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A Case Study of Water Contamination in Bharalu River, Guwahati, Assam

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Abstract— This project is about the case study of contamination in the Bharalu River, Guwahati. The Bharalu is one of the most contaminated of all the tributaries of the river Brahmaputra. The Bharalu carries a large portion of the cities' municipal and other wastes therefore contaminating it. It is regarded as one of the major sources of contamination affecting the overall quality of the Brahmaputra River. As the Brahmaputra is considered as the main source of drinking water for Guwahati and for the whole valley, it is important that the inputs to river are not excessively loaded with pollutants. Analysis of several physio-chemical parameters such as pH, BOD, DO and chemicals such as fluoride are observed.
Keywords— Groundwater pollution, Bharalu river, pollutants, chemicals, contamination.

I. INTRODUCTION

Water is considered to be an essential natural resource for the survival of life and environment and rivers contain high percentage of water. In India, river plays an important role and majority of the population are directly or indirectly dependent on the rivers. Rivers act as a major biodiversity rich area. But in recent times, it has been observed that river water has become polluted by various ways. Water is referred to as polluted when it is impaired by groundwater contaminants. Due to these contaminants, both humans and aquatic life are highly suffering. With the increasing rate in population, people are more concerned about the quality of surface and groundwater sources as they are polluted everyday and are caused mainly due to municipal dumping, domestic and industrial wastes. Moreover, the percolation of these waste or polluted water is also contaminating the groundwater aquifer and also affecting the soil in terms of which the pollutants degrade the quality of soil. Agricultural runoff, chemical leaks, sewage leaks and harmful pathogens are some of the other significant sources of surface and groundwater pollution.

The main objectives of this research paper are:

A. To perform a case study of the causes of pollution and contamination in the Bharalu River.
B. To study the main pollutants/chemicals responsible for causing pollution in the river.
C. To study about the remedial measures in order to reduce pollution in the Bharalu River.

II. LITERATURE REVIEW

Several researchers have studied about the pollution of rivers in India. A few of the studies are reviewed below:

Richard Helmer and IvanildoHespanhol (1997)had done a case study of water pollution control of the river Ganga and suggested some water quality management principles. The objective of the research was to improve the water quality of the Ganga, as an immediate short-term measure, by controlling municipal and industrial wastes. The long-term objective was to improve the environmental conditions along the river by suitably reducing all polluting influences at source.

NarayaniGogoi and Rashmi (2017)studied about the water quality detoriation of Bharalu River and stated that the entry of a pollutant the river sets off a series of physical, chemical and biological events and the effect is mainly determined by the character and quantity of the pollutant. The study showed that the river has been reduced to a stagnant water body with high toxicity levels due to free carbon dioxide and also has high levels of hydrogen sulphide (H_2S) due to heavy dumping of organic materials in bed.

A.K. Panigrahi and SubasiniPattnaik(2019)had given a review on the consequences of pollution of some major rivers in India and their remedial measures. The research indicated industrial effluents and metals like Fe, Hg, Cd, Pb and Zn to be the major souce of pollution in the rivers of India. Various water quality parameters of river water samples are studied and their results were presented.

Mahananda Borah (2020)carried a detail assessment of water quality in the Bharalu River, Guwahati**.** Several methodologies had been followed to study the water pollution in the river. The study included four stages namely, preliminary investigation, field investigation, laboratory investigation and analysis and interpretation. The nature of the pollutants, and the variations in the contamination level were studied.

III. STUDY AREA

The Bharalu is a small tributary of the river Brahmaputra on its southern bank. It originates in the foothills of the Khasi Hills of Meghalaya and enters Guwahati through the south-eastern corner. It is located within the coordinates of 25°59′ to 26°11′N and 91°43′ to 91°51′E. The total Catchment area of the Bharalu is about 120 sq. km. which is almost equally divided between the hill region and the plains and it drains an estimated area of 10.94 sq. km. of the city. The river mainly flows through 7 wards out of total 39 wards in the Bharalu river catchment area.

IV. DATA COLLECTION AND OBSERVATION

Pollution in rivers have become a serious issue in India. Many rivers such as Ganga, Krishna, Tapti and Brahmani are getting polluted every day. In Assam, the Bharalu, a small tributary of the mighty Brahmaputra, is flowing through the heart of polluted Guwahati city. The river used to carry fresh water up to around 1970 and was a source of potable water for the people living on the banks of the river. However, overtime, the river has been converted to a main drain to the city.

