Assessment of water quality of River Haora in Tripura, North-East India

Rashmi Rani[1], B K Datta[2]
[1] Assistant Professor, Department of Botany, IFTM University, Moradabad, Uttar Pradesh, India
[2] Professor, Department of Botany, Plant Taxonomy and Biodiversity Laboratory, Tripura University, Suryamaninagar, Tripura, India

Abstract
River pollution has been one of the main topics in the environmental issue. The present study involves physicochemical analysis of water samples collected from four sites of Haora River. Test were performed by analyzing 15 parameters. The test results were compared with standard permissible limits prescribed by various regulatory bodies. By analyzing the results it was observed that the Haora River is less polluted in the Champaknagar and it's getting more polluted downstream as it crosses Jirania and Khayarpur and finally crossing city area of Agartala reaching Jayanagar near the border of Bangladesh. Appropriate treatment hence be needed to enhance water quality.

Keywords: Haora River, water pollution, Tripura

Introduction
Water is the basis of life. Life originated in water. Our earth contains 70% of water and so called Blue Planet. Rivers are important source of fresh water. In India, river plays social and economic roles. It provides potable water, irrigation water, cheap transportation, electricity, and also livelihood to many people. But now day river pollution has become a serious concern for us. Rivers are now becoming a sewage carrying drain which leads to many water borne diseases. The water quality monitoring results obtained by CPCB during 1995 to 2011 indicate that the organic and bacterial contamination are continued to be critical in water bodies. This is mainly due to discharge of domestic wastewater mostly in untreated form from the urban centers of the country. The municipal corporations at large are not able to treat increasing the load of municipal sewage flowing into water bodies without treatment. Secondly the receiving water bodies also do not have adequate water for dilution. Therefore, the oxygen demand and bacterial pollution is increasing day by day. This is mainly responsible for water borne diseases. In Tripura there are many rivers out of which ten are important. And the assessment of Haora River (lifeline of Agartala) water has been taken into account in this study.
Liu *et. al*. (2003) [12] has worked on the "Water Pollution in the River Mouths around Bohai Bay" and observed that the terrestrial pollutants and nutrients are the main cause of frequently occurring red tides in the Bohai Sea. Work on "Impact of Pollutants on Water Quality of River Sutlej in Nangal Area of Punjab, India" tells that Water is not potable along downstream course but can be used for other activities. (Chauhan and Sagar, 2013) [6]. Surface water of Bangladesh is polluted by industrial effluents, agro-chemicals, domestic and sewerage dirt, oil and lube spillage and sediment. This is supported by the work on "Analysis of the Causes and Impacts of Water Pollution of Buriganga River: A Critical Study" (Chakraborty *et al* 2013) [4]. Murty and Kumar (2011) [13] has done work on 'Water Pollution in India: An Economic Appraisal" Using available data and case studies he has provided an overview of the extent, impacts, and control of water pollution in India. Work on "Cause Effects and Control of Water Pollution in River Tawi" gives an idea that the dumping of solid waste surface run off, agricultural runoff, untreated sewage, washing and bathing activities are some of the common factors for causes of water pollution in river Tawi (Bhagat *et al* 2014) [2]. Dhakyanaika and Kumara (2010) [8] has done work on "Effects of pollution in River Krishni on hand pump water quality" and observed that Hand pumps abstracting water from shallow and deep unconfined aquifers have been found to deliver polluted water in terms of color, organics and coli form bacteria. Work on chemical oxygen demand of Godavari River has been done under topic "Godavari River Water Pollution due to the industrial effluents from M.I.D.C. Nanded, Maharashtra, India" and it was observed that the COD values are higher compared to standard values of WHO & I.C.M.R. which indicates greater pollution of Godavari river water due to M.I.D.C. effluents. (Deshmukhand and Ambore, 2012) [12]. Khan and Firuza (2012) has worked on "Biological Assessment of Water Pollution Using Periphyton Productivity and Standing Crop in the Linggi River, Malaysia" He made an attempt to use periphyton productivity (in terms of biomass ash-free dry weight, AFDW) and chlorophyll-a content (measured from periphyton colonized on glass microscope slides) to assess water pollution in the Linggi river. Work on "Water quality and pollution status of Chambal river in National Chambal sanctuary, Madhya Pradesh" gives an idea that the river water in the sanctuary area is pollution free and can serve as a good habitat for many aquatic

animals including endangered species (Saksena *et al*. 2008) [14]. Chauhan and Singh (2010) [5] worked on "Evaluation of Ganga Water for Drinking Purpose by Water Quality Index at Rishikesh, Uttarakhand, India" and observed that water is not suitable for drinking purpose. "Analysis on Water Quality of Haora River in Agartala with an Assessment of Water Quality index" gives information that water of Haora is polluted (Sarkar and Misra, 2014) [15].

