Vol 6 Issue 8 May 2017

ISSN No : 2249-894X

Monthly Multidisciplinary Research Journal

Review Of Research Journal

Welcome to Review Of Research

RNI MAHMUL/2011/38595 **ISSN No.2249-894X**

Review Of Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

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ISSN: 2249-894X Impact Factor : 3.8014(UIF) Volume - 6 | Issue - 8 | may - 2017

Review Of Research

ASSESMENT OF POLLUTION: A CASE STUDY OF BHARALU RIVER BASIN, ASSAM

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ABSTRACT

The world today suffers because of various issues related to the natural environment and the three main issues in the developing countries being: Land degradation, Urban growth and Water quality degradation. Water quality detoriation is a serious problem in today's world and the entry of a pollutant into flowing water body sets off a progressive series of physical, chemical and biological events downstream and the effect is mainly determined by the character and quantity of the substances. Both domestic and industrial effluents adversely affect the water quality through direct toxin action or quantitative alteration in the character of the river or stream bed. The concept of water quality however raises a number of questions often controversial because of wide differences in technological and individual perceptions.Bharalu river has been, reduced to a stagnant water body with high toxicity levels due to free carbon dioxide (FCO2). The river also has high levels of hydrogen sulphide (H2S) due to heavy dumping of organic material in its bed. The scientists have urged the government that environment protection acts should be strictly enforced. The study of the quality of the Bharalu water itself demands necessary attention.

KEYWORDS: *pollution, river, toxicity levels, water quality, anthropogenic.*

INTRODUCTION:

Water is an invaluable resource and it shall benefit to all of mankind if proper management of this resource is done in order to avoid the disastrous consequence of its mismanagement. The public awareness about water quality is at its zenith but at the same time, the danger signals have not shown any abatement.

The concept of water quality however raises a number of questions often controversial because of wide differences in technological and individual perceptions. The economic and aesthetic considerations describing water quality should also be taken into account. Technologically, water quality can be catalogued in terms of appropriate physical, chemical and bacteriological parameters which must be accurate, unambiguous quantitative and reproducible. Many authors describe water quality in terms of the processes occurring in a catchment ecosystem. This consists of a source of water such as a river with its associated drainage areas, and is a complex combination of biotic and abiotic components and the interactions amongst

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them.

A river also receives contributions from surface runoff, through-flow and inter-flow. The quality of the river water is very different from that of the precipitation water. It clearly indicates that river water quality evolves through a complex series of interaction with soil, rock and biota of the catchment ecosystem. These interactions are always in a delicate balance and any slight modification of the catchment such as alteration of the land use pattern is likely to generate significant changes in the water quality.

OBJECTIVE

Bharalu is one of the most polluted and contaminated of all the tributaries of the Brahmaputra. The Bharalu River once provided potable water to thousands of people living along its banks. It was also a source of variety of fish and other flora and fauna for the people but the river is now badly polluted and scientists have warned that unless measures are initiated on a war-footing, an unprecedented disaster is imminent. It is therefore important that the inputs to the river through the tributaries are not excessively loaded with pollutants. The natural drainage system of Guwahati consists of the Bharalu River (a tributary of the Brahmaputra) and its inter-linkages to the beels (wetlands) and to the Brahmaputra River. Many small rivers such as the Mora Bharalu, Bahini, and Basishta serve as its tributaries. The Bharalu at present serves as the natural drainage for storm water runoff and receives a large portion of the city's municipal, industrial and other wastes. People generally consider the river to be extremely filthy and polluted and therefore are regarded as one of the major source of contamination affecting the overall quality of the Brahmaputra river water. The river has been, reduced to a stagnant water body with high toxicity levels due to free carbon dioxide (FCO2). The river also has high levels of hydrogen sulphide (H2S) due to heavy dumping of organic material in its bed. The scientists have urged the government that environment protection acts should be strictly enforced. The study of the quality of the Bharalu water itself demands necessary attention.

STUDY AREA

The Bharalusub-basin is located within the coordinates of 25°59' to 26°11' north and 91°43' to 91°51' east. The river mainly flows through 7 wards out of total 39 wards in the Bharalu river catchment area.The city of Guwahati lies on the southern bank of the Brahmaputra and straddles the valley of the river Bharalu which is a small tributary of the Brahmaputra. The Basistha-Bahini -Bharalu are the trunk channels in the city and alongwith their host of tributaries form the main conduit for surface water runoff.Originating in the foothills of the Khasi hills of Meghalaya the Bharalu enters Guwahati through the south-eastern corner. The river runs through predominantly alluvial soil throughout its course.

The total catchment area of the Bharalu is about 120 sq. km which is totally divided between the hill regions and the plains. It is estimated that the river drains an area of 10.94 sq. km of the city. The catchment area has seen a rapid urbanization in the recent years and the river has detoured to a large extent due to unabated encroachment and ever-increasing garbage into it.

