed to be constructed. Some time forested lands are destroyed to facilitate the tourist, for constructing the luxurious lodges, encampments,

electrification and communication etc. Such activities are injurious to the ecosystem and biodiversity, by which the incidents of forest fire also occur in these areas, because the tourist staying in the adjoining area resulted in heavy losses to the forest wealth.

Tourism has identified major sources of environmental stress due to tourists generated activities. The permanent restructuring of the environment brought about by a variety of construction activities and replacement of a natural environment by a new built environment has a variety of far reaching and long lasting result, in term of existing biological species and physical conditions in the area. It may also cause significant changes in the visual amenity. The important environmental impact concern recreational activities, the effect of these activities include soil compaction and erosion, change in plant cover the species diversity[2].

Dehradun is one of the fastest growing city and capital of Uttarakhand state and it is generally known for its natural beauty but last few decades this city faces huge pressure of tourists which comes from different part of the country for fun and gratification due to its climatic conditions. Sahashtradhara is about 12 km away from the Dehradun railway station. Sahashtradhara means "thousands rivers" which lies between latitudes 29°26' to 31°28'N and longitude 77°49' to 80°06'. This place is known for its natural attractiveness and thouands of tourists comes across the country to visit this place the number of tourists swells up during the summer season. This study is based on impact of touristic activities on water quality parameters of Sahashtradhara stream.

Materials and Methods



Map Showing three different study sites within the Sahastradhara stream at Dehradun District

The present study was conducted on the famous sulphur stream 'Sahastradhara' at Dehradun district during August, 2012 to July, 2013. The water samples were collected from three different sites at stretches of about 5 km area from the surface water samples to analyzed physico-chemical parameters. Water samples collected bimonthly from August, 2012 to July, 2013. Regular monthly samples were taken from each site throughout the study period. Some parameters such as temperature, transparency, pH analyzed on spot while other parameters viz. dissolved oxygen, turbidity, biochemical oxygen demand, chlorides, and hardness were brought to Zoology laboratory at Uttaranchal College of Science and Technology, Dehradun.

Parameters Studied

Water quality parameter: The study was carried out by systematic collection of water samples from three spot namely Site-I, Site-II and Site-III.

Physico-chemical Parameters

1. Temperature
2. pH
3. Transparency
4. Turbidity
5. Total Solids (TS)
6. Total Dissolved Solids (TDS)
7. Dissolved Oxygen (DO)
8. Biological Oxygen Demand (BOD)
9. Chlorides.

Physicochemical parameters were analyzed by the standard methods.[3-4]

Results and Discussion

The results obtained for this study made from July, 2012 to June, 2013, at three selected sites namely, Site-I, Site-II and Site-III. A total of nine physico-chemical parameters were monitored. Findings of water quality assessment are represented in table1-table-3 and described below.

Among the physical parameters temperature is one of the most important environmental parameter feels the moment touches the water. Temperature is an important parameter which not only impacts the external behaviour of living organisms, but also influences the internal physico-chemical milieu organism and can drastically change or influence the whole course of metabolic process within physiological process within ecosystem. During the present study the overall lowest and highest mean value of temperature were observed 10.7^0C and 21.7^0C in the month of January and June at the Site-I and Site-II, respectively. Among the three selected sites the site I, happens to be first site therefore has been treated as reference site. It can also be recorded here that normally there are no tourist at Site-I. Once again it needs to mention that as many as 98% of tourists come at Site- II this site is the point of main action.

Industrialization, modernization, spread of education, speedy communication system, and holidays changed the human life. This forced human beings for periodical refreshment of mind and body in wilderness areas for active participation in exotic activities. Presently tourism has been declared as an industry and environmental impacts are being visualized clearly on the concerned areas. India is blessed with plenty of well known touristic destinations. Tourism to these destinations brings enormous economic gain to local residents. Dehradun is one of the most important place and capital of newly carved state Uttarakhand, which receive minimum of 50,000 to 70,000 tourists per day. This leads to the accumulation of huge amount of solid waste at and around various places of the city. Similarly, Bhadula and Joshi[5] observed the highest water temperature at minor canal of river Ganga during the month of June. The temperature values obviously are highly influenced by the routine seasonal and anthropogenic activities.

