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ASSESSMENT OF WATER QUALITY OF BHARALU RIVER, GUWAHATI

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ABSTRACT:

The Bharalu River is the main water body in the city of Guwahati, India is running through its length, dividing it into two parts. The Bharalu is a small tributary of the Brahmaputra on its southern bank. It is flowing through a heart of Guwahati through densely populated residential, industrial and commercial areas then converge with Brahmaputra at Bharalumukh. The Bharalu River carries a large portion of the city's municipal as well as other wastes and it also serves as the natural drainage for storm water runoff. As the Brahmaputra is the main source of drinking water for Guwahati and for the whole valley, it is important to keep check on its tributaries, making sure they are not polluted. The Bharalu water is extremely filthy and is regarded as one of the major sources of contamination affecting the overall quality

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of the Brahmaputra water. The present investigation is carried out to assess pH, conductivity, turbidity, T.S.S., sulphate, chloride, T.D.S., hardness, alkalinity, fluoride, BOD and COD and also find out the Water Quality Index (WQI) of the river water. GIS is used to help in determining the river course and locating the sample sites. Total of 5 samples are collected and are tested in PCBA laboratory. After analyzing the tests results, it is found that there are certain parameters such as BOD, COD and others, exceed their permissible limits. This indicates that the state of the river is highly degraded because of high pollution level. This is a serious concern for the inhabitants of the area near the river course and the city itself.

Keywords: Bharalu, Water quality, Physiochemical, WQI, GIS

INTRODUCTION:

The Bharalu is a small tributary of the Brahmaputra on its southern bank. It is flowing through a heart of Guwahati through densely populated residential, industrial and commercial zones to meet the mighty Brahmaputra at Bharalumukh. It originates in the Hilly catchment of Meghalaya, and remains in a relatively natural state till it enters the densely inhabited areas of Guwahati incorporated in Assam`s Kamrup Metro District. The Bharalu carries a large portion of the city's municipal as well as other wastes and it also serves as the natural drainage for stormwater runoff. As the Brahmaputra is the main source of drinking water for Guwahati and for the whole valley, it is important that the inputs to the river through the tributaries are not excessively loaded with pollutants. People generally consider the Bharalu water water to be extremely squalid and populated and is regarded as one of the major sources of contamination affecting the overall quality of the Brahmaputra water. Bahini and Bharalu is the same river. The initial 13 kilometre stretch of the river is known as Bahini, which gets named Bharalu after it passes the Assam State Botanical Zoo area. The stretch of Bharalu river is 6.2 kilometres and it eventually meets the Brahmaputra river at The deterioration of the Bharalu River starts from the Basistha hill south National Highway 37 Bharalumukh. Meanwhile, another stretch of Bharalu river – Basistha river – branches out towards the Borsola Beel from where it flows further down and meets Deepor Beel located at the outskirts of the Guwahati and worsen as it flows through the densely populated residential and commercial areas of Guwahati and undergoing more intense deterioration till it joins Brahmaputra at Bharalumukh. The major localities of the city that contribute to the deterioration are Sixth Mile, G.S Road, Zoo Road, Bhangagarh, Athgaon and Bharalumukh. The waste water discharging from the Indian Oil Corporation Refinery at Noonmati drains directly into the

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Bharalu. The waste water from household, commercial establishment and small to medium industries within the city flows directly into the Bharalu River through the system of interconnected drains. The deterioration caused by domestic and commercial wastes poses a serious threat to the inhabitants of Guwahati and the downstream receptor. Water Quality Index plays an important role as a basis for the assessment of a watercourse in relation to the pollution. For calculating WQI following parameters are considered, i.e., Temperature, pH, Turbidity, Biochemical Oxygen Demand (BOD), Hardness, Alkalinity, Chemical Oxygen Demand (COD), Total Dissolved Solids, Chloride, Following table shows the permissible value for water parameters.

STATEMENT OF THE PROBLEM:

Water is very important for all living beings and is consumed by all and as such it is essential that all should get pure and clean drinking water. Basic access to safe water and satisfactory sanitation is basically the initial step to ensure human wellbeing, and as an essential human right (Pandey, S., 2006). The subject of manageability emerges identifying with the new water asset. The 1992 International Conference on Water and Environment (ICWE) and the UN Conference on Environment and Development featured the need of concentrated and genuine contemplations at various levels on various parts of the restricted accessibility and conceivable outcomes of misusing and dealing with the world's new water asset. In Assam, the Bharalu River, a tributary of the Brahmaputra River once furnished with consumable water to a great many individuals living on its banks. It was additionally a source of assortment of fish and other other maritime generally differed vegetation for the people. The river is presently so seriously dirtied that researchers have cautioned that except if measures are started on a war-balance, a phenomenal calamity is approaching (Roy, S., 2011).