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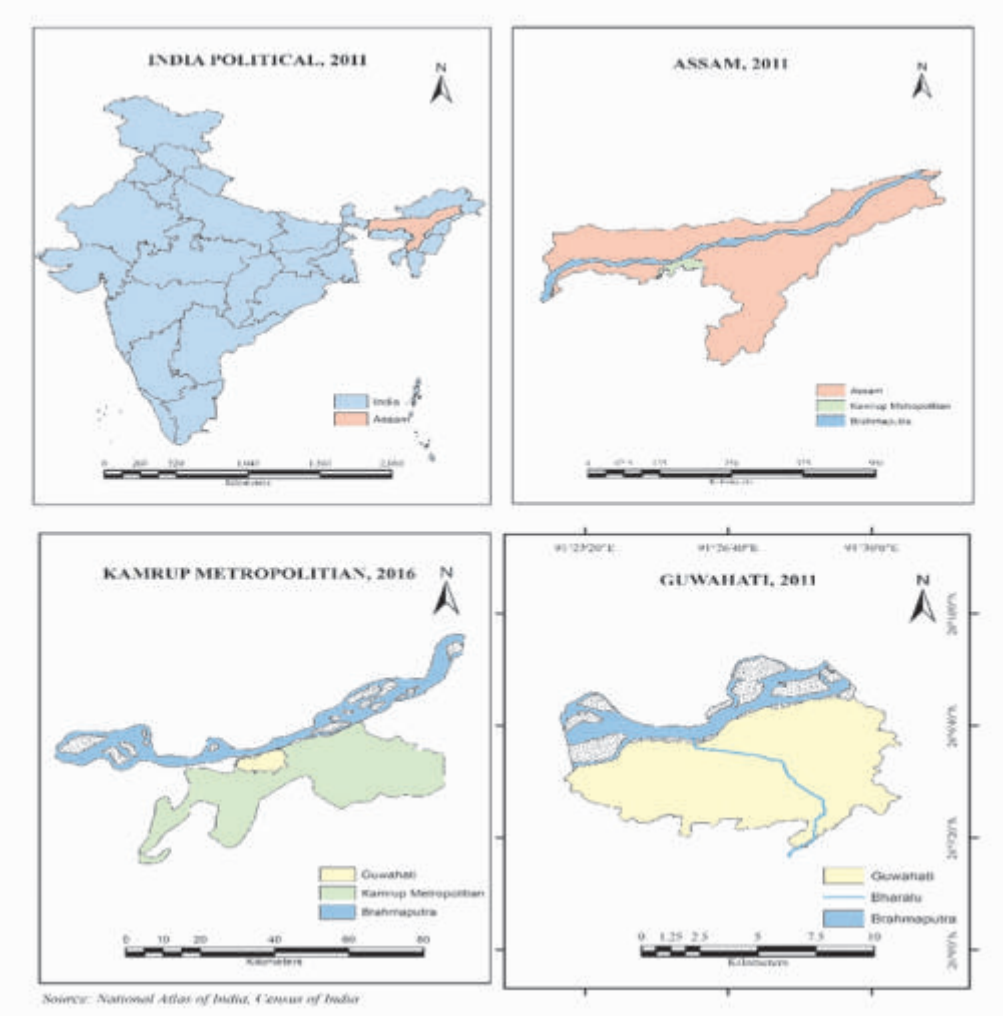
Plate 1: Shows the location map of the study area



Between Basishtha and Bharalumukh the river has a stretch of about 10.2 km and a bed width of about 9 to 5 meters. The depth of the flow is not uniform, the average depth being about 3 meters. The velocity of the flow is estimated at about 0.76 m/sec for the stretch between Basishtha and R. G. Baruah road and 1.07 – 1.37 m/sec for the rest of the course. The average discharge at Bharalumukh is 71500 liters/sec. The stretch of Bharalu and Bahini which traverses through the populated areas of Guwahati is approximately 16 kmlong with a catchment area equally divided between the hilly regions and the plains. The hilly upstream section of the Bharalu has a catchment area of 60 km2 (where it is known as Bahini), and a catchment area of 40 km2 in its downstream stretch passingthrough Guwahati It discharges into the Brahmaputra at Bharalumukh (Plate 1).

The original channel bifurcates into two rivulets after flowing a few kilometers. One rivulet known as the Basistha River flows towards DeeporBeel. The other rivulet (initially called Bahini and later Bharalu) passes though the city.

DATABASE AND METHODOLOGY

The data collected for the study include both primary and secondary data. Secondary data for the case study of Bharalu river has been mainly collected from the River and Conservation Cell; Pollution Control Board, Assam (PCBA) and mainly includes Water Quality Data of the river water.Primary data has been mainly collected through the process of simple random sampling where a total number of 150 questionnaires were being filled up through interaction with the local residents along the banks of the river and also in various wards throughout Guwahati. The collected primary data was analyzed in the form of graphs and tables in the process of assessment

of conclusions for all for objectives throughout the study. Maps and diagrams used in the case study have been prepared using the software's Arc GIS 10.2 and Ms Excel.

RESULTS AND DISCUSSION

Natural water is chemically impure. It contains foreign constituents like minerals containing various metal ions, soluble acids like alcohol, acid and sugar, trace amount of organic and inorganic compounds which are normally insoluble, suspended particulates, living organism and products of their metabolism, floating matter such as oil etc. All these either come through solution of aerosol particles, which act as nuclei for condensation of raindrops, or through solution of atmospheric particles by falling raindrops below the cloud level on impaction. Terrestrial aerosol particles are rich in Ca^{2+}, NH_4^+, No_3^- , HCO_3^- and SO_4^{2-} .

Chemical quality of precipitation and that, of water as a whole differs significantly during the interception by vegetation cover.

