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Drains Contaminate Ganges

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Abstract: *Flow of 701 MLD with 70.19 TPD of organic load from 30 priority drains discharged into main stem of Ganga River in Phase-I, Segment-B during post monsoon, 2016. BOD in 16 drains, COD in 11 drains, TSS in 14 drains, TDS in 6 drains, Cl^- in 1 drain and NH_3-N in 5 drains were beyond the standards, indicated under brackish water categories and definitely attribution from the sewage and industrial activities in the vicinity and farmers using ammonia rich fertilizers in and around the Ganga basins. Bacteriological parameters like Total Coli form and Fecal Coliformwere noticed in all drains beyond the limit. Presents of OCPs like β-HCH, γ-HCH, δ-HCH, PP'DDT and PP'DDE as well as OPPs like Monochrotophos. The concentration of Cadmium in 1drain, Arsenic in 3 drains, Chromium in 4 drains and Manganese in all drains were observed, beside the drain like Wazidpur nala was at levels 43 times higher Chromium against the CPCB general standard for discharge of environment pollutant in public sewers (2.0 mg/l). Industries and agricultural activity is major source for high concentration of Zinc in the drains during the investigation as well as confirmed that Industries like metallurgic operations involving zinc and use of commercial products containingzincand the use of commercial products such as fertilizers and wood preservatives that contain zincdischarge their effluent to the corresponding drains and contaminate Ganges.*

Keywords: *Drains, Discharged, Sewage and Ganga River.*

1. INTRODUCTION

If Culture is lost, Identity is lost, certainly Ganges is contaminate, Indian philosophy will be blur. Because, the story of the Ganges, from her source to the ocean, from ancient times to now, is the story of India's civilization and philosophy, of the rise and fall of empires, of great and proud cities, of adventures of man. The water of Ganga is believed to be self-cleaning in nature and it is said that a single dip in the water of this holy river will wash away all the sins of a person. Thousands of human and animal dead bodies are consigned to Ganga River. The last rites of the thousands of people are performed at the numerous ghats along the shores of Ganga at the Gangotri, Devprayag, Rishikesh, Haridwar, Kashi, Varanasi and Nabadip etc. and millions of people take bath in the Ganga day in and out and millions more in a single day during festival seasons throughout the year. But, yet there is no sign of contagious diseases, skin disorders spreading from person to person due to contact after bathing in Ganges water!

"Ganga Snanna, Tunga Panna" is the saying of Indian spiritualand it is scientifically fact. After testing the water quality of Ganga by E. Hanbury Hankin, a British physician in 1896, wrote in a paper published in the French journal Annales de Institute Pasteur, 'The bacterium Vibrio Cholera which causes the deadly Cholera disease, when put into the waters of Ganga died within three hours! But, the same bacteria continued to thrive in distilled water even after 48 hours, suggested cholera disease never spread in the region of Ganges from ancient. Further, another British physician C.E. Nelson noticed that, the waters of Ganga when taken even from one of its dirtiest mouths at Hooghly, by the ships returning to England, remained fresh throughout the long journey! A French microbiologist, Flix dHerelle was amazed when he saw that only a few feet below the bodies of persons floating in the Ganga who had died of dysentery and cholera, where one would expect millions of germs, there were no germs at all in 1927! Professor D.S. Bhargava, an Indian Environmental Engineer has spent a life time studying the amazing properties of Ganges. He measured the remarkable self-cleansing ability of Ganges in an exhaustive three year study which showed that Ganges is able to reduce its Biochemical Oxygen Demand (BOD) levels much faster than

other rivers! Professor Bhargava says that the self-purifying quality of Ganges leads to oxygen levels that are 25 times higher than any other river in the world. The Ganges cleans up suspended wastes 15 to 20 times faster when compared to other rivers! Similarly, a case study conducted by the Malaria Research Centre in New Delhi it was observed that the water from the upper reaches of Ganga did not host mosquito breeding, and also prevented mosquito breeding in any water it was added to! On the other hand, water from other rivers were shown to allow mosquito breeding! Therefore, to stop the contamination from various point and non-point sources, quantification of pollution load and identification of specific is important. During the present study specific attention was given for measurement of flow and advance technology was used for analysis of.

