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Water quality assessment of Harmu river, Ranchi (INDIA)

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ABSTRACT

Safe water availability is a human right that sustains good health of human beings, but more than hundred millions of people on earth are denied of safe water. Thus water quality monitoring and assessment are key working components of UN Organizations, national and international governmental bodies and researchers. This paper attempts to monitor the water quality of Harmu River that passes through the Ranchi city (India) and is highly polluted due solid waste dumping and liquid wastewater discharges. Although the state of the river is very poor it is currently being used by low income group residents for small scale farming and bathing. Even though the state of the Water quality of the river is poor, governmental organizations are taking no effort to maintain the aesthetics of the river or stop the consumption of water from it. Thus we attempt to highlight the crucial case of the river by monitoring and assessing the water quality of Harmu river. Water samples were collected randomly from various locations throughout the length of river and were analyzed for 17 parameters. Based on the analysis it is observed that the water quality does not meet the specifications of Indian Standards for drinking, irrigation, aquaculture propagation, and industrial cooling. It is thus recommended that the water be restricted for any further use till treatment and cleaning is not conducted. With this work, we attempt to sensitize the users and administrative bodies on restricting the use and taking measures for river rehabilitation.

Keywords: Water Quality; Harmu River; Water use suitability; Indian Standards

INTRODUCTION

Freshwater bodies are interconnecting features on earth that connect the sky and the ocean through hydrological cycles (Chapman 1996). Rivers are examples of freshwater bodies that flow from uplands to lowlands to finally meet the ocean that are facing the menace of pollution in the current decade (UNICEF 2008). Even the most prestigious and sacred rivers of India have been facing the curses of pollution and climatic changes (Rai et al. 2012; Sanghi 2014). Urbanization, industrialization and population increase induce the process of degradation of water quality worldwide (Tyagi *et al*. 2013). Good quality of water serves as a habitat for aquatic plants and animals and large number of phytoplankton and zooplankton species (Saksena 2008). Pollutants whether released into the atmosphere or soil finally reach the aquatic system and pollute them, making them extremely vulnerable (Chapman 1996) and resulting in reduced freshwater availability, outbreak of diseases, loss of biodiversity, and tourism. Sanders et al. 1983 define water quality as process of collection of information on the physical, chemical, and biological characteristics of water. Water quality monitoring is explained as a mean to understand the water quality problems existing in a region (USDA 2003; Strobl and Robillard 2008). When the physical, chemical, and biological characteristics are present in concentration beyond permisicible limits, it causes health impacts and is thus not suitable for drinking purpose (Jarvie *et al*., 1998; Ramachandran 2003; USEPA 2009; WHO 2012; BIS 2012; CPCB 2013). The 2006 Global UNICEF strategy paper lays stress on protection of freshwater resources, community based surveillance and strengthening of monitoring capacities among strategies for strengthening water quality (UNICEF 2006). Scientists from across the globe are working on river water quality monitoring and assessment.

The discharge of industrial effluents into rivers has resulted in degradation of water quality of Vrishabavathi River (Madhukar and Srikantaswamy 2013), Betwa River (Magarde *et al*. 2009) and streams in Nakawa Ntinda (Walakira 2011). Subramanyam and Yadaiah 2014 highlights the impacts of industrial and other wastewater discharges into soil and streams that’s ultimately contaminates the groundwater. A study on the water quality of Birma River, Uttar Pradesh (India) was conducted to assess its use for drinking, irrigation and fish production. It was found that the water is polluted downstream due to sewage disposal and agricultural runoff (Saha 2014; Zaidi 2014). Similar results were also obtained for Machna River where sewage disposal has detrimental effect on river water quality (Shrivastava *et al.* 2013). In this research work, authors attempt to monitor and assess the water quality of Harmu river that flows across the Ranchi city of Jharkhand state in India. Harmu River is a tributary of Subarnarekha River that forms the main local river system in Jharkhand. Harmu River which once provided water to habitation settled near its course has now turned into a waste dumping ground resulting in complete deterioration of water quality and aesthetics. Fig.1 shows the status of the river within Ranchi city premises. The river is further affected by negligent administration and researchers not interested to cover local issues. Only one published work has been observed that studies the water quality of the river and concludes that the river water is unfit for any drinking purpose (Rai *et al.* 2012). Thus this work attempts to monitor the water quality of the river from its start point at 85026”E and 230.37”N to its end point at 850.36”E and 230.34”N coordinates