Water from surface runoff incorporates the soluble material and entrains sediment particles, making water turbid. The sediment particles are likely to absorb ions and other matter. Water infiltrating into the soil have its water quality modified appreciably due to soil water interactions. During dry periods, evaporative loss will be maximum and the constituents of the subsurface water will be enriched. The exchange reactions and the chemical equilibrium, involving soil and water, are known to play an important role in determining water quality. Water also behaves as a chemical weathering agent and this aspect is reflected in water quality through dissolved silica, Na^+, Ca^{2+}, Mg^{2+}, HCO_3^-.The quality of water in contact with soil is also governed by complex biotic regulation which is reflected in NH_4^+ and NO_3^-

The quality of ground water, on the other hand, depends on the type of rock entrapping the water and also on the depth and location of aquifers.

There are also numerous other channel processes influencing stream water quality. These are particularly responsible for controlling temperature, dissolved oxygen, and suspended sediment levels of stream water. Diurnal fluctuations in pH, Ca^{2+} and HCO-3 are brought about by release of CO_2 during the night by photosynthetic organisms in a river. Stream sediments absorb large amounts of Ca^{2+}, Mg^{2+}, K^+ and PO_4^{3-} and subsequently act as buffers for these ions. Nitrogenous pollutants on the other hand, influence the dissolved oxygen values in river water.

The annual pattern of variation of river water temperature is directly proportional to that of air temperature and dissolved oxygen is inversely proportional to the air temperature. Suspended solid or turbidity bears a positive relationship with the level of water discharge and dissolved solid is inversely proportional to the same.

Pollution in the Bharalu river however has increased constantly over the years and no measures have been adopted for its abatement. In a survey conducted among 150 residents in the catchment area, 84% of the population agrees that there has been a constant increase in the sources of pollution in the river and 4% are of the view that pollution has decreased as the government has taken steps to block the sides of the river. Another 4% are of the view that the sources have been constant and another 4% of the sampled population is not aware of the amount of pollution as they have newly migrated into the city or are not aware about the increasing hazards as a result of increasing pollution in the river body. (Fig 1)

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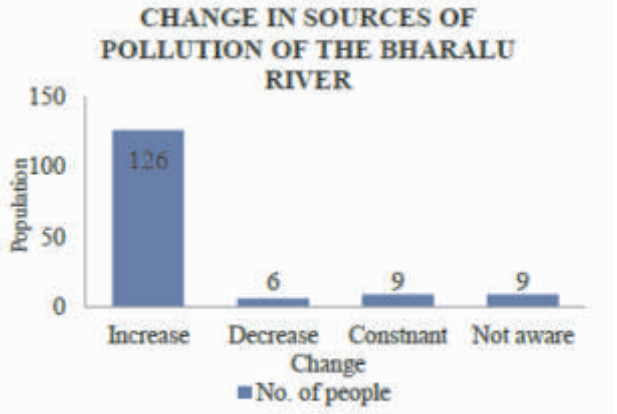
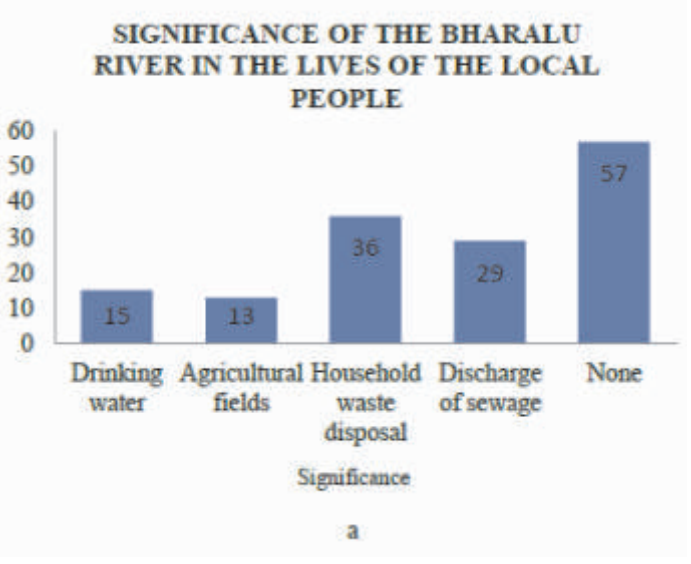
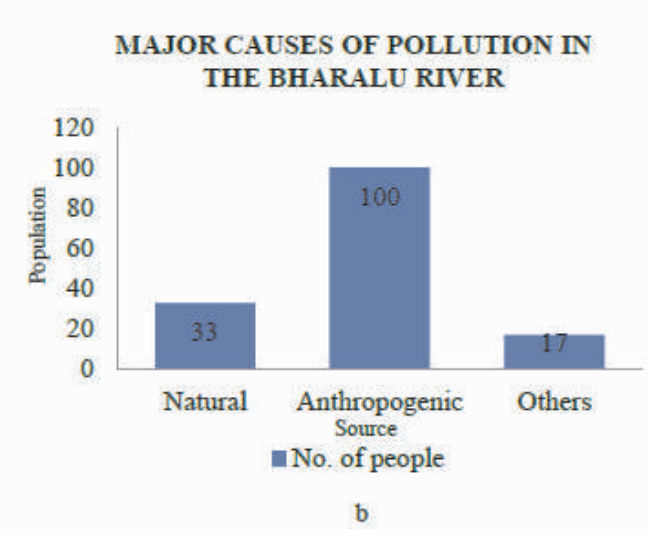


Fig 1: Shows the change in sources of pollution of the Bharalu River

River Bharalu has long lost the qualities of a natural river and has been rendered useless by the residents along its banks. When asked about the significance of the river to the locals (Figure 2 a) during the