2. MATERIAL AND METHODOLOGY

2.1. Study Area and Hydro-Geologic Setting

The River Ganga basin is bound in the north by the Himalayas and in the south by the Vindhyas. The River originates in the Garhwal Himalaya (30o 55' N, 79o 7' E) under the name of the Bhagirathi.

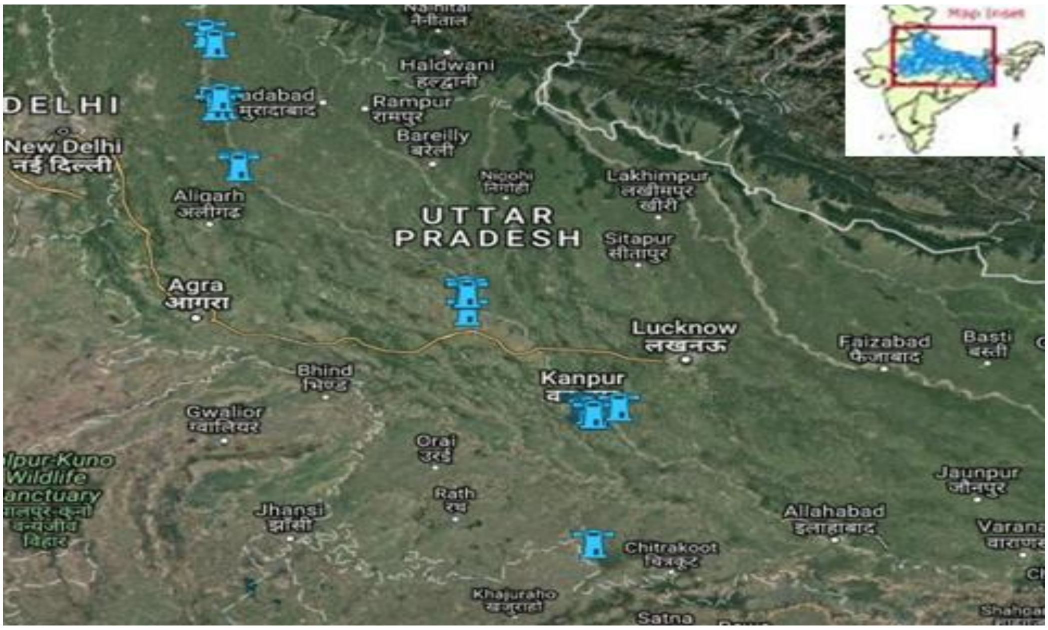


Figure1. *Study Area-Phase-I, Segment-B*

The ice-cave of Gaumukh at the snout of the Gangotri glacier, 4100 meters above sea level, is recognized as the traditional source of River Ganga (Photo1). The River cuts its path through the Himalayas and flows a distance of about 205Km from Gaumukh and transverses through two districts of Uttarakhand state i.e. Uttarkashi and Tehri to reach Devprayag where another head stem, the Alaknanda, joins it to form Holy Ganga (Photo 2). The River Alaknanda is a major tributary of the River Ganga at Uttarakhand that begins at the confluence of the Satopanth and Bhagirathi Kharak glaciers in Uttarakhand and it travels approximately 190Km before meeting Bhagirathi. After flowing through the northern most part of Uttarakhand, the River flows through Uttar Pradesh, Bihar, Jharkhand and West Bengal and finally meets Bay of Bengal. The River traverses a length of 1450Km in Uttarakhand and Uttar Pradesh while touching the boundary between Uttar Pradesh and Bihar for a stretch of 110Km. It then flows through Bihar, more or less covering a distance of 405Km length of the River measured along the Bhagirathi and Hooghly Rivers during its course in West Bengal is about 520Km.