Aquatic organisms need the pH of their water body to be within a certain range for optimal growth and survival. Although each organism has an ideal pH, most aquatic organisms prefer pH of 6.5 – 8.0. Outside of this range, organisms become physiologically stressed. Reproduction can be impacted by out-of-range pH, and organisms may even die if the pH gets too far from their optimal range. During the present study the overall lowest and highest mean value of pH were observed 7.0 and 7.9 in the month of June and December at the Site-II and Site-I, respectively.

Transparency is a measure of how clear the water is. It is important, because aquatic plants need sunlight for photosynthesis. The clearer the water, the deeper sunlight will penetrate. Transparency has direct bearing on the light penetration of water and depends upon suspended matter and dissolved coloured substances. The data of present study reflect that a relative comparison in transparency showed wide variation in water quality. During the present study the overall lowest and highest mean value of transparency were observed 1.0cm and 45.7cm in the month of August and January at the Site-II and Site-I, respectively. Present study reveals that a relative

comparison in transparency showed comprehensive variation in water quality. The maximum transparency was found at the site-I during month of January and at site-II transparency relatively low due to the touristic activities.

The Turbidity of any water sample is the reduction of transparency due to the presence of particulate matter such as lay or slit, finely divided organic matter, plankton and other microscopic organisms. During the present study the overall lowest and highest mean value of turbidity were observed 7NTU and 302 NTU in the month of January and August at the Site-I and Site-II, respectively.

The maximum relative difference (200%) was found in turbidity at Site-II during month of January as compared to Site-I may due to touristic activities in this ghat. Similarly, Bhadula and Joshi (2011) reported high turbidity in the Ganga River due to anthropogenic activities which may lead to serious water quality pollution earlier described by Saini et al.[7] reported that the number of patient were rised due to water borne diseses at touristic place due to touristic activities.

Total Solids (TS) is related to turbidity, except that it includes not just suspended solids, but also dissolved solids such as the mineral ions calcium, phosphorus, iron, sulfur and bicarnonate. In the present study the overall lowest and highest mean value of total solids were observed 75mg/l and 1762mg/l in the month of January and August at the Site-I and Site-II, respectively. Total dissolves solids (TDS) are naturally present in water or are the result of mining or some industrial treatment of water. In the present study the overall lowest and highest mean value of total dissolved solids were observed 46 mg/l and 1430 mg/l in the month of January and August at the Site-I and Site-II, respectively.

The oxygen is most important gas, produced during photosynthesis by the phytoplankton in aquatic environment. In the present context DO reduces during the summer season as compared to winter and monsoon months it may be due to huge amount of organic matter being released by the tourist in the river in the form of polythene plastic bottles, rappers of synthestic items or it may be due to seasonal variation. In the present study the overall lowest and highest mean value of dissolved oxygen were observed 7.0mg/l and 10.8mg/l in the month of June and January at the Site-II and Site-I, respectively. DO show negative correlation with temperature. Similarly Upadhya and Verma[6] reported the value of DO 8.05 mg/1 during the month of January for river Subernarekha at Ranchi.

BOD is the amount of oxygen required for the oxidation of organic matter by micro-organisms in aerobic condition. During the present study the overall lowest and highest mean value of bio-chemical oxygen demand were observed 1.0mg/l and 3.0mg/l in the month of January and June at the Site-I and Site-II, respectively. Similarly Bhadula and Joshi[5] showed similar results and described that BOD was certainly rise in the River water due to various anthropogenic activities in which BOD was 3.24mg/l during the month of June.