A. *Major Pollutants Responsible for Pollution in Bharalu River*

1) *Biochemical Oxygen Demand (BOD):* BOD is one of the prime causes of pollution in Bharalu River. Sources of BOD includes leaves, woody debris ,dead plants and animals, animal manure, effluents from pulp an d paper mills, wastewater treatment plants, failing septic systems and urban storm water runoff.
   Desirable limit: 4 mg/l
   Limit in Bharalu river : 12mg/l Limit
2) *Fluoride:* Fluoride pollution in Bharalu River is caused due to the release of industrial effluents which contains inorganic fluorine compounds. Fluorine is used in aluminium production and as a flux in the steel and glass fiber industries. They are also released during the production of phosphate.
   Desirable limit: 1mg/l
   Maximum permissible limit: 1.5mg/l
   Limit in Bharalu River: 0.02 mg/l to 3.73 mg/l
3) *pH:* Fluctuations in pH in the river water is caused due to agricultural runoff, acidic mine drainage, fossil fuel emissions such as carbon dioxide, which causes a weak acid when dissolved in river water. pH of water greatly affects the water quality and the aquatic flora and fauna. If the pH of water is too high or too low, the aquatic organisms living within it will die. pH can also affect the solubility and toxicity of chemical and heavy metals in the water.
   Desirable limit: 7-8.5
   Maximum permissible limit: 6.5- 9.2
   pH limit in Bharalu River: 6.8- 7.7
4) *Dissolved oxygen (DO):* Dissolved oxygen has been a fundamental requirement for plant and animal life in water.Depletion of DO is indicative of presence of pressure of substances collectively called oxygen demanding wastes. Low values of DO indicates presence of large amount of biodegradable organic matter which makes the water aesthetically unacceptable as anaerobic decomposition of organic matter leads to septic conditions and production of noxious gases. DO also influences the equilibrium between water and the sediments by controlling reduction/ oxidation reactions as well as leaching of metal ions from the soil.
   Desirable limit: 6mg/l
   Maximum permissible limit: 4mg/l
   DO limit in Bharalu river: 0.5 mg/l -1.25 mg/l



Fig. 1 A picture of the pollution in the Bharalu river. (Source: pratidintime.com)

V. REMEDIAL WAYS TO REDUCE POLLUTANTS/POLLUTION IN BHARALU RIVER

Selection of appropriate method is important for the restoration of river ecosystem. The remediation of contaminated river is a burning issue in many developing countries due to high level of pollutions. Polluted river water can be remediated by either in-situ water treatment or pollution control at the source point.

Ways to reduce pollution in the Bharalu River:

A. Interceptor pipe drains along the river Bharalu to collect the sewage from either side of river.

B. No industries should directly discharge their effluent directly into drains without treatment, rather they should reuse their treated effluent/sewage.

C. Identification of towns for installing sewerage system and sewage treatment plan.

D. Household or hotels/restaurants nearby should not be allowed to dispose untreated sewage and solid waste into the nearby drains and river.

E. Public awareness programs to control open defecation and understand the sanitary hygiene.

F. Remedial ways to reduce pollutants in the river: To reduce the effects of the pollutants/compounds, some remedial measures are to be taken:

1) *Biochemical Oxygen Demand (BOD):* BOD can be reduced by adding hydrogen peroxide to the wastewater solution. The hydrogen peroxide will chemically attack the organics in the wastewater, degrading and reducing the measured BOD.

2) *Fluoride:* Fluoride is a chemical compound which is very difficult to remove from water. We can use dialysis and electro dialysis process to reduce fluoride level in water.

3) *pH:* Certain acidic chemicals are used to reduced pH of wastewater. Sulphuric acid is the cheapest and most commonly available. It is strongly corrosive, dense and oily. Sodium hydroxide and calcium hydroxide have been used to neutralize acidic wastewater.

4) *Dissolved Oxygen (DO):* Low dissolved oxygen primarily results from excessive algae growth caused by phosphorus. Nitrogen is another nutrient that contributes to algae growth. As the algae dies and decompose, the process consumes dissolved oxygen. Dissolved oxygen levels are increased by supplementing wind and wave action, adding plants to water and exposing water to purified oxygen.

VI. CONCLUSION

Sources of pollution identified indicates that the main cause of pollution in the catchment area are anthropogenic causes (population growth, overconsumption, overexploitation, chemical explosions, subsurface mining) and one of the major reasons behind this is lack of awareness among the common mass. Lack of government concern and policy for the river environment is also another cause and hence proper steps must be taken for the restoration of the river environment which if not maintained will lead to serious imbalances in the environment. High amount of pollution has already led to the disappearance of important flora and fauna along the banks within a very short time span hence appropriate measures need to be taken to preserve the remaining ecosystem.