The Ganga has by far the largest river basin in India, 15^{th} in Asia and 29^{th} in the world, draining as much as 861404 Sq.Km within the country, covering more than a quarter (26.2%) of India's geographical area. The basin has large surface water and groundwater resources and receives rainfall from both the northeast and southwest monsoons and the wettest months are July, August, September and October in that order and the annual flow in the basin is 468.7 billion m^3, which accounts for 25.2% of India's total water resources (Dhirendra Mohan Joshi *et al.*, 2009). Geography, geomorphology, climate and quaternary stratigraphy of the study area have been detailed by Ahamed *et al.*, (2006) and Acharyya and Shah (2007).

2.2. Sampling

Forty-Six (46) drains were monitored in the various locations of Phase-I, Segment-B Ganga front towns from Haridwar downstream to Unnao(Figures 1 and 3). Samples were collected from the drains and followed the Standard Method (American Public Health Association and approved protocols under National Accreditation Board for Laboratories) to prevent any contamination during the Post-Monsoon, 2016. The samples were preserved for Heavy Metals and Pesticides prior to their instrumental analysis. For sample collection, polyethylene bottles of different size with inner cap were used. For each sample, details of location, pH, temperature, odour, colour and surrounding environmental conditions etc. were recorded and appropriately labelled, sealed and transported to the laboratory on the same day.

The sampling locations were selected in confluence of drain and River Ganga.The sample locations were chosen in such a way to represent the both quality and quantity of sewage discharged into main stem of River Ganga. Analysis of all parameters was done at laboratory of Central Pollution Control Board.

2.3. Method of Flow (Discharge) Calculation

The Ball float method (Area Velocity method) was adopted for instantaneous flow measurement and accordingly, the flow of drains has been expressed in Million Litre per Day (MLD) as well as using calculating formula as follows;

Discharge, Q **= A*V** (in appropriate units)

Where;

A = Average Flow area (in sq. m),

= Average Width multiplied by avg. Flow Depth (metres);

V = Average Velocity of flow (m/sec).

Flow depth (s), width (s) and surface velocity were measured at least 3 points and average values were considered for calculation.

2.4. Application of Suitable Factor for Flow Calculation

Factor of 0.65 was applied only to the drains / channels with natural boundaries having width more than 1.50 metres and flow depth more than 0.6 metres.

No factor was applied for well-defined shape (lined rectangular, trapezoidal) and flow depth less than 0.6 metre, because velocity variation in such cases are minimum.

Velocity profiles /distributions across common cross-sections are shown below. The numbers indicate the percentage of maximum velocity.