Chlorides concentration is an important ion required by photosynthesizing cells. The water from human excreta is rich in chlorides. Human body discharge about 8.0gm to 15.0gm chloride per day. Therefore chlorides concentration serves as an indicator of pollution. During the present study the overall lowest and highest mean value of chlorides were observed 17mg/l and 42mg/l in the month of January and July at the Site-I and Site-II, respectively. Similar results were found by the Semwal and Akolkar (2006) in which chlorides were 126.12% higher in the polluted site in comparison to non-polluted site. In the present study higher concentration of chlorides was recorded in monsoon festivals while the lower concentration was recorded during winter festivals as also reported by Roy and Mandloi (2007). It was also observed that lack of municipal facilities has resulted into degradation of environment. Flora and fauna disturbed by the developmental activities in the concerned area.Therefore it is required to make an applicable strategy to check these problems which are related to tourism.

Table-1: Table Showing Physico-chemical Parameters in Sahashtradhara Stream at site-I

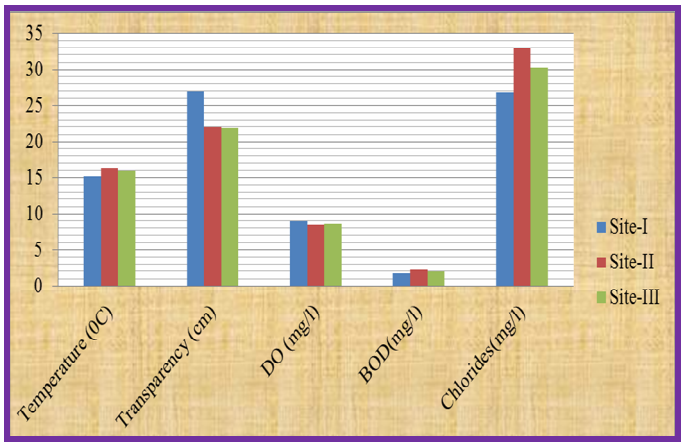
S.N	Parameters	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct	Nov.	Dec.
1.	Temperature (^oC)	**10.7**	**11.2**	**13.7**	**14.7**	**16.3**	**19.5**	**18.7**	**18.5**	**17.2**	**16.0**	**14.0**	**11.2**
2.	pH	**7.8**	**7.7**	**7.5**	**7.3**	**7.2**	**7.0**	**7.1**	**7.3**	**7.6**	**7.7**	**7.7**	**7.9**
3.	Turbidity (NTU)	**7**	**15**	**23**	**32**	**45**	**108**	**178**	**167**	**98.0**	**57.0**	**20.0**	**8**
4.	Trans. (cm)	**45.7**	**40.6**	**32.5**	**27.8**	**25.3**	**12.4**	**5.0**	**7.0**	**18.0**	**30.0**	**37.0**	**43.0**
5.	TS (mg/l)	**75**	**187**	**269**	**654**	**768**	**1346**	**1586**	**1560**	**1020**	**570**	**101**	**82**
6.	TDS (mg/l)	**46**	**127**	**238**	**436**	**546**	**1094**	**1187**	**1170**	**601**	**201**	**59**	**51**
7.	DO (mg/l)	**10.8**	**10.1**	**9.6**	**8.7**	**8.0**	**7.5**	**8.0**	**8.3**	**8.0**	**9.1**	**9.3**	**10.0**
8.	BOD (mg/l)	**1.0**	**1.5**	**1.7**	**1.9**	**2.0**	**2.4**	**2.3**	**2.0**	**1.9**	**1.8**	**1.7**	**1.3**
9.	Chlorides (mg/l)	**17**	**23**	**26**	**30**	**32**	**34**	**35**	**32**	**28.0**	**25.0**	**22.0**	**19**

Table-2: Table Showing Physico-chemical Parameters in Sahashtradhara Stream at site-II