Materials and Methods

Study area: Tripura is a state in North-East India which borders Bangladesh, Mizoram and Assam. It is surrounded by Bangladesh on its north, south and west: the length of its international border is 856 km (84% of its total border) (http://tripura.gov.in/knowtripura).The state lies between 22º56' to 24º 32' North latitudes and 91º09' to 92º 20' East longitudes with an aerial extent of 10,491.69 sq. km(TSPCB,2005). Haora is called the life line of Agartala city because it is one of the most important rivers of Tripura. Peoples of Agartala depend on Haora river water for drinking water supply. It fulfills daily needs of people. They are dependent directly or indirectly on Haora river water (60% dependence) The River Haora has originated from Baramura hills of West Tripura district. After flowing through the places like Chandrasadhubari, Champak Nagar, Debendranagar, Jirania, Ranirbazar, Pratapgarh the river has entered into Agartala city and ultimately met with river Titas in Bangladesh. The length of the river in Indian part is 53 km. The basin is situated between the latitudes of 23˚37′ N and 23˚53′ N and longitudes of 91˚15′E and 91˚37′ E. Having 1106 first order streams, 176 second order streams, 47 third order streams, 21 fourth order streams. The river possesses a basin area of about 457.97km2. (TSPCB, 2012).The flow length of the river is 53 km in Indian territory and basin area is 570 sq.km. The annual flow of this river is 36,032 m3. (TSPCB, 2005).
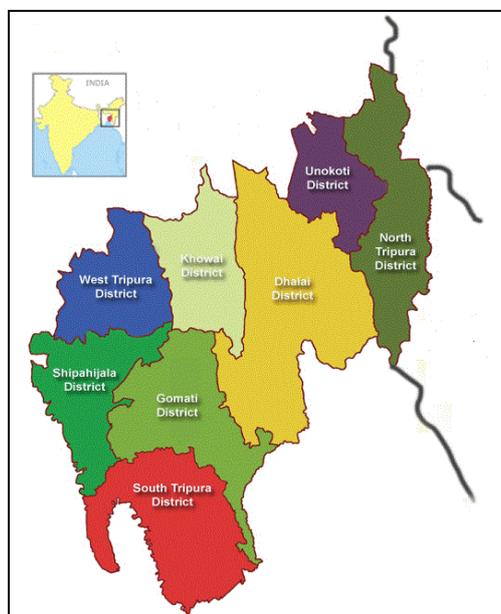

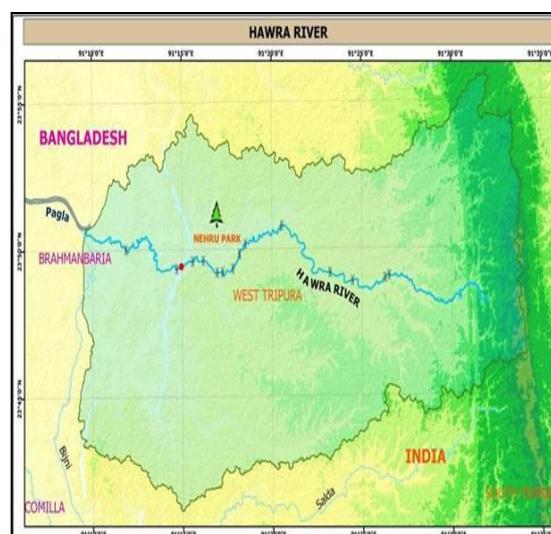**Fig 1:** Map showing study area of west Tripura in India.

Fig 2: Map showing study area of west Tripura in India.

Methodology

Water Quality Assessment Authority created under Environment Protection Act, 1986 (https://cpcb.nic.in/env-protection-act/) has notified a Protocol for Water Quality Monitoring. Samples were collected from four different locations along the stretch of Haora River. The GPS location of sample collection has been noted. Sample water has been collected from the sub surface level of river. The Physico-Chemical quality of surface water was analyzed using the standard methods given in APHA (American Public Health Association) (Greenberg et al, 1992). Waste water quality of river Haora was monitored on the basis of different physico-chemical parameter. Some tests as that of temperature, odor, and color have been done on the spot. DO (dissolved oxygen by Winkler's method) and BOD(DO consumption in 3 days at 27 °C), COD (Potassium dichromate method) , Nitrate (by Colorimetry) and chloride content (Argentometric titration) phosphate content(Colorimetry), acidity, alkalinity, pH(pH meter), conductivity(Conductivity meter)etc. have been performed in laboratory.