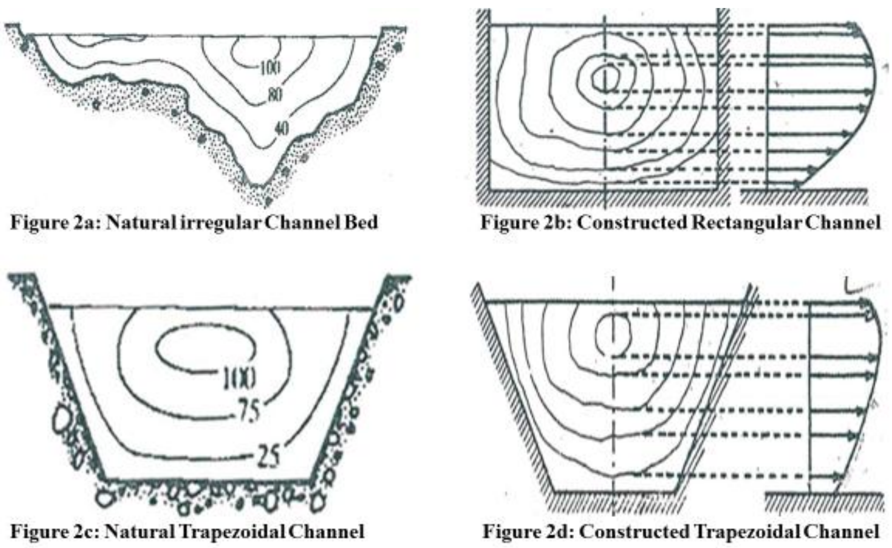


Figure2. *Velocity profile for various sections of open channels/rives.*

Since the flow velocity is not same in the entire cross-section of drain, it is reasonable to apply suitable factors so that flow is not exaggerated/ overestimated.

The average velocity is about 0.8 multiplied by the surface velocity as explained, the influence of the channel geometry is apparent (Subramanya, 1997 & 2005). The velocity 'v' is zero at the solid boundaries and gradually increases with distance from the boundary. The maximum velocity of the cross-section occurs at a certain distance below the free surface. This dip of the maximum-velocity point, giving surface velocities which are less than the maximum velocity, is due to secondary currents and is a function of the aspect ratio (ratio of depth to width) of the channel. Thus for a deep narrow channel, the location of the maximum velocity point will be much lower from the water surface than for a wider channel of the same depth. This characteristics location of the maximum velocity point below the surface has nothing to do with the wind shear on the free surface.

A typical velocity profile at a section in a plan normal to the direction of flow is presented (Figure 2). The profile can be roughly described by a logarithmic distribution or a power law distribution up to the maximum velocity point. Field observations in rivers and canals have shown that the average velocity at any section, 'v_{av}' occurs at a level of 0.6 'y_o' from the free surface, where 'y_o' = depth of flow. Further, it is found that;

$v_{av} = (v_{0.2}+v_{0.8})/2$

In which $v_{0.2}$ = velocity at a depth of 0.2 y_o from the free surface, and $v_{0.8}$ = velocity at a depth of 0.8 $y_o$from the free the surface. This property of the velocity distribution is commonly used in stream gauging practice to determine the discharge using the area velocity method. The surface velocity 'v_s' is related to the average velocity 'v_{av}' as

$v_{av} = k_{vs}$

Where, k = a coefficient with a value between 0.8 and 0.95. The proper value of 'k' depends on the channel section and has to be determined by field calibrations. Knowing 'k' one can estimate the average velocity in an open channel by using floats and other surface velocity measuring devices.

Factor of 0.80 was used for velocity and factor 0.80 for averaging the flow width. Therefore, resulting factor0.80*0.80 ~0.65 was considered for flow calculation for natural drains.

3. RESULT AND DISCUSSION

Central Pollution Control Board (CPCB)along with Uttar Pradesh Jal Nigam (UPJN), Uttar Pradesh Pollution Control Board (UPPCB) and National Mission for Clean Ganga (NMCG) identified/monitored 46 drains in various Ganaga front towns, like Sukratal, Bijnor, Gajrola, Garh, Anupshahar, Badaun, Farrukhabad, Bilhur, Bithoor, Kanpur and Unnaoof Phase-I, Segment-B. But, drains having negligible flow (< 1MLD)and not discharged into main stem of Ganga River and Rivers like Banganga, Malan, Sot and Ishan etc.are not to be considered as drains in the present study except 30 priority drains which are having flow equal to or more than 1MLD and directly discharged into main stem of Ganga River (Figure 4). Out of 30 priority drains, few drains were tapped (3), dry (1), standing (1), not monitored (2) and 23 were flowing meets river ganga (Figure3). Similarly, 16, 11 and 1 drains were found to be sources of pollutant of domestic, mixed and effluent respectively (Figure 5). Lentic Bagad drain of Gajrola is the only 1 drain which is recipient of effluent from the nearest various industries (Figure 4).