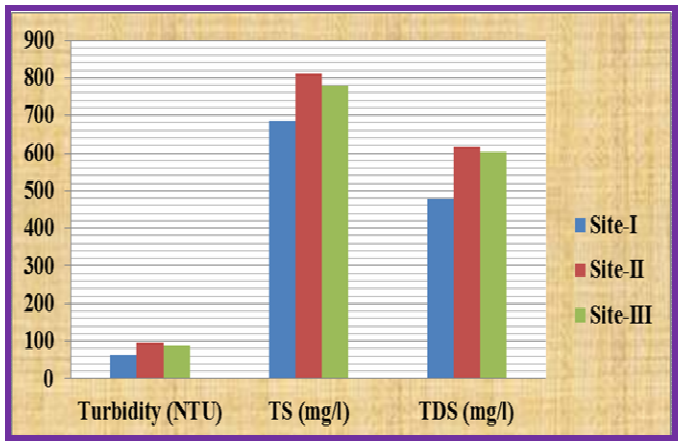
S.N.	Parameters	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct	Nov.	Dec.
1.	Temperature (^oC)	**11.5**	**11.8**	**14.9**	**15.7**	**17.0**	**21.7**	**19.7**	**19.3**	**18.7**	**17.2**	**16.0**	**12.9**
2.	pH	**7.7**	**7.8**	**7.6**	**7.5**	**7.3**	**7.1**	**7.3**	**7.5**	**7.7**	**7.8**	**7.7**	**7.8**
3.	Turbidity (NTU)	**12**	**20**	**28**	**41**	**54**	**120**	**197**	**302**	**204**	**110.0**	**52.0**	**14.0**
4.	Trans. (cm)	**40.5**	**37.5**	**30.8**	**22.6**	**20.0**	**9.0**	**3.7**	**1.0**	**14.0**	**21.0**	**30.0**	**34.0**
5.	TS (mg/l)	**87**	**206**	**295**	**740**	**780**	**1440**	**1687**	**1762**	**1524**	**867**	**211**	**124**
6.	TDS (mg/l)	**60**	**145**	**268**	**538**	**640**	**1145**	**1275**	**1430**	**1130**	**612**	**102**	**60**
7.	DO (mg/l)	**9.6**	**9.1**	**8.7**	**8.3**	**7.5**	**7.0**	**7.6**	**8.0**	**8.3**	**8.5**	**9.0**	**9.2**
8.	BOD (mg/l)	**1.5**	**1.7**	**1.9**	**2.3**	**2.6**	**3.0**	**2.7**	**2.5**	**2.2**	**2.0**	**1.9**	**1.9**
9.	Chlorides (mg/l)	**26**	**30**	**31**	**35**	**35**	**38**	**40**	**42**	**35.0**	**29.0**	**26.0**	**28.0**

Table-3: Table Showing Physico-chemical Parameters in Sahashtradhara Stream at site-III

S.N	Parameters	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct	Nov.	Dec.
1.	Temperature (^oC)	**11.0**	**11.3**	**14.5**	**15.4**	**16.7**	**20.0**	**19.9**	**19.0**	**18.0**	**16.5**	**16.3**	**11.8**
2.	pH	**7.8**	**7.5**	**7.5**	**7.3**	**7.4**	**7.2**	**7.3**	**7.4**	**7.6**	**7.7**	**7.8**	**7.9**
3.	Turbidity (NTU)	**10**	**18**	**25**	**35**	**50**	**117**	**180**	**290**	**186**	**100**	**43.0**	**12.0**
4.	Trans. (cm)	**38.5**	**35.5**	**28.6**	**25.6**	**18.7**	**11.0**	**5.7**	**2.0**	**16.0**	**24.0**	**27.0**	**30.0**
5.	TS (mg/l)	**85**	**200**	**283**	**728**	**768**	**1420**	**1640**	**1675**	**1440**	**800**	**186**	**104**
6.	TDS (mg/l)	**56**	**140**	**262**	**530**	**628**	**1140**	**1260**	**1400**	**1100**	**600**	**85**	**45**
7.	DO (mg/l)	**9.9**	**9.2**	**8.9**	**8.5**	**7.7**	**7.2**	**7.8**	**8.2**	**8.4**	**8.7**	**9.2**	**9.5**
8.	BOD (mg/l)	**1.6**	**1.5**	**1.7**	**2.1**	**2.3**	**2.8**	**2.5**	**2.3**	**2.0**	**2.0**	**1.9**	**1.8**
9.	Chlorides (mg/l)	**24**	**28**	**29**	**30**	**32**	**35**	**37**	**40**	**32.0**	**28.0**	**24.0**	**25.0**