LITERATURE REVIEW:

Lal, Prem Chandra, (1992) studied the municipal and other inputs to the Bharalu and have accounted the general environmental situation pertaining to the river and also described inadequacies of the city’s water supply, sewerage and drainage systems. The physico chemical test of Bharalu river water results indicated high tubidity, TSS and TDS antichloride.BOD and COD loads are very large along with low DO levels. This study concludes that River has very high oil

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and grease content and phenol content is also considerable. The river is thoroughly polluted with faecal coliforms from its origin to its confluence with the Brahmaputra.

Lakhimi Gogoi, (2013) studied the degradation natural resources in Guwahati city and its impact on the environment. The study is based on primary and secondary data which has been collected from the field and different sources. The study is carried out in three phases -pre fieldwork, field work, and post field work. The study observed that various human activities such as encroachment along the river banks, industrial discharges into the River contribute to the heavy level pollution in river. Present study revealed that due to rapid population growth and urbanization, illegal settlements, industries and excessive growth of invasive species the natural resources has been degrading gradually. As a result hills and wetlands are encroached.

Jiwan Singh and Ajay S.Kalamdhad, (2015) carried out the study on agitated pile composting of water hyacinth collected from different areas (Bharalu River, Agriculture site, Boragaon landfill site and Industrial site) and evaluated nutrients (Na, K, Ca, total nitrogen and phosphorus) in all agitated pile composting. Stability parameters such as CO2 evolution rate and oxygen uptake rate, biochemical chemical oxygen demand and chemical oxygen demand. The result showed that nutrients content in compost of water hyacinth collected from Bharalu River site was highest and the stability parameters were significantly reduced as compared to other agitated piles. After the study the researcher concluded that in the final compost of all trials, total coliform and fecal coliform were reduced significantly, which are pathogen indicators in the compost. The best compost quality was found in water hyacinth collected from Bharalu River site.

Karishma Hussain et al., (2015) studied the sediments of the Bharalu River to obtain PAH levels in the river and their possible sources. The PAHs or polycyclic aromatic hydrocarbons were determined in river bank sediments during two distinct seasons namely pre and post monsoon. The results indicated maximum concentrations of PAHs during post monsoon season. The study revealed that diagnostic ratios indicated both petrogenic and pyrogenic origin of the PAHs. The pyrogenic contributions were mainly attributed to emissions from diesel, gasoline and wood combustion which are mainly from anthropogenic sources.

Navanita Das et al., (2016) carried out the study on self purification phenomenon of Bharalu River. Various laboratories test were conducted on the water samples obtained from various sources

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starting from Zoo Road till Bhoothnath via G.S. Road and Bharalumukh. Along the length of the running water of the Bahini-Bharalu River, the DO content was found to be very low at first, and then showed a definite increase at site 4. Similarly the BOD and COD values were very high in the sites taken into the city, but then slowly decrease towards site 3 and site 4 (i.e. towards its merging point with the Brahmaputra).Thus, the results obtained concluded that from the three different tests i.e. BOD, COD, DO are in good agreement with the self purification phenomenon.

N.Sharma, (2017) carried out the study on water related disaster in urban areas. The study revealed that the Bharalu basin is the most flood prons having several pockets of low lying areas and back flow nature from Brahmaputra during rainy season. After the study the author concluded that If the system does not work properly, it leads to environmental hazards. Government needs to strictly enforce use of only biodegradable materials for packaging of essential commodities for the citizens.

Manish Kumar et al., (2019) carried out the study on analyzing the concurrence of PPCPs, enteric viruses, antibiotic resistant bacteria, metal, and faecal contamination in water of Bharalu River. The study revealed that antibiotic resistance is neither correlated with the prevalence of PPCPs nor E.coli but As, Co and Mn appear to be inducing antibiotic resistance in E.coli. The study concluded that the concurrence of pollutants and multi-drug resistant E. coli, owing to the complete absence of wastewater treatment, puts the city in a highly vulnerable state. Pollution is being regulated only by the dilution capability of the Brahmaputra River, which needs to be further researched for seasonal variation.