Table 1: GPS data of the site of sample collection. (West Tripura)

Sl. No.	Name of the place	Latitude	Longitude
1	Champaknagar	23°48'08.9"	91°29'32.0"
2	Jirania	23°48'55.6"	91°26'27.7"
3	Khyarpur	23°50'40.9"	91°20'37.5"
4	Jaynagar	23°49'27.7"	91°15'20.6"

Results

Table 2: Physiochemical Status of River Haora

S. No.	Parameters	S1	S2	S3	S4
1	Color	Light brown	Light brown	Light brown	Light brown
2	Odor	No smell	No smell	No smell	No smell
3	Temperature (c)	19	20	20	21
4	pH	8.09	7.2	7.29	7.05
5	Conductivity (μmhos/cm)	10.84	10.14	14.57	17.88
6	DO (mg/l)	6.1	7.2	7.1	5.5
7	BOD (mg/l)	1	1.3	1.5	2.5
8	COD (mg/l)	23	48	106	70
9	Chloride(mg/l)	18.86	14.145	14.145	18.86
10	Nitrate (mg/l)	0.4	0.9	2.4	3.1
11	Phosphate (mg/l)	0.038	0.016	0.020	0.059
12	Alkalinity (mg/l)	153.0	95.68	81.32	76.54
13	Turbidity	30.1	61.4	134	203
14	TSS (mg/l)	64	68	70	78
15	Salinity (psu)	0.02	0.01	0.01	0.01

Sample 1: CHAMPAKNAGAR Sample 2: JIRANIA
Sample 3: KHAYARPUR Sample 4: JAYNAGAR

Bar Graph Showing Comarision of Water Quality Parameters of Haora Riverat Different Locations
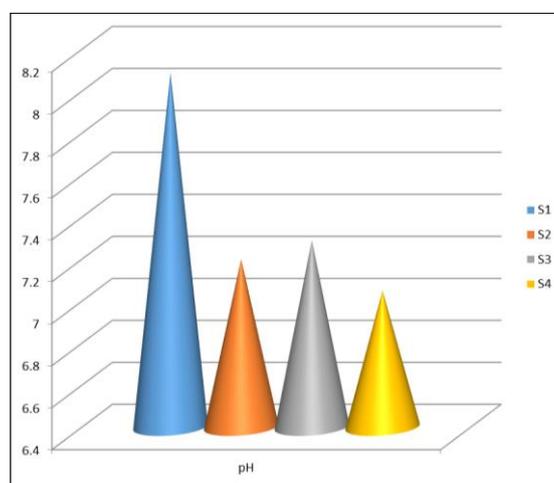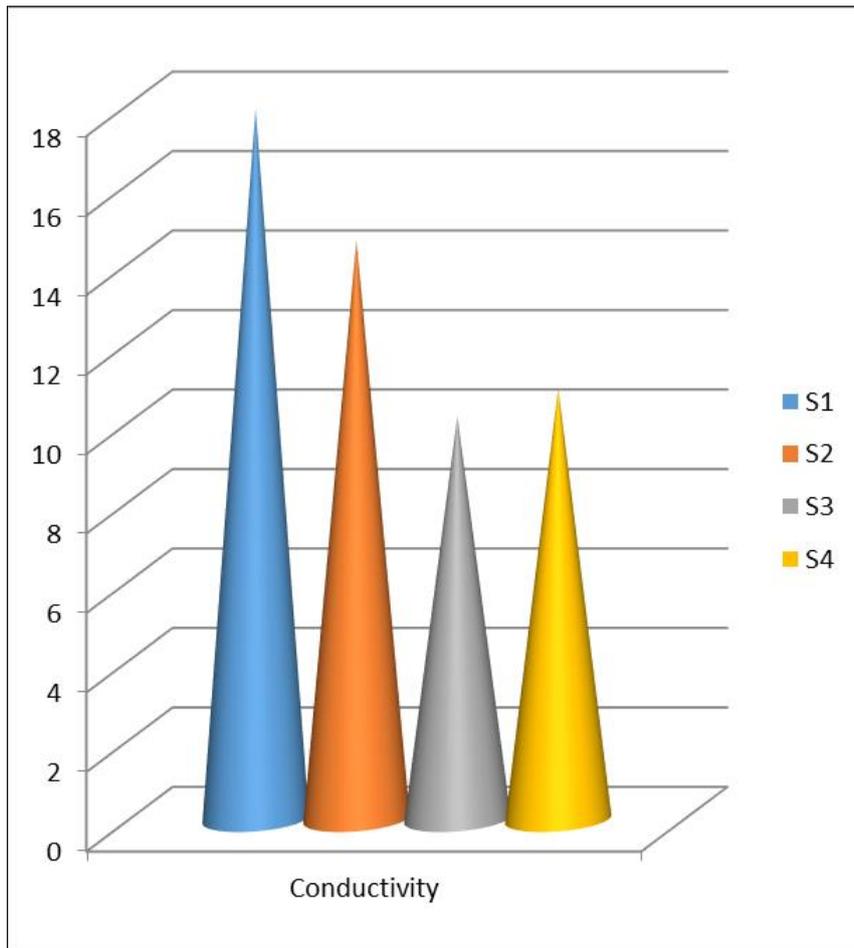