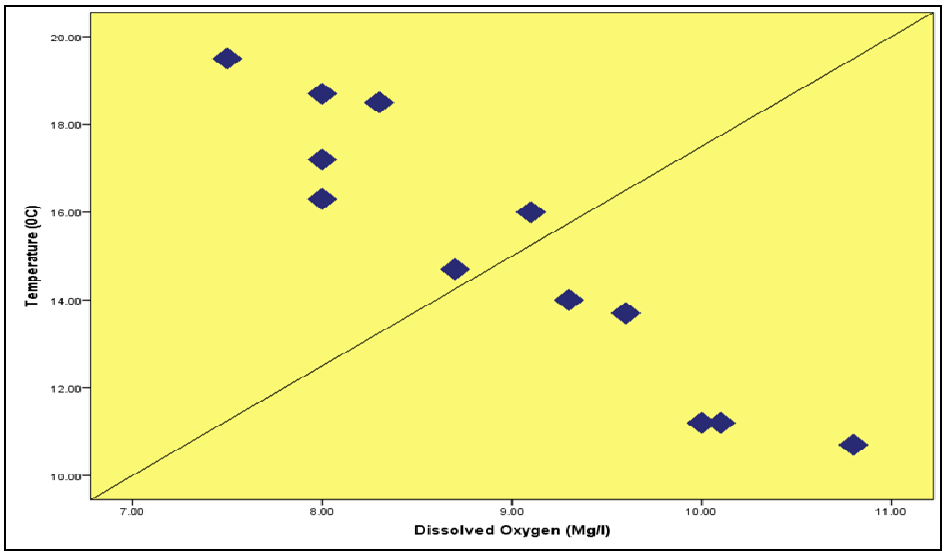


(a)

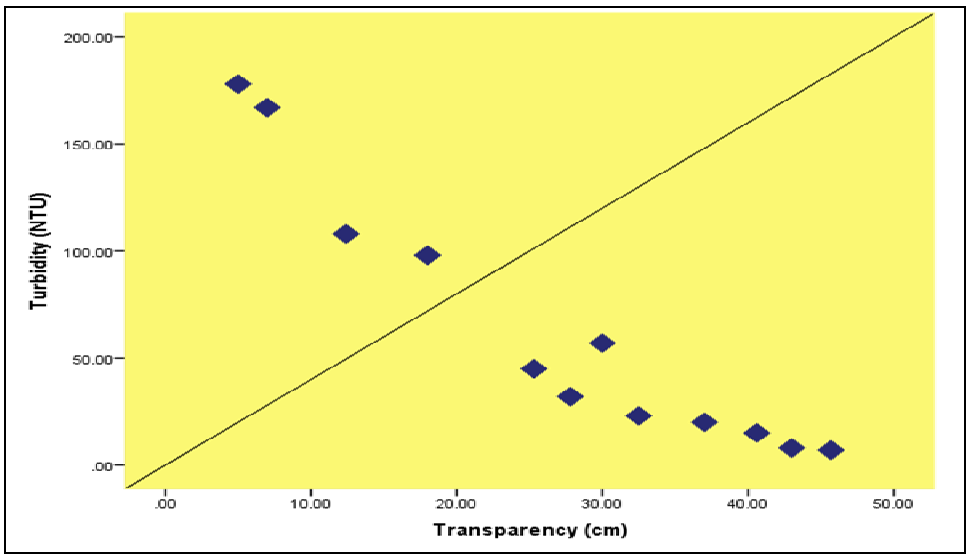


(b)

Comparative graphs (A & B) of Physico-chemical parameters in three selected sites at sahashtradhara Stream