STUDY AREA

The Bharalu originates in the hilly catchment of Meghalaya, and remains in a relatively natural state, till it enters the densely inhabited areas of Guwahati incorporated within Assam's Kamrup Metro District. The Bharalu is a small tributary of the Brahmaputra on its southern bank. It is flowing through the heart of Guwahati (the capital city of Assam, India) through densely populated residential, industrial and commercial areas to meet the Brahmaputra at Bharalumukh. It Originates in the foothills of the Khasi Hills of Meghalaya, the Bharalu enters Guwahati through the southeastern corner.It is known as the Bahini or Bihini in its 2 upper reaches. The geographic coordinates are 260 10′22″ N and 91046′45″E.

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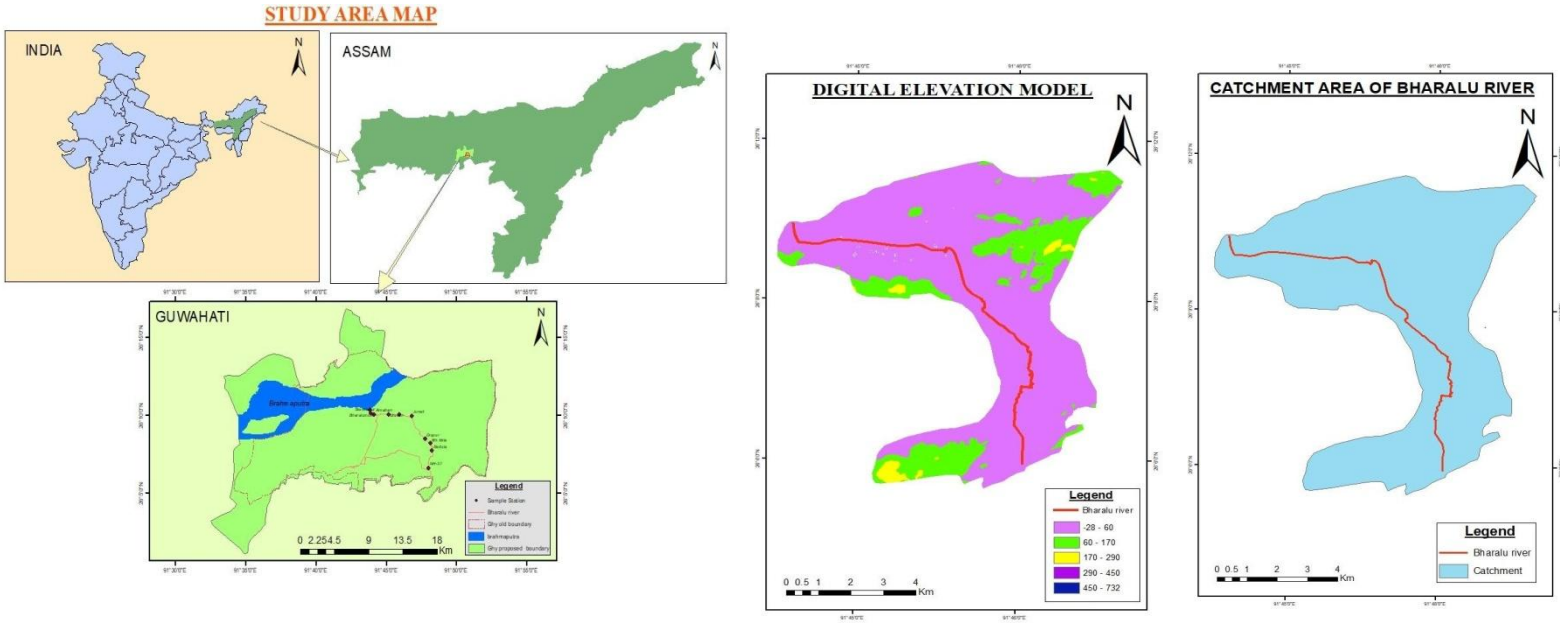

Fig 1: Study area map

METHODOLOGY

For water quality assessment, the present work is divided into three parts as:

- Field survey carried out for identifying sampling stations for water collection.
- As a field work 5 study sites have been selected from the river Bharalu and its tributaries.
- Collected samples will be tested in the Central Pollution Board of Assam.