Fig 3: Comparison of pH

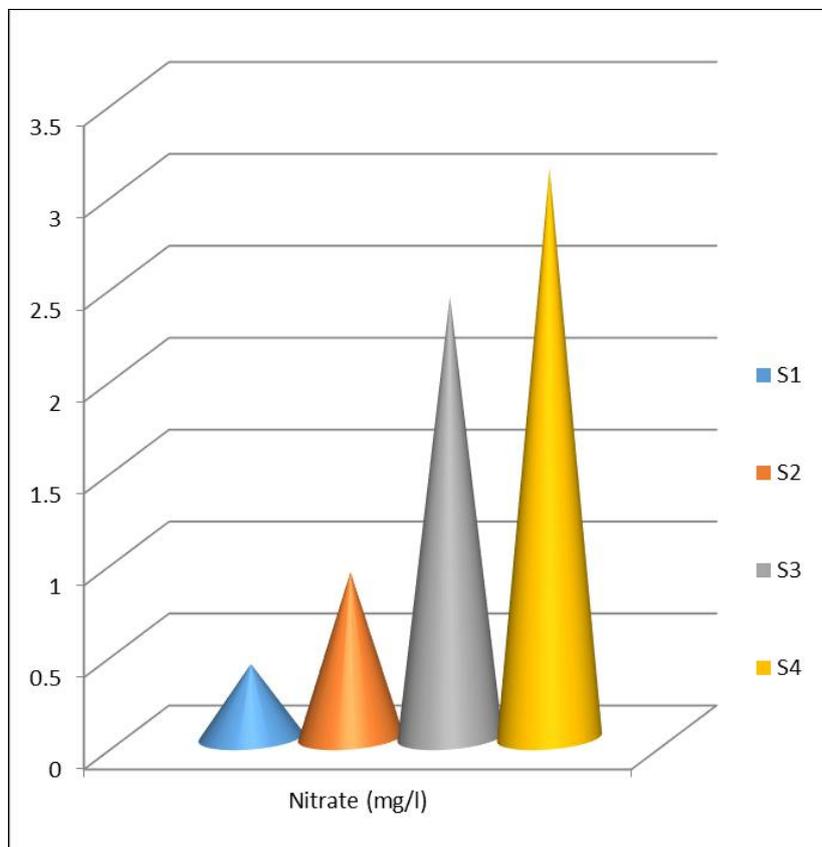