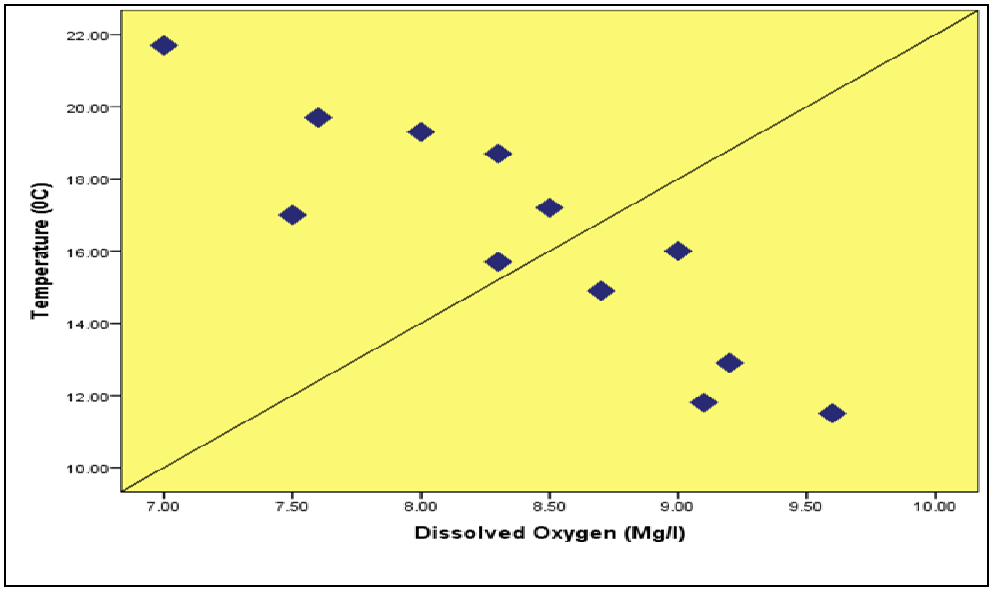


(C)

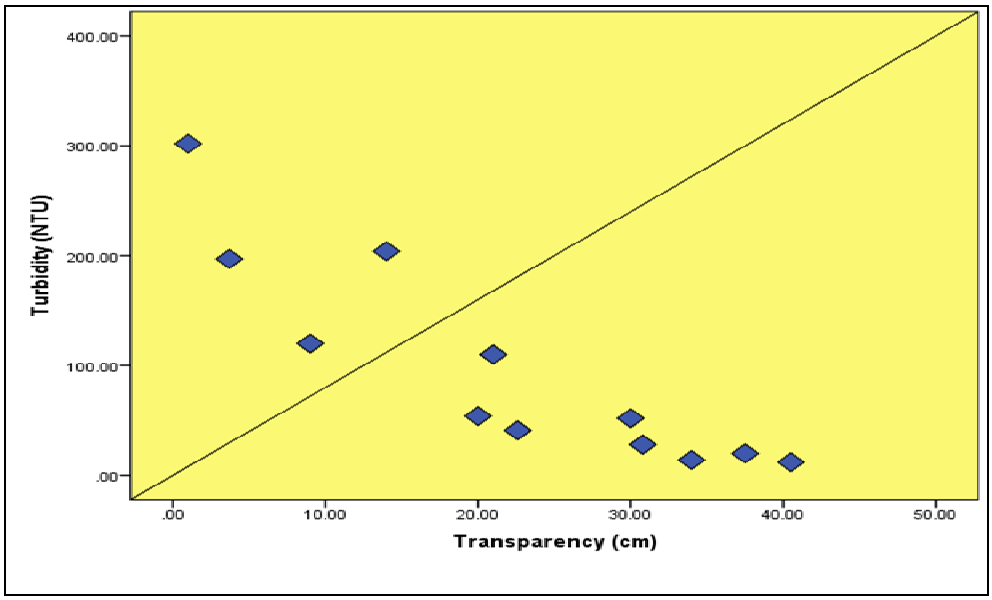


(D)

Graphs C & D Showing Negative correlation between Temperature vs Dissolved Oxygen and Turbidity vs Transparency, respectively at Site-I