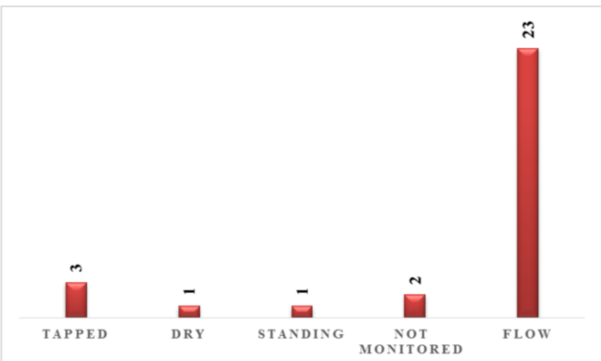


Figure3. *No. of tapped, dry, standing, not monitored and flow priority drains in Phase-I, Segment-B.*

Flow of 701 MLD with 70.19 TPD of organic load in terms of BOD from 30 priority drains in Phase-I, Segment-B is directly discharged into main stem of Ganga River during post monsoon, 2016, suggested drains also main point sources of pollution (Figures4 & 5). Wazidpur nala of Kanpur (870 mg/l), Chhoiya drain of Bijnor (137 MLD) and Loni drain of Unnao (16.19 TPD) are the highest Biological Oxygen Demand (BOD), Flow and Organic Load carrying drains in Phase-I, Segment-B respectively (Figure 4).

Dissolved Oxygen (DO) is the most important parameter to study the quality of water and is required for the metabolism of all aquatic organisms and if the concentration of DO in water