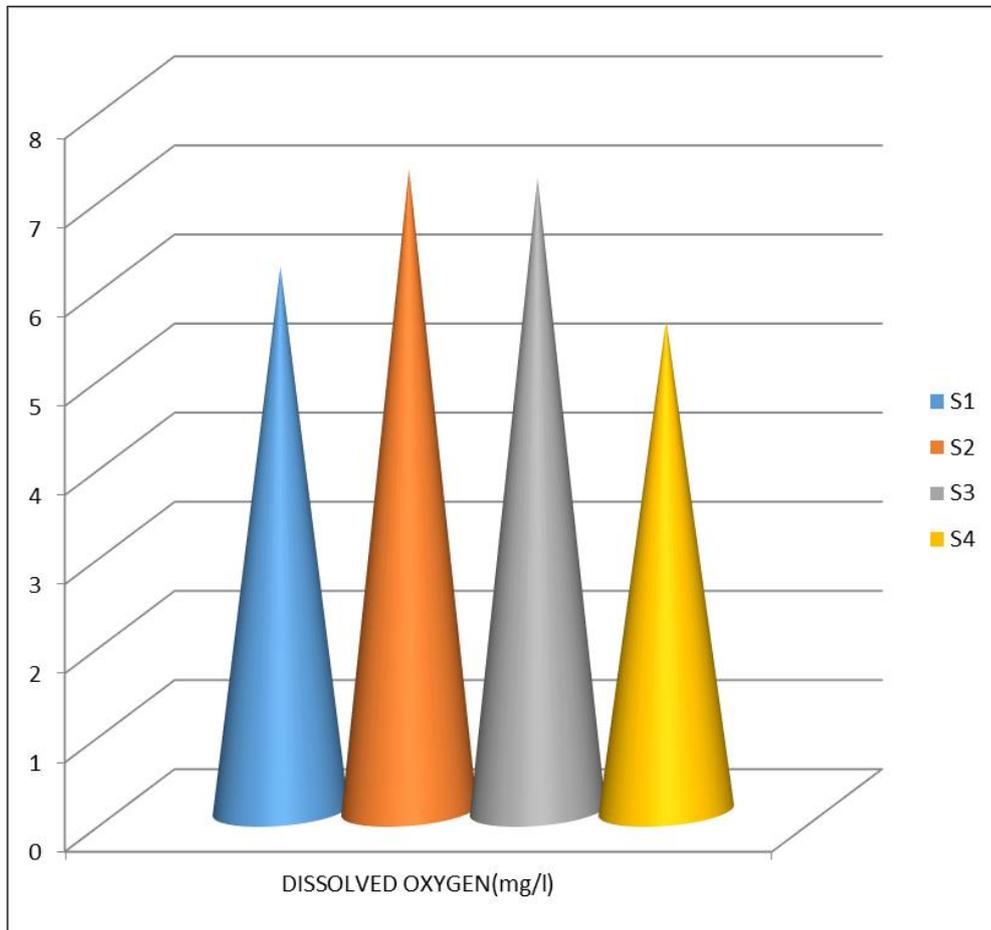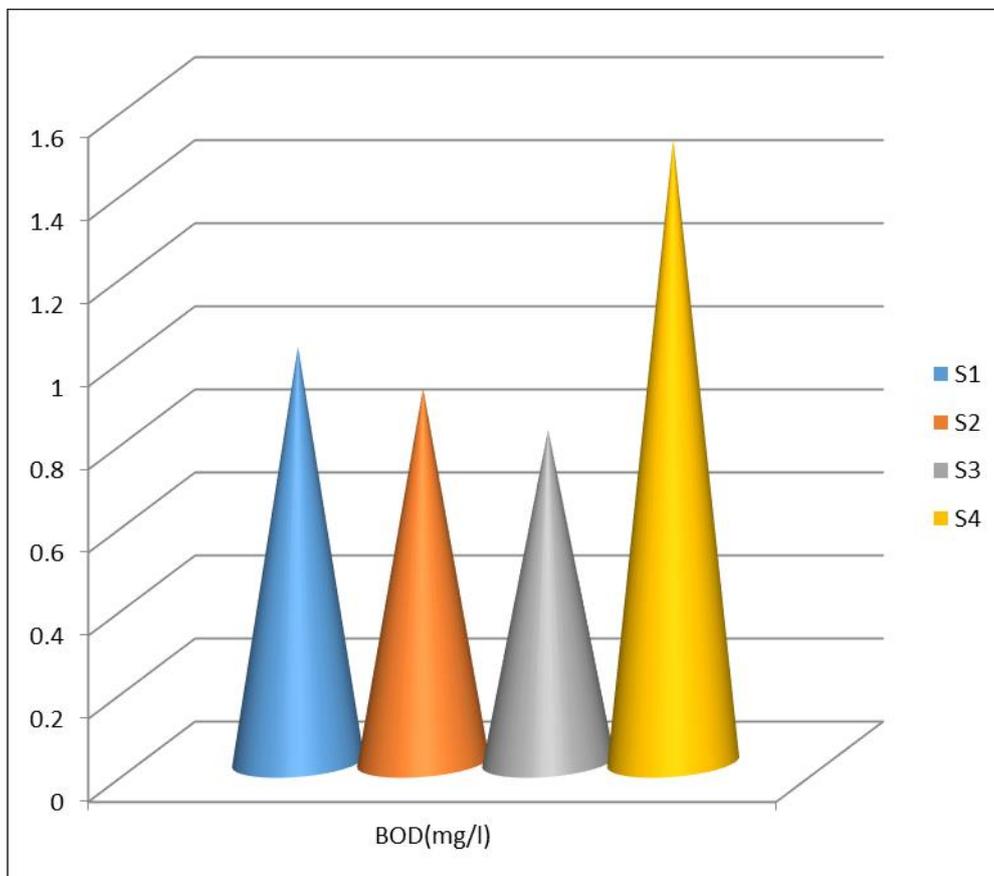