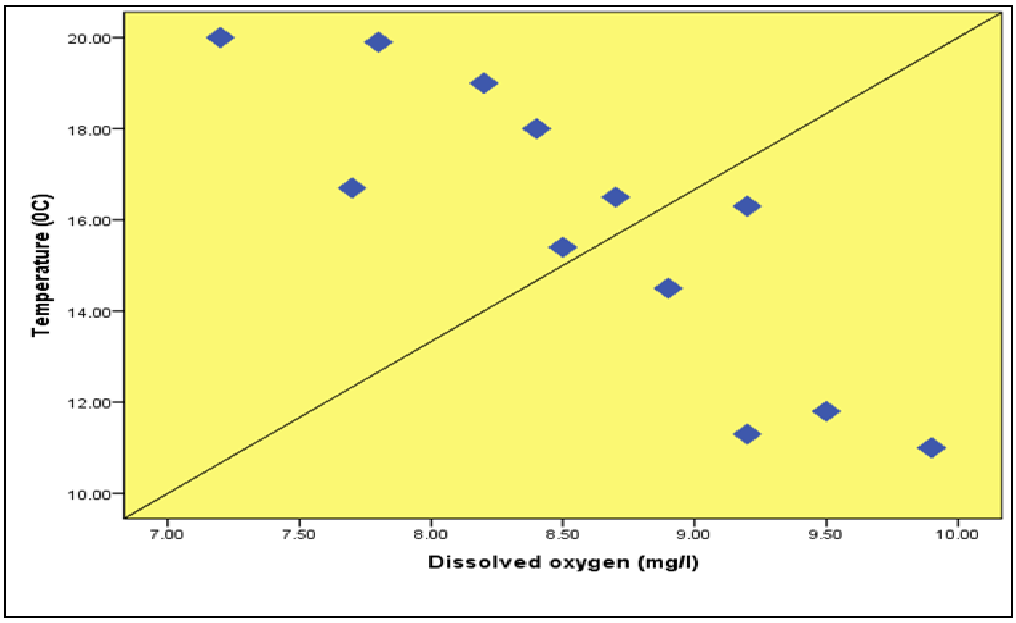


(E)

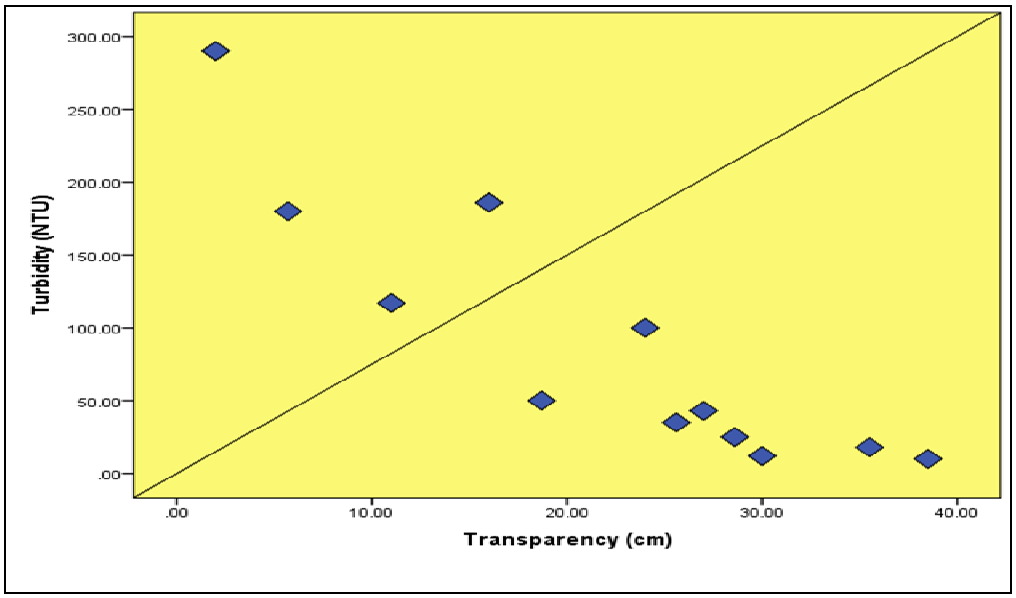


(F)

Graphs E & F Showing Negative correlation between Temperature vs Dissolved Oxygen and Turbidity vs Transparency, respectively at Site-II



(G)



(I)

Graphs H & I Showing Negative correlation between Temperature vs Dissolved Oxygen and Turbidity vs Transparency, respectively at Site-III

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