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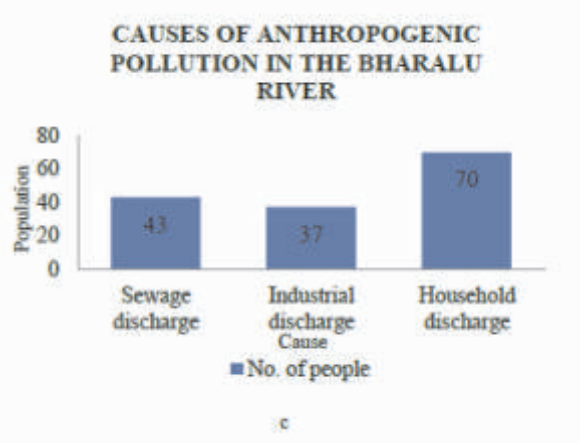

Fig 2 a shows the significance of the BharaluRiver in the lives of the locals; b shows the major sources of pollution in the river; c shows the main causes of anthropogenic pollution.
Source: Primary survey

field survey a majority of 38% population said that the river did not fulfill any of their needs. Another 36% population used it for discharge of household wastes which mainly included kitchen wastes and 29% population used it for discharge of the entire sewage from their homes as they lacked any alternative drainage facility and hence used the river as the main source of discharge. Another 15% of the population said that they depended upon the river for meeting their drinking water needs as the city has a very low water table and a condition exists where more than 45% of the population has to buy water for each and every need for around 5- 6 months (January- June) of the year, as their wells and boring had very little amount of water because of the river which flows along. Another 13% on the other hand, used its banks for irrigating their agricultural fields in which they mostly cultivated rabi crops and mostly included vegetable cultivators.

Among the total surveyed population 67% are of the opinion that the major cause of pollution in the river is anthropogenic, while 22% refer to natural causes such as landslide or erosion in the nearby surrounding hills and the rest 11% refer to other sources or are not aware of the causes of pollution (Figure2 b) (Photograph 1).

Photograph 1: Shows causes of pollution in the Bharalu. From left to right top row shows Plastics in pot holes formed by the river, garbage dumping in the Bharalu. Second row left to right shows landslide due to anthropogenic cause in the Basishtha hills and picnic on the Bahini River i. e. origin of the Bharalu.
Source: Primary survey.

Respondents further divided the major causes of anthropogenic pollution into: sewage discharge; industrial discharge; household discharge. 46% of the total surveyed population refers to household discharge as the main cause followed by sewage discharge by 29% and industrial discharge by 25% of the surveyed population (Figure 2 c).

Thus, the main sources of pollution in the river are categorized as follows:

SEWARAGE AND NON SEWARAGE MANAGEMENT

SEWARAGE MANAGEMENT

Pollution in the river

There are multiple sources of pollution in the Bharalu river.Identified sources include the following:

Raw domestic sewage: Raw domestic sewage drains are directly connected to the storm water drainage system. The direct sewage discharges contribute heavy organic loads which affect water quality and also include bacteria, viruses, and other pollutants harmful to human and ecological health. (Photograph 2).

Municipal Solid Waste (MSW): MSW (i.e., garbage) is routinely dumped in the city streets and along the banks of the Bharalu River. Nearly everywhere along the river banks, MSW is strewn about in thin, non-contiguous layers, but in many location, thicker, contiguous fills exist on the River banks and lie in contact with the flowing water (Photograph 2). In many cases, metal, wood, and food wastes appear to be scavenged by local populations ofdogs, pigs and other animals, and the resulting mixture is dominated by plastic wastes (Photograph 2). As these wastes slowly degrade, they release toxic pollution in the water.

Photograph 2: From top shows drains directly connected to the river, MSW along the banks of the Bharalu in the form of a layer in the centre and pigs scavenging for food wastes in the garbage looking for food waste in the garbage bottom.

Industrial pollution: Industrial pollution sources include the automotive maintenance areas, fueling stations, and other industries in the catchment area. Any pollution from these sources is directly discharged into the drainage system, which may flow overland, or may infiltrate into the groundwater which ultimately enters the Bharalu.

Storm water: Storm water is directly discharged to the Bharalu River via the surface drainage system, and also as overland surface runoff. In both cases, this storm water carries solids and pollution from the city streets into the river. In addition to domestic sewage, this runoff likely includes particulates from combustion of diesel fuel and other petroleum fuels, pollution from MSW, oils and greases from pavement areas, abraded asphalt particulates, animal wastes, agricultural waste products, and other pollution sources.

Drainage channel: The Bharalu is the master drainage channel of the GMC area which is highly commercialized and industrialized and drains into the Brahmaputra at Bharalumukh. From BasisthaChariali, the Bharalu flows up to Bharalumukh for about 16 km with an average width of 5 to 9 m of the river. The water depth varies with flow and due to other reasons, but is on average 3 m. The peak discharge of the Bharalu is about 35 m3/s.

The Bharalu is the primary drainage course for most of the area and especially for the southern part of Guwahati. Bharalu has several storm outfalls which drain into it. The Bharalu catchment area covers the G.N. Bordoloi Road in the North from Chandmari to Bharalu, R.G. Baruah Road in the East including the Chandmari flyover, G.S. Road in the South & South West from Dispur to Ulubari and L.P.B. Road up to Sabipool and the road along the Bharalu River, reaching KumarparaPachali.