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Parameters to be tested in water samples are given below in the table:

Table 1: Name of the Parameters

SL No.	Name of the Parameters
1	Ph (by 50 ml)
2	Conductivity
3	Turbidity(by 50 ml)
4	Total dissolved solids
5	Total suspended solids
6	Hardness (by 10ml)
7	Alkalinity(by 50 ml)
8	Chlorides(by 50 ml)
9	Fluoride
10	Sulphates
11	BOD
12	COD

Sampling Location:

The location of sampling sites (Latitude and Longitude**)** of the River Bharalu is shown in the below table.

Table 2: Sampling Sites

Sample No.	Location Name	Latitude And Longtitude
1	Near NH-27	26° 6'39.14"N, 91°47'57.72"E
2	Beltola	26° 7'43.64"N, 91°48'12.76"E
3	6th Mile	26° 8'12.15"N, 91°48'6.49"E
4	Dispur	26° 8'29.19"N, 91°47'44.58"E
5	Jonali	26° 9'57.65"N, 91°46'47.45"E

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6	Bhangagarh	26°10'2.71"N, 91°45'53.92"E
7	Ulubari	26°10'4.40"N, 91°45'8.72"E
8	Amabari	26°10'4.22"N, 91°44'6.27"E
9	Bishnupur	26°10'8.13"N, 91°43'52.09"E
10	Bharalumukh	26°10'20.76"N, 91°43'50.03"E

ASSESSMENT OF WATER QUALITY INDEX (WQI)

The calculation of the WQI was done using weighted arithmetic water quality index which was originally proposed by Horton (1965) and developed by Brown et al (1972). The weighted arithmetic water index (WQIA) is in the following form:

$$WQI = \sum wiqi / \sum wi$$

Where,

n = the number of variables or parameters, wi = relative weight of the ith parameter

qi = water quality rating of the ith parameter.

The unit weight (wi) of the various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters. According to Brown et al (1972), the value of qi is calculated using the following equation:

$$qi = 100 [(Vi – Vid)/ (Si – Vid)]$$

Where,

Vi = observed value of the ith parameter,

Si = standard permissible value of the ith parameter

Vid = ideal value of the ith parameter in pure water

All the ideal values (Vid) are taken as zero for drinking water except pH and dissolved

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Oxygen (Tripaty and Sahu, 2005). For pH, the ideal value is 7.0 (for natural / pure water) and a permissible value is 8.5 (for polluted water). Therefore, the quality rating for pH is calculated from the following equation:

qpH = 100[(VpH – 7.0)/ (8.5-7.0)]

where,

VpH = observed value of pH.

For dissolved oxygen, the ideal value is 14.6 mg/L and the standard permissible value fordrinking water is 5 mg/L. Therefore, its quality rating is calculated from the following equation:

qDO = 100[(VDO – 14.6)/ (5.0-14.6)]

where,

VDO = observed value of dissolved oxygen.

RESULTS AND DISCUSSION:

The experimental results of the different Physcio-Chemical parameters for the different sampling location are given in the table below.

Table 3: Physico-chemical Parameters

Sl No	Properties	6th mile	Dispur	Jonali	Bhangagarh	Ambari	WHO Permissible Limits
1	Ph	7.6	7.5	7.5	7.4	7.5	6.5-8.5
2	Conductivity	554	636	584	714	600	250mg/l
3	Turbidity	12	7	8	12	16	10-25NTU
4	Total	358	410	374	458	388	500mg/l

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	Dissolved Solids(mg/l)						
5	Total Suspended Solids(mg/l)	124	118	136	132	134	100mg/l
6	Hardness	86	82	110	92	110	300mg/l
7	Alkalinity	164	172	218	204	218	200mg/l
8	Chloride	102	92	84	80	76	250mg/l
9	Fluoride	.52	.56	.58	.62	.64	1-1.5
10	Sulphates	28	26	32	36	28	200mg/l
11	BOD	42	38	44	46	48	<4
12	COD	128	118	138	134	146	<10