The fluoride content in the river water of the Bharalu has fluoride concentration varying from 0.02 to 3.73 mg/l. The result indicates that the fluoride level exceeds the permissible limit of 1.5 mg/l. For the dumping location sites, the location having fluoride concentration beyond its permissible limits are found in Municipal, Commercial, and Industrial waste sites. In a similar manner, the BOD, DO, fluoride and pH also showed drastic variations from their desirable limits. From this project, it can be concluded that if appropriate measures as mentioned in chapter 5 are adopted properly, pollution in the Bharalu River can be reduced to a great extent. As rivers are natural sources, proper measures should be adopted in order to save it from being getting polluted.

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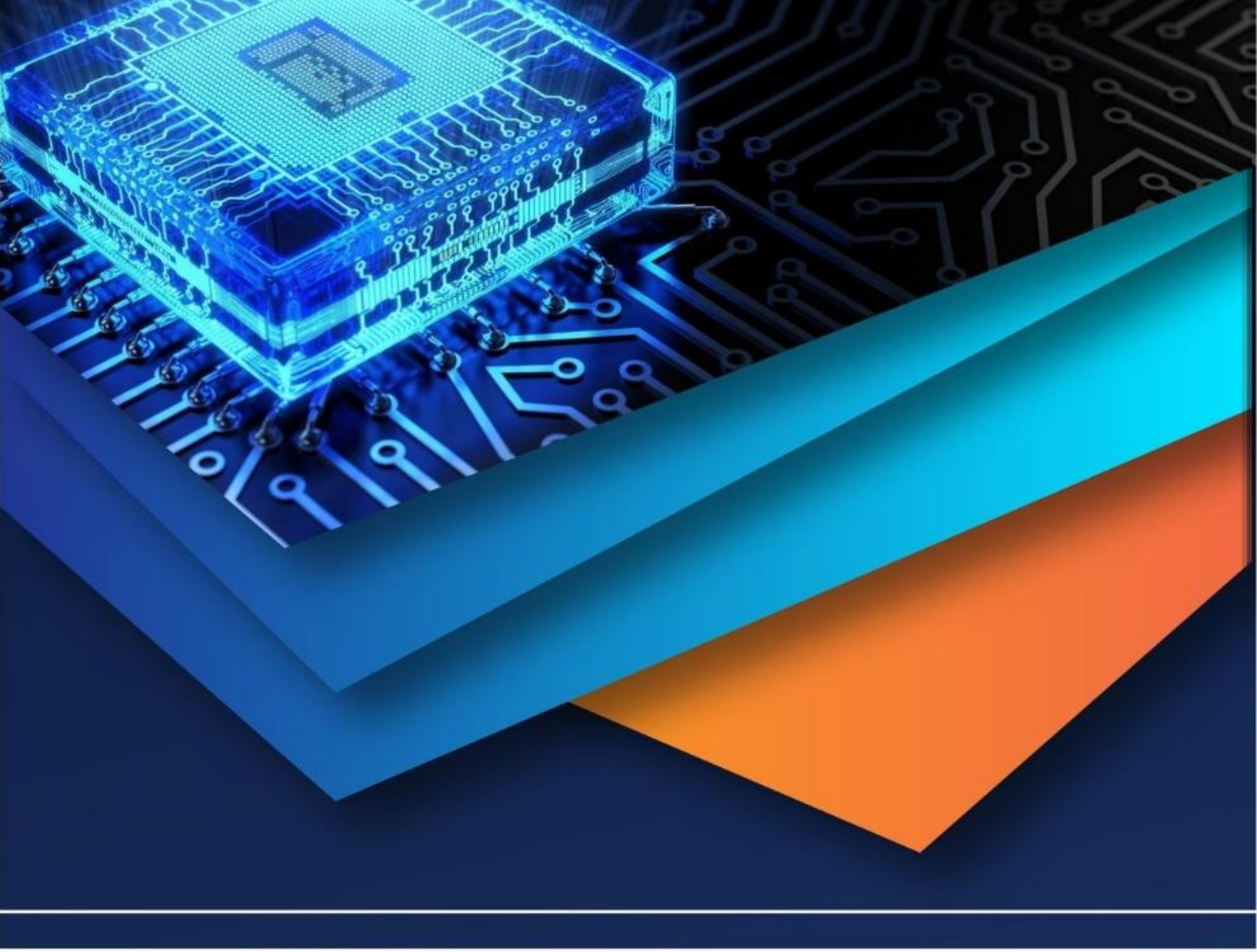
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