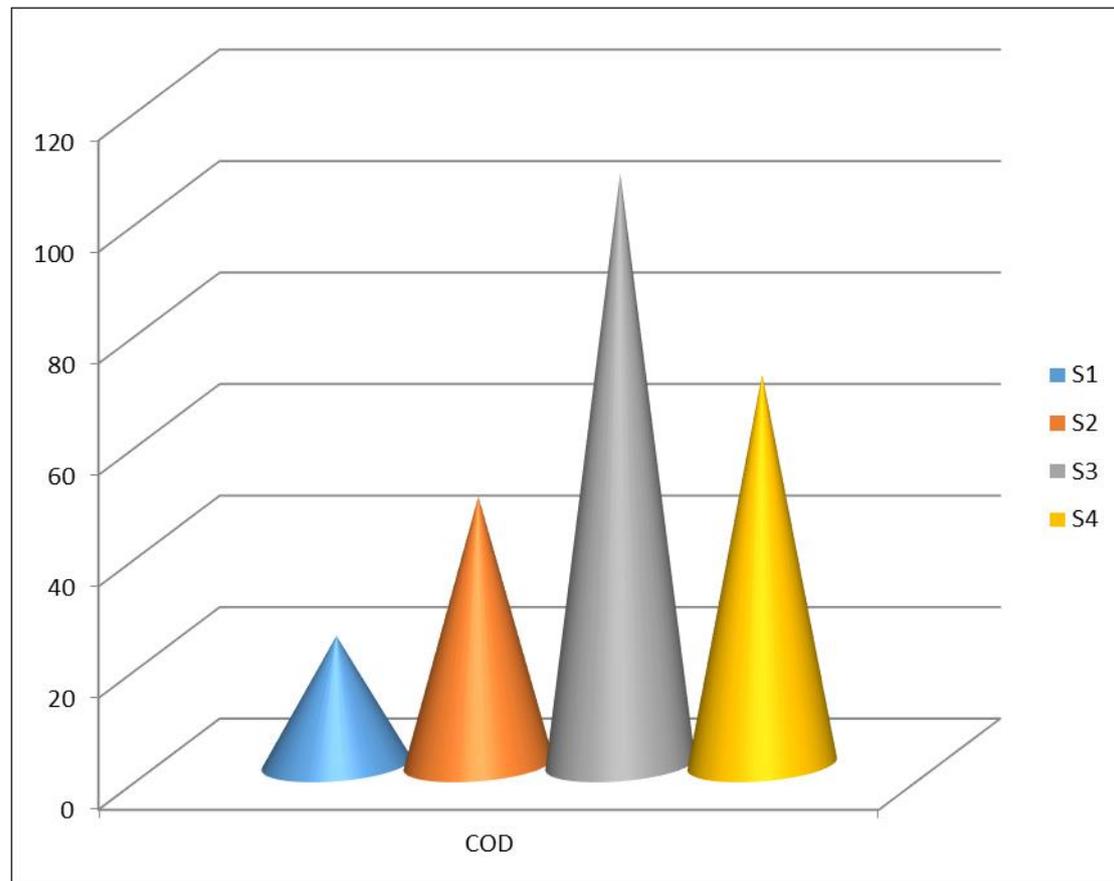**Fig 4:** Comparison of Conductivity