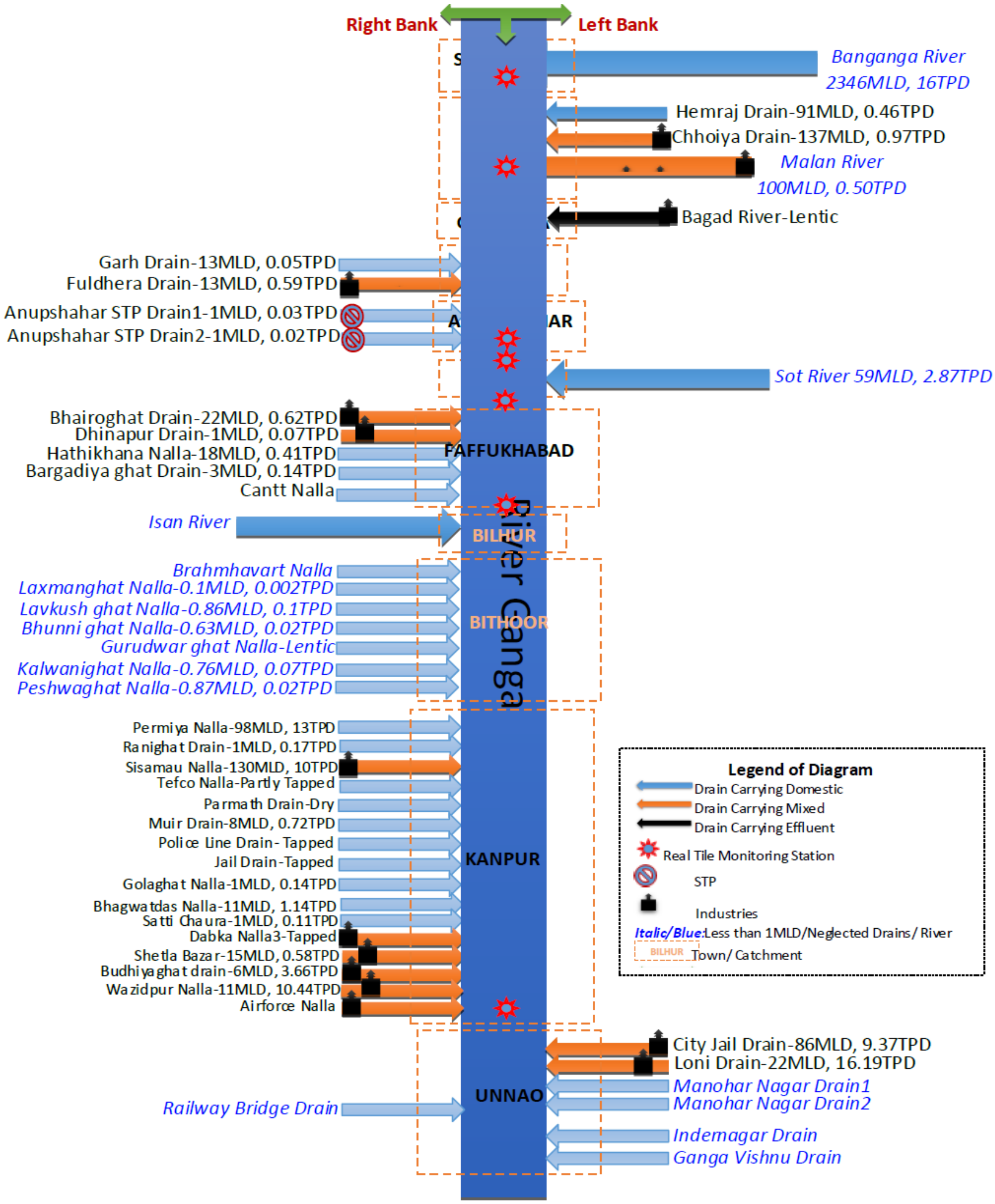


Figure5. *Line Diagram of drains discharged into main stem of Ganga River in Phase-I, Segment-B*

body is less than 2mg/l, indicate poor water quality and thus would have difficulty in sustaining many sensitive aquatic life(Tamot and Bhatnagar, 1988 and Seema Tiwari, 2015). Similarly, Colour and Acidity (as pH value) measurement is also very important in water sample, because it is an indicator of the existence of life (Seema Tiwari, 2015). In this study, all 30 priority drains have pH value within the standards (6.5 to 8.5pH, IS10500:2012) during the investigation. But, concentration of DO in all drains were not traceable and have distinct colours (dark black, brown, yellowish brown and milky), indicated poor water quality and conceived DO and colour in water body is inversely proportional (Photos 3 to 15).

Biological Oxygen Demand represents the quantity of Oxygen which is consumed in the course of aerobic processes of decomposition of organic materials, caused by microorganisms. The BOD therefore provides information on the biologically convertible proportion of the organic content in water. This leads to the consideration of these materials in terms of their susceptibility to oxidation by the use of Oxygen (Rahashyamani Mishra *et al.*, 2011). Similarly, the Chemical Oxygen Demand (COD) which is also commonly used to indirectly measure the amount of organic compounds in water. The value of COD in conjugation with BOD is helpful in knowing the toxic conditions and presence of biologically resistant organic substances (Rajkumar *et al.*, 2003, Gupta *et al.*, 2011 and Rahashyamani Mishra *et al.*, 2011). In this study, the range of BOD and COD values in drains are 4 to 870 mg/l and 24 to 2796 mg/l were obtained during post monsoon, 2016 respectively and it is observed that BOD in 16 priority drains and COD in 11 priority drains were beyond the standards (BOD 30 mg/l & COD 250 mg/l, IS10500:2012). The maximum value of both BOD and COD was observed in Wazidpur nala, Kanpur which is receiving sewage and effluent from tannery industries, clearly indicated sources of pollution is discharge anthropogenic activities (Rahashyamani Mishra *et al.*, 2011) (Photo 5).