Municipal wards covered by this area are mainly Wards 18, 19, 20, 27 to 36 and 38 to 44. The topography is fairly flat with very little natural slope. The remaining parts are covered with some hillocks and pockets of low lands. The basin covers very densely populated areas of Guwahati. To regulate the flow of the river, a sluice gate has been constructed by the State Water Resources Department at Bharalumukh(Photograph 3) near the outfall of the Bharalu to prevent reverse flows from the Brahmaputra during high floodsprimarily during the monsoon season when the Bharaluexceed the full supply level (FSL) in order to limit the flooding in the adjacent areas and pumpout the excess water near the downstream end.

Photograph 3: sluice gate at Bharalumukh
Source: Primary survey.

However, during the dry season, the flow is very low, theprimary source being urban drainage (sewage).

Several obstructions have been identified in the Bharalu between R.G. Baruah Road Bridge Crossing and Bharalumukh. For example, at R.G. Baruah Road crossing, projection of the lower slab of the road bridge together with crossings of service pipelines have obstructed the flow through the drainage course and reduced its carrying capacity. Moreover, a large number of temporary wooden foot bridges along with a number of old existing bridges (both made of wood/timber and concrete) at various locations along the Bharalu have obstructed normal flow of water during peak hours due to lower deck level and thereby have reduced the travel time of storm water through the drain considerably. At various locations, these obstructions have led to water overflowing into the adjoining areas. A number of shops and commercial establishments have encroached on

the waterway of the drain at Fatasil area. The width of the Bharalu ranges from approximately 10 to 18 m along with the banks. Its width increases to 36 m at the outfall point.

There are several prominent secondary drains which serve the Bharalu catchment area (Plate 2):

Pub-Sarania – Rajgarh Area Secondary Drain: This is major secondary covered drain carrying storm water from parts of Chandmari, Krishna Nagar and from the foothill of Sarania Hill on the eastern side. The drain is divided into two parts; one towards Nabin Nagar-Anil Nagar underground drain and the other reaching Lachit Nagar underground drain. The total length of this drain is 3700 m.

Lachit Nagar Area Storm Drain (Lachit Nagar Road to Bharalu Drainage Channel via B.T. College Road): It is a

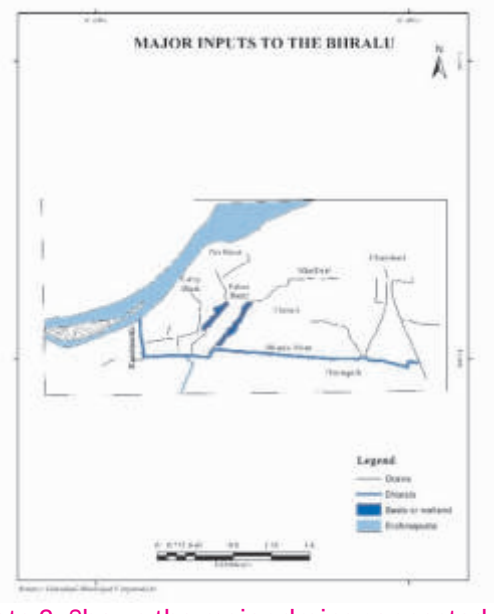

Plate 2: Shows the major drains connected to the Bharalu

combination of a pipe conduit (N.P.-3 Hume Pipe) and a concrete box drain. This underground drain carries storm water from all of Lachit Nagar and the southern part of the Sarania Hill catchment area through drains meeting it at different locations. This drain starts at the Lachit Nagar G.S. Road junction and terminates at the Bharalu River through B.T. College Road. The approximate length of the drain is 1 km.

Railway Open Drain (from Voltas Point near Sadin Office to B. Baruah over bridge): This is an open concrete drain that was constructed in 2004. It carries storm water from parts of Nabagraha Hill, Chandmari, Krishna Nagar and Silpukhuri area. It flows through the railway culvert below the B. Baruah over-bridge and passes through Hedayatpur and ultimately outfalls at BorosilaBeel through Solapara. The total length of the drain is about 1.3 km.

Underground drain from Ambari via parts of G.N.B. Road to Railway open drain at Ambari: This drain carries storm runoff from Lamb Road area, Ambari and parts of Uzan Bazar Area. This drain originates at the Lamb Road area, and then meets the railway culvert below B. Baruah over-bridge, and finally outfalls at BorosilaBeel.

R.G. Baruah Road Drain (From Zoo NarengiTiniali to Bharalu Drain): This is an open concrete drain. The origin point of this drain is at Zoo NarengiTiniali; the outfall is at the Bharalu. This is one of the major open secondary drains collecting storm/ waste water from the Guwahati Refinery, Noonmati and Bamunimaidan area through drains running along the railway line at Bamunimaidan, the Bhaskar Nagar area and ultimately meeting it at Zoo NarengiTiniali. Water from Narikal Basti and Ambikagiri Nagar also contributes to this drain. Some of the runoff from the Rajgarh and Chandmari areas is also contributing to this drain. This drain meets the Bharalu at Jonali, the confluence between the Bharalu and the Bahini Rivers. The total length of the drain is about 1 km.

Chandmari - Bharalu Secondary Drain (through Bhaskar Nagar, Rajgarh, Nabin Nagar, Anil Nagar): This drain was constructed by the T&CP Department and carries water from parts of the Chandmari area, Bhaskar Nagar,

Rajgarh, Nabin Nagar, part from PubSarania and Anil Nagar. The total length of this drain is almost 5 km.
Underground drain along the boundary of Nabin Nagar and Anil Nagar to Bharalu (through Anil Nagar): This drain carries storm runoff from the Anil Nagar area. Part of drain flows towards the Chandmari - Bharalu Secondary drain; the remaining part of the drain flows towards the Bharalu primary drain. The total length of the drain is 1.4 km.