Fig.1: Status of Harmu River within Ranchi City Premises

MATERIALS AND METHODS

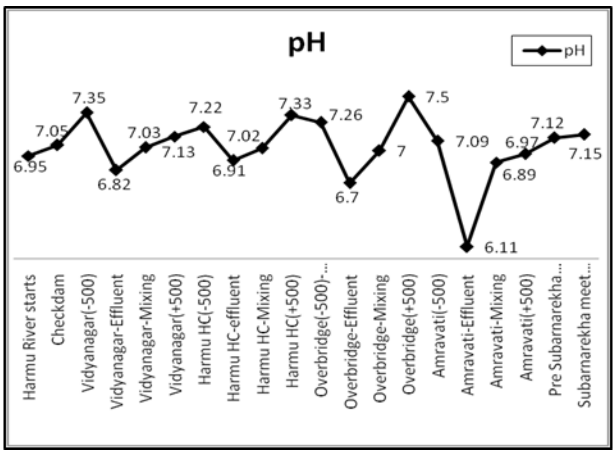
Random sample were collected from different locations of the Harmu river (USEPA 2015). Start Point, Vidyanagar colony, Harmu Housing Colony (Harmu HC), Overbridge, Amravati and End point where Harmu River meets Subarnarekha are identified as key locations and 18 samples locations were identified based on whole representation and mixing zones of effluents from domestic sewers. Four samples from effluents that were mixing in the river near Vidyanagar colony, Harmu HC, Overbridge, and Amravati were also collected. Table 1 shows the location names and their coordinate values. The water samples are collected from surface near the margins of the small river between 9a.m. to 11.30a.m in one litre plastic bottles for physicochemical analysis and 100 ml plastic bottles for heavy metal analysis at each selected site. Sample collection and analysis was based on guidelines provided in APHA 1998. 16 physicochemical parameters were analysed for assessing the water quality of Harmu River. These parameters are Temperature, pH, Electrical Conductivity, Dissolved Oxygen (DO), Alkalinity, Free Ammonia, Phosphate, Nitrate, Arsenic, Iron, Manganese, Copper, Zinc, Chromium, Cadmium and Lead. The results obtained is analysed on the basis of water quality criteria for various uses given by Central Pollution Control Board, New Delhi (CPCB 2015) and water quality standard code IS 2296:1992 (NIH 2015) and IS 10500 (BIS 2012) of India.

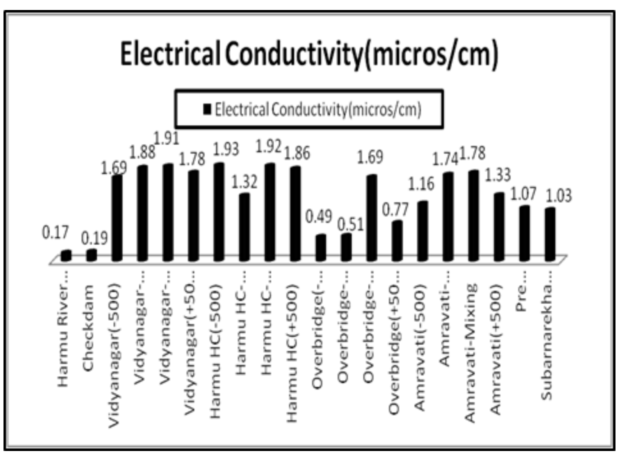
	Table 1: Sample Locations	
	Locations Names	**Co ordinates Values**
1	Harmu River starting point	85.262405 E 23.370320N
2	Near Checkdam	85.282036 E 23.365412N
3	500m before Vidyanagar colony	85.302817E 23.362301N
	Vidyanagar-Effluent Discharge Point	85.303931 E 23.362851N
4	Vidyanagar colony	85.304081 E 23.362722N
5	500m after Vidyanagar colony	85.305369 E 23.363429N
6	500m before Harmu HC	85.314774 E 23.363005N
	Harmu HC-Effluent Discharge Point	85.316169 E 23.360099N
7	Harmu HC-Mixing	85.316305 E 23.360128N
8	500m after Harmu HC	85.317851 E 23.357227N
9	500m before Overbridge	85.323554 E 23.351974N
	Overbridge-Effluent Discharge Point	85.325529 E 23.349911N
11	Overbridge-Mixing	85.325522 E 23.349669N
12	500m after Overbridge	85.326792 E 23.345971N