Fig 5: Comparison of Nitrate Content

Fig 6: Comparison of DO

Fig 7: Comparison of BOD

Fig 8: Comparison of COD

Discussion

From above observation the temperature reading of all four sites ranges from 19°-21°.In the water temperature may be governed by surrounding air. No smell from water has been observed in any of the sites. So it lies under the permissible limits of BIS.

pH observed in water samples from all the sites lies between 7.05 to 8.09 which is under the drinking water category of CPCB (2007). Conductivity of Champaknagar water sample is lowest at 10.84 and it gradually increases from Jirania, Khyarpur to Jaynagar reaching to 17.88. This phenomena may be explained on the basis that as the river enters the urban area gradually the addition of different wastes into the river water increases which increases the conductivity of river downstream.

Dissolved oxygen (DO) is the main criteria to assess the water quality of river water. It is defined as the amount of oxygen present in water and for drinking purpose, it should be 6 mg/l or more. Less DO suggests pollution in water body. As per my observation DO of champaknagar, Jirania, Khyarpur are more than 6 mg/l but the DO level of Jaynagar is 5.4 mg/l. This means water of Jaynagar is relatively more polluted and is not safe for drinking purpose. In the Jaynagar, many slum dwellers have built unsanitary latrines on the bank of Haora River and they are directly connected to the river water. This is the main cause of the less DO at the Jaynagar. Strangely Champaknagar's water sample DO has been observed less as compared to the DO of Jirania and Khyarpur. This effect could be attributed to the fact that religious wastes were lying in the water body from site of water sample collection at Champaknagar. Religious wastes are thrown as such in the river water which may lead to increase in the amount of heavy metals in the water which is a serious health concern for the society.

Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. Permissible level of BOD for drinking purpose is 2 mg/l which has been observed in Champaknagar, Jirania and Khyarpur but the level has been exceeded in the Jaynagar. This again reinforces that the pollution of water body at the Jaynagar is due to direct sewage disposal into the river water. COD is used as a general indicator of water quality and is an integral part of all water quality management programs. It measures the equivalent amount of oxygen required to chemically oxidize organic compounds in water. Its value is always greater than BOD. COD level has been observed to be increasing downstream that means pollution is increases as the river enters the urban establishment. But the COD level in Khyarpur has been observed to be the maximum. This may be because vegetables were thrown in the river water at the site from where water sample has been collected. So the amount of oxygen required to degrade these wastes is high.

Nitrate level observed from all the sites seems to be increasing downstream which clearly indicates addition of sewage and organic wastes from the city area. But the level of nitrate observed is well within the permissible limits from all the sites. Highest level of nitrate in Jaynagar again reflects the addition of sewage water directly

into the Haora River. Nitrate level beyond the permissible limits is hazardous for the pregnant ladies and children as it causes severe disease.

Phosphate is not toxic to animals or plants. It is a plant nutrient which stimulates the growth of aquatic weeds and algae. This may cause lakes and rivers to become clogged and overrun with plants. Detergents are among the greatest contributors to phosphate content in rivers and lakes because phosphate containing compounds are used in detergent formulation as water softeners. Maximum Phosphate level at Jaynagar indicates use of detergents on the Haora bank.

Alkalinity is a measure of the buffering capacity of water. Waters with low alkalinity are very susceptible to changes in pH. Waters with high alkalinity are able to resist major shifts in pH. In our observation alkalinity is highest at Champaknagar which means it can resist change in the pH of water more than that of Jirania, Khyarpur and lowest level at Jaynagar indicates least power to resist the pH change.

Turbidity is the measure of relative clarity of a liquid. High concentrations of particulate matter affect light penetration. High turbidity means increase in sedimentation and siltation, which can result in harm to habitat areas for fish and other aquatic life. Suspended particles also provide attachment places for other pollutants, notably metals and bacteria. For this reason, turbidity readings can be used as an indicator of potential pollution in a water body. In our observation turbidity limit has crossed the permissible limits of 10 NTU at all the four sites. At Champaknagar the high level may be because of dumping of religious waste in the river. At Jirania it is high because of the presence of brick fields along the bank of the river which results in siltation of river. At Khyarpur and Jaynagar it is high because of sewage disposal and also the because of the construction work going on in the Agartala city.

Haora River is the life line of Agartala city and all the drinking water supply depends on the Haora river water. So the water of river must be kept clean. For this purpose many steps have been taken by the state government. It has directed State Pollution Control Board to continuously monitor the water quality of Haora. Tripura State Pollution Control Board is doing work for continuous assessment of water of Haora River. Agartala Municipal Corporation (AMC) has also taken many steps for this purpose. As the mixing of sewage in river water is the main cause of pollution so AMC has set up Underground Sewerage System having 8 MLD capacities under 102.21 crore scheme of JNNURM. AMC has decided to do house to house survey of septic tank and prepare a soft database of septic tank information which will help AMC to monitor the septic tanks before it fills up and overflow and mixed in river water. It has set a target to clean 6000- 7000 septic tanks mechanically per year using Suction tankers (cess pool)machines and also to procure four new cess pools including split type to get access in narrow lanes. They are also thinking to develop software with the help of NIC or DIT for online booking and payment of cess pool service. Public awareness program is also being run using print /electronic media as development of small video clips, school awareness programs, printing attractive leaflets, radio program, publicity on posters, placards, rallies. Integrated Low Cost sanitation (ILCS) scheme of Ministry of HUPA, Gov. of India is being implemented under AMC. There are three khals in Tripura viz. Old Haora khal ,Akhaura khal and Kata khal. Water of these khals looks blackish due to mixing of septage so steps have been taken to avoid mixing of khals with the river water.