Extended stretches of several drains are clogged with silt and garbage. Storm runoff from adjoining hills and the runoff carry huge loads of silt and vegetation, which ultimately get deposited within the drains, severely restricting flow. The outfalls in the BorosilaBeel have been reduced significantly due to encroachment and garbage dumping, reducing the storage capacity of the lake.

Several of the manholes have been paved over by a layer of bitumen during road construction. Some of the existing manholes were found to be damaged or broken. Sometimes, manhole openings are inadequate for manual cleaning.

The major reasons of ineffectiveness of drains are therefore as follows:

Deposition of garbage and solid waste that reduce the carrying capacity of the drain, HFL of the drain is higher than the surrounding area causing backflow, obstruction of flow at the outfall point due to silt deposition, obstruction in flow due to construction of low level cross structures on the drain, non-functioning of installed equipment due to lack of maintenance.

Atmospheric deposition: The air quality in Guwahati is affected by sources such as the combustion of petrochemicals for transportation, energy, and industrial purpose and regional air quality pollution. Particulates which contain toxic combustion by-products and heavy metals such as mercury settle and dissolve into the city's waterways.

Due to the density of the residential population, the most significant source of pollution to the Bharalu River appears to be the direct discharge of domestic sewage. Given the prevalence and magnitude of the problem, MSW dumping may also be a significant source. It is likely that the pollution loads from storm water, industry, and atmospheric deposition are less significant, but there has been little study done to confirm this assertion.

Waste water disposal: At present, the city of Guwahati does not have an integrated sewerage system except for selected residential areas such as the Railway Colonies, the Oil Refinery colonies and residential areas under defense establishments which have their own sewerage and treatment facilities. The only collection and treatment process followed is the use of septic tanks. Therefore, much of the waste water generated in the city is being disposed of into rivers without treatment.Table 1 shows the amount of wastes being generated in the city of Guwahati.

Table 1: Waste water generation in Guwahati

Total households in the city	Total waste water generated in the city (m^3)	Total households connected to septic tanks	Total waste water collected in the septic tanks(m^3)
2,30,769[1]	1,03,932[2]	1,38,427[3]	17,442[4]

Source: 1 As per Census data 2011
2 Assumption being 80% of 135 lpcd water supplied to 9, 62,334 people
3 As per secondary data obtained from GMC
4 Assuming average household size of 4.2 (as per Census 2011) and 30 lpcd of wastewater

Presently there is no organized sewerage system in Guwahati City. Untreated or semi-treated sewage are discharged to the storm water drains due to lack of a proper sewerage and sanitation system in the city. The large input of sullage water comes through a number of major drains meeting the Bharlau at various points. A

few of these drains are :

A drain carrying storm water runoff from Guwahati refinery, meets the Bharalu at R. G. Baruah road. This on its way collects on its way domestic waste water from New Guwahati Railway colony, Bamunimaidam, Jyoti nagar, Krishna nagar, Narikalbasti and other areas.

Drain originating from the All India Radio complex at Chandmari passing through the thickly populated areas, of Chandmari, Rajgarh and Krishnanagar discharges into the Bharalu at the eastern side of the Rajgarh bridge near Bhanagarh.

Another drain, carrying wastewater from Lachitnagar, Pub Saraniya and Gandibasti areas, runs under the road in front of the Banikanta B. T. College and meets the Bharalu in the western side of the Rajgarh bridge near Bhanagarh.

A drain originating in the Nabagaraha- Silpukhuri areas and passing through the northern side of the railway line crosses the railway line and the B. Baruah road near stadium over bridge, passes through the highly commercial Paltanbazar areas and after crossing the G. S. Road, discharges into the Chalabeel near the Meghdoot cinema. This Chalabeel (natural reservoir and wetland) is connected to the river Bharalu via a culvert over the Sati Jaymati road near Sabipool L. P. School. This drain bridges in the wastewater from entire Nabagraha, Silpukhuri and Hadyatpur areas.

A natural rivulet, coming out from the Khasi Hills, enters Guwahati near the CRPF complex near Khanapara and runs along the eastern side of the G. S. Road. The rivulet collects waste water from the Assam Agricultural University Campus and Agricultural Department Complex at Khanapara, crosses the sixmileNarangi road at Juripaar and after flowing through Panjabari and other areas discharges into a small natural basin, which in turn is connected to the Bharalu near the road at Hengearabari.

Another major drain, extending from the G. N. B. Road to the BarchalaBeel, discharges into the Bharalu after carrying wastewater from Pan Bazar police reserve and Paltan Bazar areas.

Besides these a large number of small drains flow to the Bharalu all along its course . A large number of garages and automobile service centers, the Railway Diesel Locomotive shed at New Guwahati and ASTC Transport Workshop at Ulubari discharges their wastewater into the Bharalu. Effluents from a number of flour, rice, oil and saw mill, brass steal and leather works, carbon products industry, bamboo and cane industry, metal products, candle industries, printing and binding works, hospital and nursing homes, cinema photographic studio, hotel and restaurants, vegetable and other markets enter the Bharalu.

In the rainy season, the inputs far exceed the capacity of the Bharalu. Further low-lying ditches and channels with local drainage patterns lead to frequent over flooding of the adjoining areas due to inefficient hydraulic capacity and sullage water spread. Indiscriminate construction activities in low lying areas by blocking the natural drainage channels and reservoirs have resulted in such conditions.