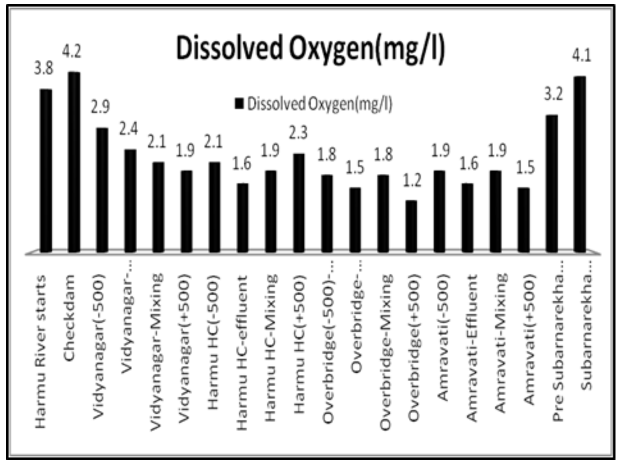
13	500m before Amravati	85.336778 E 23.343594N
	Amravati-Effluent Discharge Point	85.3397966E 23.342498N
15	Amravati	85.339767 E 23.342312N
16	500m after Amravati	85.343037 E 23.341745N
17	Pre Subarnarekha meet point	85.358478 E 23.339688N
18	Subarnarekha meet point	85.361972 E 23.341187N

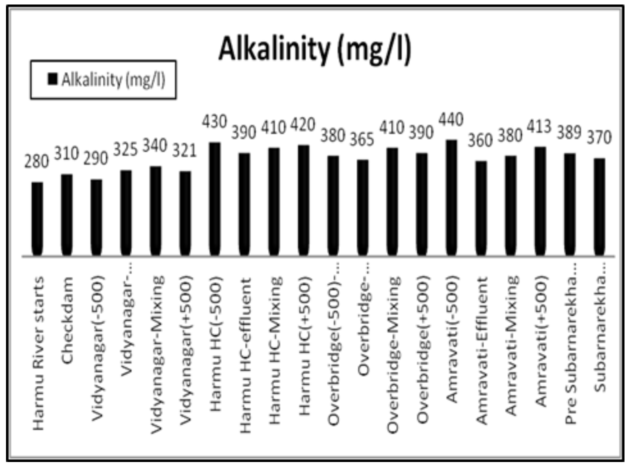
RESULTS AND DISSCUSSION

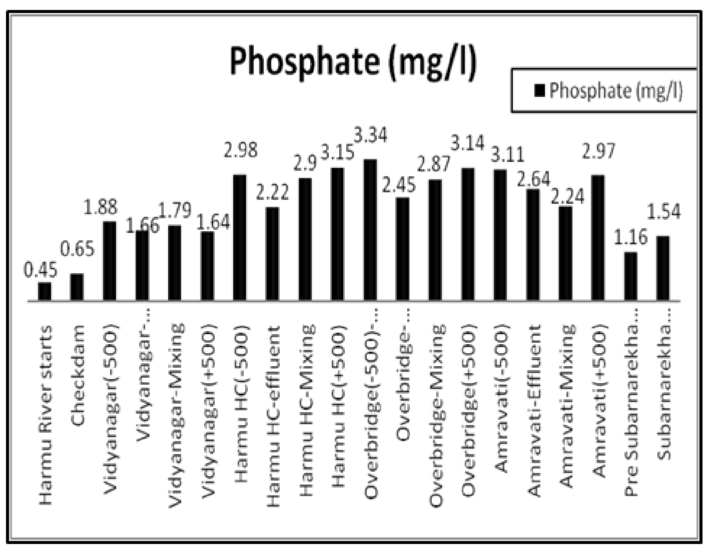
Water quality analysis shows that Copper, Zinc, Lead, Cadmium and Chromium are found below detection limit. Temperature of the river water and effluent was in the range of 190C and 22.50C. The results of other parameters are shown below:

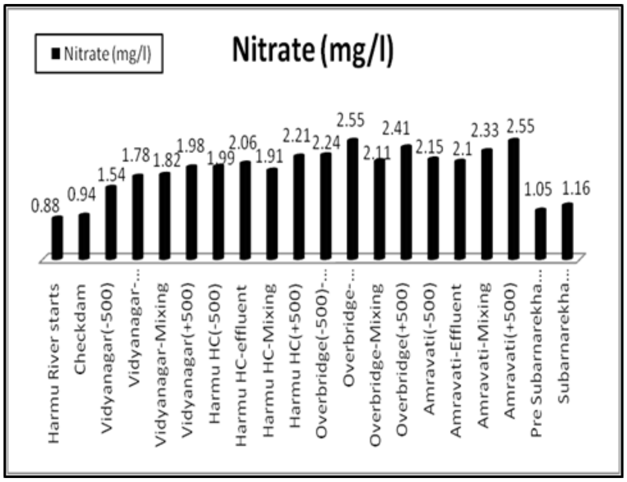


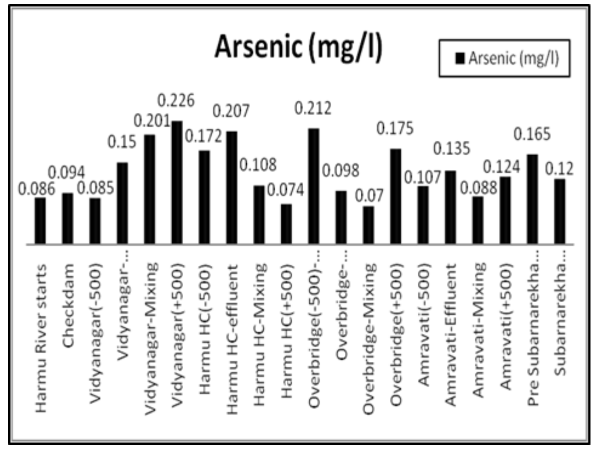


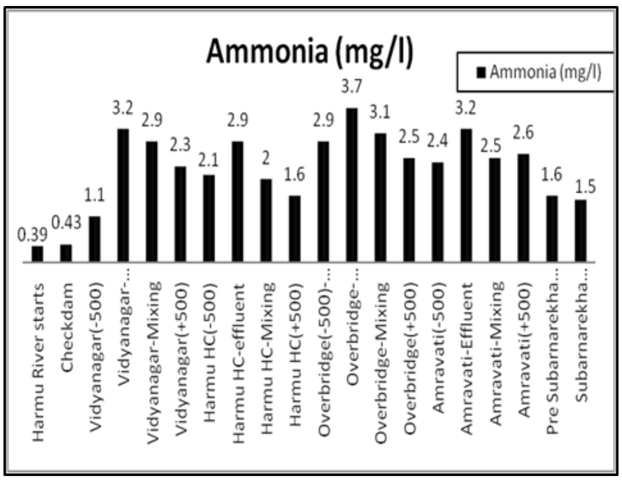


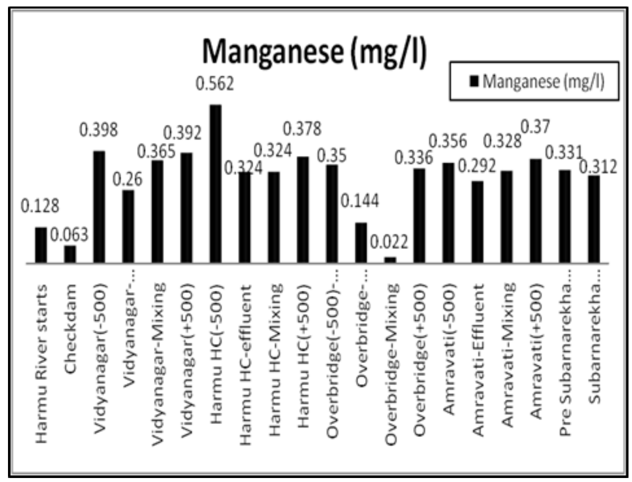


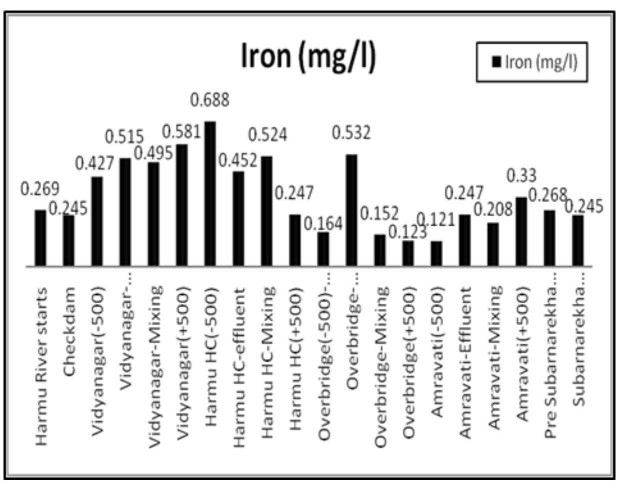












Results show that the concentrations of alkalinity and arsenic is beyond desirable limit of drinking water and thus not suitable for drinking purpose and that the concentration of dissolved phosphate, nitrate, iron, PH, and electrical conductivity are within the desirable limits of drinking water norms (IS10500, 2012).The concentration of iron is observed to be within desirable limits in the starting and end locations of the river. Iron concentration increases from Vidyanagar to Harmu HC but is within limits till the end point of the river. The concentration of DO is decreases from the start point of the river to the centre of the river where it passes through the main city. DO is observed to be 4.1 at Check dam location and end point of the river. Thus based on Central Pollution Control Board of India, 2015 norms on water use criteria, the entire stretch of the river is unfit for drinking purpose (even after treatment and disinfection), outdoor bathing purpose, propagation of wildlife and fisheries, irrigation, and industrial cooling, except for the location of check dam and end point where is marginally meets the requirement on DO.

CONCLUSIONS

The objective of the research work was to assess the potability potentials of Harmu River that flows from the centre of Ranchi Municipal Area. It is observed that water quality of the river is unsuitable for drinking, open bathing, irrigation, industrial cooling and propogation of wildlife as the desired concentration of dissolved oxygen for these purposes are not met. Arsenic and iron is also found beyond desirable limits that can pose serious health hazard for human beings. High alkalinity concentration shows the presence of carbonates and bicarbonates that may be due to direct discharge of wastewater from domestic sewers. Lower DO concentrations signify less mixing of the atmospheric oxygen into river water. This is evident by the huge solid waste such as plastics being dumped into the river. It has resulted in low DO and rising eutrophic conditions of the river. Although the effects of arsenic is not found on human beings currently as the water is not being used for drinking purposes. However since the water is being used in some pockets for agriculture purposes a long term study is suggested. A study on bioaccumalation of arsenic in surrounding areas is suggested. Health survey in an around the area is also suggested to find the impacts of deteriorated water quality of Harmu river. With this article, we attempt to highlight the critical condition of the river that once supported the city with its water. It is also suggested that the government or non-governmental organization take up initiatives to generate awareness and display warning boards pertaining to the quality of the river.

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