Conclusion

By analyzing the results obtained we can found the Haora River is less polluted in the Champaknagar and its getting polluted downstream as the river into the city area of Agartala. As Haora river is considered as lifeline of Agartala it is highly important that its pollution in kept under check as it crosses Agartala city or else it may lead to serious health concerns and deteriorate the environment.

Solution for Water pollution of river can be done in following ways.

- Prevention of water pollution source
- Reduction of contaminants from the water source in a sustainable way.
- Drainage system should be well maintained and disposed.
- Adoption of scientific methods for sewage disposal.
- Waste water must be treated before putting it into the waterbody. There are three waste water treatment technologies for the treatment of waste water viz. primary, secondary, tertiary treatment.
- Awareness program should be conducted periodically.
- Discharge of wastes –sewage, chemical, dye and other waste into water bodies must be stopped by enforcing strict regulations.
- Recycle, Reuse and Reduce.
- Modern technology should be used
- The municipal authorities should be made to build and adequate sewer system and improve the existing service.

Declarations

Conflict of interest

The authors declared no conflict of interest with respect to the research, authorship and publication of this article.

References

1. American Society for Testing and Materials, 1195. Standard Methods for Chemical Oxygen Demand (Dichromate Oxygen Demand of Water D1252-95, ASTM Annual Book of Standard, American Testing and Materials, Philadelphia, PA.
2. Bhagat NK, Lal M, Mhajan R. "Cause Effects and Control of Water Pollution in River Tawi". *Indian Journal of applied research*,2014:4(7):157-158.
3. Central Pollution Control Board. Guidelines for Water Quality Monitoring, New Delhi, India, 2007.
4. Chakraborty C, Huq MdM, Ahmed S, Tabassum, Taslima Mi. "Analysis of the Causes And Impacts Of Water Pollution Of Buriganga River: A Critical Study". *International Journal of Scientific & Technology Research*,2013:2(9):245-252.
5. Chauhan A, Singh S. "Evaluation of Ganga Water for Drinking Purpose By Water Quality Index At Rishikesh, Uttarakhand, India". *Report and Opinion*,2010:2(9):53-61.
6. Chauhan BS, Sagar SK. "Impact of Pollutants on Water Quality of River Sutlej in Nangal Area of Punjab, India*". Biological Forum – An International Journal*,2013:5(1):113-123.
7. Deshmukh JU, Ambore NE. "Godavari River Water Pollution due to the industrial effluents from M.I.D.C. Nanded, Maharastra, India". *Journal of Industrial Pollution Control*,2012:28(2):187-190.
8. Dhakyanaika K, Kumara P. "Effects of pollution in River Krishni on hand pump water quality".*Journal of Engineering Science and Technology Review*,2010:3(1):14-22.
9. Greenberg AE, Clesceri LS, Eaton AD. Standard Methods for the examination of water and wastewater. American Public Health Association, Washington DC, 1992.
10. https://cpcb.nic.in/env-protection-act/
11. Khan IN, Begham FM. "Biological Assessment of Water Pollution Using Periphyton Productivity and Standing Crop in the Linggi River, Malaysia". *International Review Hydrobiology*,2012:97(2):124-156.
12. Liu CW, Zhao-Y, HE Y." Water Pollution in the River Mouths around Bohai Bay". International Journal of Sediment Research,2003:18(4):326-332
13. Murty MN, Kumar S. Water Pollution in India: An economic appraisal. Report on India Infrastructure, 2011, 285-298.
14. Saksena DN, Garg RK, Rao RJ. "Water quality and pollution status of Chambal river in National Chambal sanctuary, Madhya Pradesh". *Journal of Environmental Biology,*2008:29(5):701-710.
15. Sarkar S, Misra U. Analysis on Water Quality of Haora River in Agartala with an Assessment of Water Quality index. International Journal of Civil Engineering Research,2014:5(4):447-452.
16. Standard Methods for the Examination of Water and Wastewater; APHA, AWWA and WEF, 21st Edition, 2005.
17. Tripura State Pollution Control Board. "Pollution Status Assessment of Haora River, Tripura". Ministry of Environment, Forests & Climate Change, Govt. of India, 2005.
18. Tripura State Pollution Control Board. "Geo-environmental Status of Haora River, Tripura, ENVIS Centre", Ministry of Environment, Forests & Climate Change, Govt. of India, 2012.
19. Winkler LW. Die Bestimmung des in Wasser gelösten Sauerstoffen. Berichte der Deutschen Chemischen Gesellschaft,1888:21:2843-2855.