There is one STP in Guwahati located at the northern end of BorsolaBeel which discharges to the Bharalu. The SPT serves the area to the north-east of AK Azard Road. The plant was developed by the GMAC and is reported to have a capacity of 1.5 MLD. It was installed as part of the development in the area, and is not adequate for handling any additional wastewater discharge and/or is operationing in a fashion to remove all of the wastewater contribution to the BorsolaBeel.

In the older part of Guwahati un-treated sewage and sullage is discharged into storm water drains causing unhygienic conditions for the city dwellers and also a grave risk to health of sanitation workers. Newer houses in relatively better planned and organized colonies have septic tanks but most of them lack soak pits. Partially treated effluent is usually discharged into open road drains which flow into the natural drainage channels that pass through the city. This results in unhygienic conditions of the surrounding areas as well as pollution of ground and surface water sources. This also poses, even greater health risks as ground water is also extracted for using it as potable water in some areas, the commissioning of the ongoing water supply systems is still pending. The two main causes of concern from the sanitation and health perspective are the untreated or partially treated effluent stream from septic tanks (if not being soaked into a soak pit) and the sewage being emptied from the septic tanks.

In view of existing status of environment of Guwahati without any engineered sewage system and

treatment facilities, it is extremely important to plan and implement a scientific system of underground sewerage and sewage treatment to save the population from a calamity in the near future. Further, in accordance with the norms of the Government of India, a city like Guwahati with a population over 7.5 lakhs falls under the obligation of having adequate facilities of sewerage and sewage treatment in the city.

Service delivery for sanitation in Guwahati does not match the requirements of the city and also the stipulated service level benchmarks (SLBs) by the Ministry of Urban Development, Government of India.

Institutional arrangements to deal with sewerage issues are inefficient at present and rest with a number of agencies. While the GMC is responsible for water supply only for a part of the city, its primary responsibility is managing the solid waste, along with maintenance of storm drains and cleaning of septic tanks. GMDA is responsible for planning and carrying out some of the major developmental works to be undertaken in the city in future.

Status of Water supply

The existing water supply system in Guwahati City consists of several schemes covering different parts of the city. Treatment Plants at Panbazar, both operated by GMC and PHED, along with AUWS&SB operated Zoo Road treatment plant and the GMC-operated treatment plant at Satpukhuri supply water to the central region. 35% of the city is covered by piped water supply (Master Plan 2025). The potable water generation capacity in Guwahati is 98 million litres per day (MLD). At present, about 73.5 MLD of potable water is produced in Guwahati by the GMC; out of this, 72 MLD is drawn from the Brahmaputra to eight water treatment plants. The produced water is insufficient for the current demand of 132 MLD. Therefore, aside from water produced by the GMC, approximately 65% of the residents extract potable water from the ground with hand pumps, tube wells and wells in the GMA (Carrying Capacity Based Urban Development Regulations, Guwahati, 2011). The projected demand for the city by year 2025 is estimated to be 425 MLD. As only one third of the population of the whole city is served by piped water supply systems (that too with frequent complaints of inadequacy of water supply), the majority of the population is dependent on their individual water sources such as shallow tube wells or dug wells. Most of these sources are heavily contaminated. A few inhabitants can afford tapping water from deeper subsurface layers which are generally free from bacteriological contamination. However, water from those layers may contain elevated iron concentrations and other impurities. Even many of those houses having piped water supply connections have tube wells or dug wells as stand-by sources due to the unreliability of the piped water supply system. The major industries (including the IOC's oil refinery, The Railways, Airport and Defense establishment) in Guwahati collect, treat, and supply their own water; water is obtained mainly from the Brahmaputra River but one of the major cause of concern is the fact that the Bharalu flows into the Brahmaputra without any treatment of its water and hence carries all its debris and pollutants into the river which is a major source of water not only for the residents at Guwahati but also Assam.

NON-SEWERAGE MANAGEMENT

River Front Development

The Bharalu River is a small river and tributary of the Brahmaputra that flows through the heart of Guwahati. At present no river front development exists at the Bharalu except at Bharalumukh where the river drains into the Brahmaputra. This makes the river very dirty due to anthropogenic activity from the residents living near the banks.

Riverfront development works for the Bharalu River will be initiated in the line of Brahmaputra Riverfront development scheme. The development scheme will include steps like boulderpitching, walkways with ornamental railings, footbridges, resting sheds, benches, street lights, signage, kiosks, and parking spaces arid widened carriage-widths.

Community sanitation scheme

Availability of toilets is an important indicator of sanitation. Providing adequate and clean toilets, to the citizens is a key responsibility of the GMC.Open defecation has serious ramifications on the health of the people,

the quality of the river water of the Bharalu and the image of the city as well. There is no information available on the number of public toilets in the slum area of the City of Guwahati.

Community toilets will be constructed along with river front development schemes. A total of six community toilets are proposed in the scheme. The toilets will have separate facilities for male, female and the physically challenged people.The toilets will be built with rain water harvesting on the roof, and solar lighting. The toilets wall will be painted with various information for creation of awareness about personal hygiene among local lower income group of people who use the river banks for open defecation. The operation and maintenance of the community toilets will be outsourced after construction to ensure sustainability and to provide high quality hygiene services to the people living along the river front.