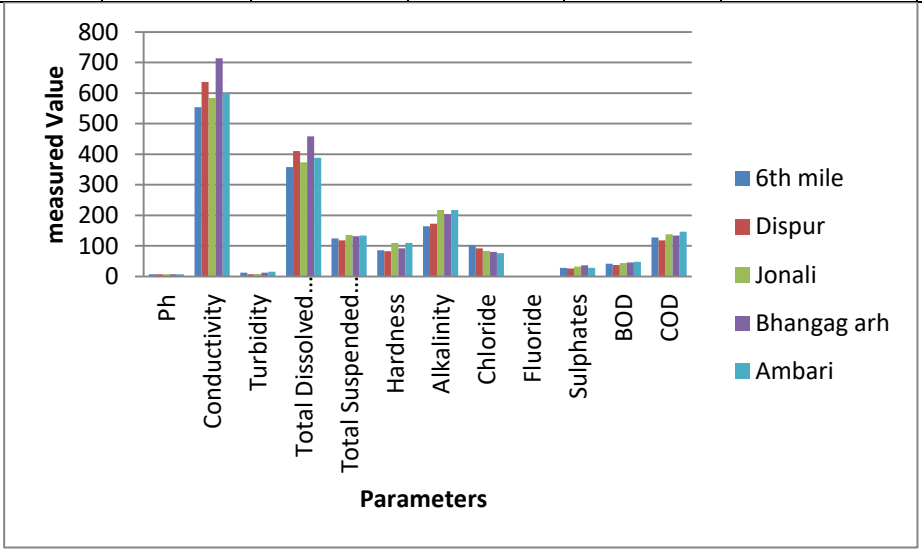

Fig 2: **Physico-chemical Parameters**

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The following table gives the observed values of WQI.

Table 4: Water quality index (WQI) calculation

Location	WQI value
Sixmile	183.9624
Dispur	169.43
Jonali	191.6383
Bhangagarh	201.6628
Ambari	10.9477

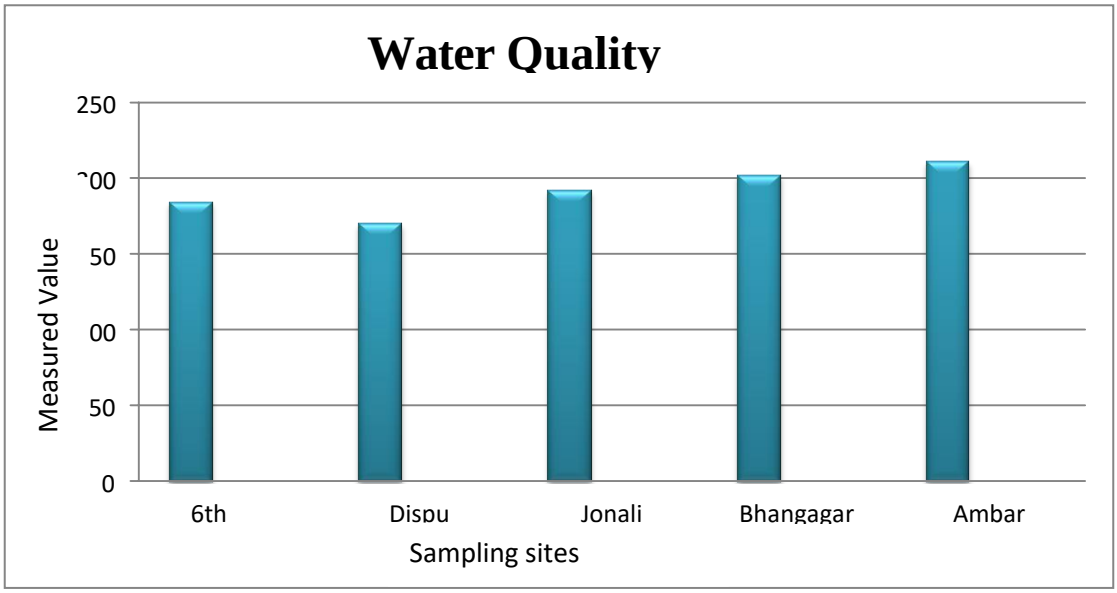

Fig 3: WQI value

From the study and laboratory test results, it can be quite clearly summed up the river that has been degraded to an extent that it is beyond usable for any purpose. Results revealed that some of the parameters of the water from Bharalu River, which are very much potent to its natural quality are found to exceed their permissible limits which made the water unfit for consumption as well as for any