Community kiosks

Community kiosks will consist of small houses along the river front. Their purpose is to let individual for small business activities , such as saloon, water, tea/cold drink, snacks, vending, selling pan, providing first aid treatment and emergency medicines (Photograph 4). The individual will also be provided with basic health checking facilities, such as blood sugar and blood pressure. This will enhance the use of river fronts. Currently, the conditions of such kiosks, is very unhygienic and unattractive.The kiosks will have rainwater harvesting and solar lighting. Materials related to community awareness and education will also be available in the kiosks. Small reading facilities such as a

Photograph 4: Tea stall under unhygienic condition to be replaced by a Kiosk
Source:PCBA

'chai library" will also be included. The rental fees charged on these kiosks will be utilized for hiring community security personnel for the benefit of the people.

Crematoria

There are two conventional crematoria on the bank of Bharalu one at Basishtha(Photograph 5) near the source of the river and the other near Ulubari. Immediate data are not available for waste generation however; an unknown number of people use the river bank for cremation because such records cremation near the river ghats could be prevented to a greater extent. A gas-based crematorium has been started in Nabagraha in 2012, although this has minimal implication for the Bharalu River.

Photograph 5: Shows crematoria along the banks of the Bharalu. Images from left to right shows the remainsbeing disposed into the Bharalu where the red arrows show the course of the river; the second picture shows the board of the Basishtha Bhutnath crematory.
Source: Primary survey.

Dhobi ghat

There are few river ghats in Guwahati that are used for washing clothes by dhobis which contributes to pollution. The main ghats used by the dhobis are in Hatigaon and Basistha (Photograph 6). Data collected through field surveys and field observations indicate that only a few residents currently use the BharaluRiver for washing clothes upstream and not downstream due to the severely poor quality of the water.

Photograph 6: Dhobi ghat at the source, Basishtha
Source: Primary survey

Public bathing

Bathing ghats are not clearly established and are makeshift where they exist. Bathing facilities in the shape of pucca or kutchaghats can be built near the banks of rivers.Due to the lack of maintenance or otherwise, some of these facilities have become defunct and need renovation. At some places, the existing facilities are inadequate and need to be supplemented.(Photograph 7)

Carcass Disposal

There is no exact place earmarked for the disposal of carcasses, and hence it is difficult to determine the number of carcasses disposed of in a year.

Photograph 7: Top people bathing at the course of the Bharalu at Basishtha Ashram; below banana tree waste being disposed along the banks after a puja
Source: Primary survey

Others

A major problem of the Bharalu is the large-scale disposal of banana plants (Photograph 7 above) after Diwali and wedding season. Wastes from dairies and slaughter houses are also disposed into the river. Daily and weekly local market vendors also dispose their daily garbage into the river or along its banks as observed through field observations. However, no government records are maintained about the waste disposed by slaughter houses and local daily and weekly markets into the river.

Thus, the river is highly polluted and has lost its natural significance in the region as a water body and has been turned into a drain carrying large amounts of sewage and unnecessary wastes. Large amounts of contamination in the river have resulted in change in the quality, quantity and sedimentation in the river water (Fig 3.3).

Answers received from respondents during the fieldwork when asked about the changes over the last two decades in the water quality, quantity and sedimentation clearly shows that there exists a direct relationship between the decrease in water quality and quantity and an inverse relation with the amount of increase in sedimentation as seen in figure 3.3. Respondents are of the view that both water quality and quantity has decreased over the years and has resulted in an increase in the amount of sedimentation in the river.

A majority of the respondents are also of the view that the amount of pollution increases with the onset of summer months i.e. April to June and is least during monsoon months i.e. July to September. Locals are of the view as they believe that pollution in the river increases during the summer months as the amount of water decreases and decreases with the coming of the monsoon rains when the amount of water increases and almost fills up till the banks thus carrying the garbage and other pollutants from the banks and surrounding areas (Fig 3.4).

However, previous studies based on water testing results show that it is difficult to establish seasonal trends about the pollution in the river. Respondents in the area base their perceptions from a common layman's perspective as can be seen through the naked eye. It also proves lack of awareness among the general masses of the area and the need to increase the awareness levels.

CONCLUSION

Sources of pollution identified till the submission of the report indicate that the main cause of pollution in the catchment area is anthropogenic causes 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.

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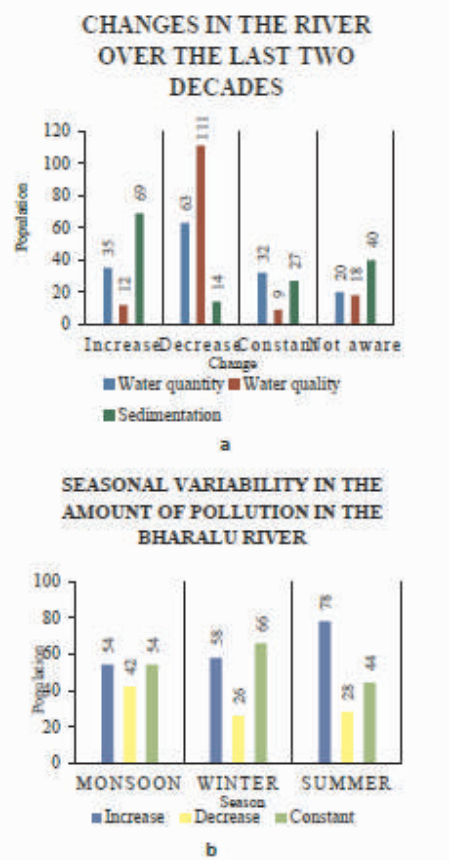

Fig 3.4: a shows the changes in the Bharalu River water quantity, quality and sedimentation over the past two decades; b shows the seasonal variability in the amount of pollution in the Bharalu River.
Source: Primary survey.

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