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other domestic usage. The pH of water is very important in that changes in pH values may affect the toxicity of microbial poisons in the water. In the present study, maximum pH is recorded in Sixth Mile i.e. 7.6 and minimum pH is recorded in Ambari i.e. 7.4. pH near neutrality of the water sample poses no health risk to consumers who use the water for cooking, drinking, washing, bathing etc. In the present study, the conductivity is ranges from 554 µS/cm to 714 µS/cm for all the sites. The maximum conductivity of Bharalu water is recorded in Ambari i.e. 714 µS/cm and minimum conductivity of Bharalu water is recorded in Sixth Mile i.e. 554 µS/cm.The value of all the sites exceed the permissible limit of conductivity. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. The maximum turbidity is recorded in Bhangagarh and minimum turbidity recorded in Jonali i.e. 8 NTU. Since the permissible limit of turbidity is ranges from below 1-5 NTU, the turbidity in all the location are much higher than permissible limit. Hence it is not suitable. the total dissolved solids (TDS) ranges from 358 mg/l to 458 mg/l). The maximum total dissolved solids are recorded in Ambari i.e. 458 mg/l and minimum total dissolved solids are recorded in Sixth Mile i.e.358 mg/l. Dissolved salts in water will affect the taste. The suspended solids are insoluble particles that either float on water or are in suspension causing turbidity. The total suspended solids(TSS) value ranges from118 mg/l to 136 mg/l which exceeds the normal range as described by WHO for drinking water standards. The maximum total; suspended solids are recorded in Jonali and minimum total suspended solids are recorde in Near Dispur i.e. 118 mg/l. the total hardness of water ranges from 82 mg/l to 110 mg/l. The maximum total hardness recorded is 110 mg/l and minimum total hardness recorded is 82 mg/l. The recorded data of total hardness in the site sixth mile, Dispur, Jonali, Bhangagarh, and Ambari are ranges from 82 mg/l to 110 mg/l. Hence it is classified as moderately hard. the total hardness of water ranges from 82 mg/l to 110 mg/l. The maximum total hardness recorded is 110 mg/l and minimum total hardness recorded is 82 mg/l. The recorded data of total hardness in the site sixth mile, Dispur, Jonali, Bhangagarh, and Ambari are ranges from 82 mg/l to 110 mg/l. Hence it is classified as moderately hard. the chloride concentration of water ranges from 80mg/l to 102 mg/l. The maximum chloride is recorded in 6 th mile i.e. 102 mg/l and minimum chloride is recorded in Ambari i.e. 80 mg/l. Excessive chloride concentration increases rates of corrosion of metals. Chloride is one of the major anion in water, it is generally associated with sodium. The maximum fluoride of water is recorded in Ambari i.e. .64 mg/l and minimum fluoride is recorded in 6th mile i.e. .52 mg/l. The maximum sul[phates of water is recorded in Bhangagarh i.e. 36 mg/l and minimum sulphates is recorded in Dispur i.e. 26 mg/l. From the recrded data, the BOD ranges from

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38mg/l to 46mg/l. The maximum BOD is recorded in Ambari i.e. 48mg/l and minimum BOD is recorded in Dispur i.e.38 mg/l. As per data, the BOD of Bharalu river much higher than the prescribed level. As per the CPBC, a water body with BOD of more than 6 mg/l is considered to be polluted. Hence, the Bharalu river is not clean. The COD of our sample ranges from 118 mg/l to 146 mg/l.The maximum COD is recorded in Ambari i.e 146mg/l and minimum COD is recorded in Dispur i.e 118 mg/l. All the recorded data are exceeded the WHO permissible limit. Thus water from these sites cannot be used for domestic purpose.

All the samples of the river Bharalu exceeded 100, the upper limit for drinking water.The maximum WQI is recorded in Ambari, i.e. 210.94 and minimum WQI is recorded in Dispur i.e. 169.43. The high value of WQI in Ambari has been found to be mainly from the higher values of BOD, Conductivity, Total suspended solids, Alkalinity, Chloride. The WQI values of the river Bharalu show that unsuitability of water for human use. The comparatively high level of conductivity indicates that the water of Bharalu is not suitable for domestic use without giving treatment. High level of BOD indicates that the water of Bharalu is needed amount of Dissolved Oxygen. The analysis reveals that the water of the river of Bharalu needs some degree of treatment before consumption, and it also needs to be protected from the perils of contamination.

CONCLUSION:

We can conclude that water pollution is still a really huge problem in Bharalu River and it is a matter of concern because it is affecting the health of the people and it also can have negative effects in various forms. The factors that cause pollution to the river are mainly human activities and it is therefore highly important to devise a method to reduce the level of water pollution through individual actions like using environmentally friendly detergents, not pouring oil down drains, reducing pesticides, and so on. We can spread awareness among the mass and as community implement laws that will make pollution lesser. We can also take community action by helping out on cleans or litter picks to keep our rivers that little bit cleaner.

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