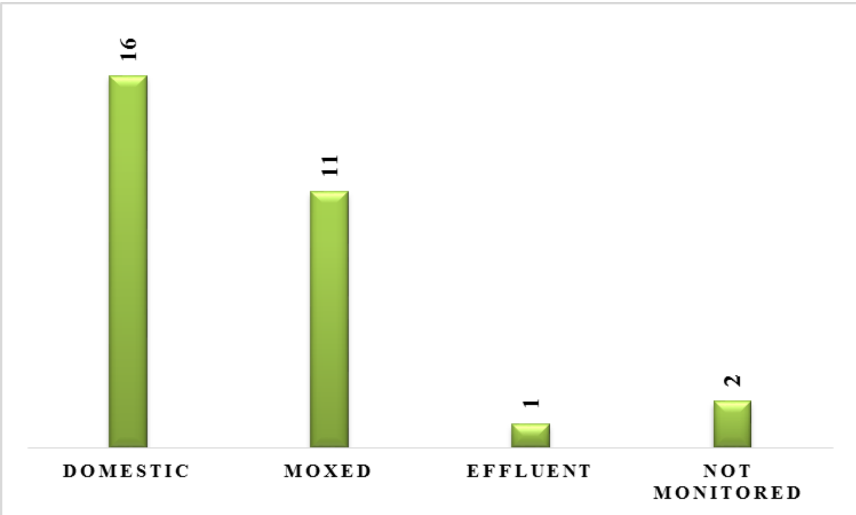


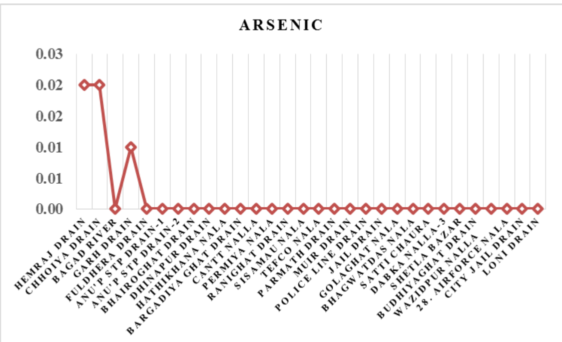
Figure5. *No. of priority drains as sources of pollution contribute into Ganga River in Phase-I, Segment-B*

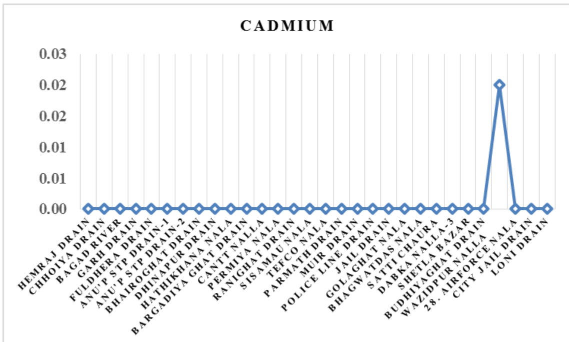
Total Suspended Solids (TSS) is an indication of the amount of erosion that took place nearby or upstream. Sediment deposition may also affect the physical characteristics of the drain bed. Sediment accumulation causes drain bed elevation and a decrease in channel capacity (Seema Tiwari, 2015). Similarly, The Total Dissolved Solids (TDS) in water consist of inorganic salts and dissolved materials. In natural waters, salts are chemical compounds comprised of anions such as Carbonates, Chlorides, Sulphates, and Nitrates and cations such as Potassium, Magnesium, Calcium, and Sodium. In ambient conditions, these compounds are present in proportions that create a balanced solution. If there are additional inputs of dissolved solids to the system, the balance is altered and detrimental effects may be seen (Davis and De Wiest, 1966 and SeemaTiwari, 2015). In this study, TSS values were found ranging from 2 to 5274 mg/l with an average value of 510 mg/l. It is observed that out of 30 priority drains,14 drains are beyond the desirable limit (100 mg/l, IS: 10500:2012),indicated intrusion from anthropogenic waste. Because, Loni drain which is having maximum concentration of TSS and Organic Load has been receiving sewage and effluent from industrial area site-1 and site-2 in Unnao City (Photo 4). Further, concentration of TDS values were found ranging from 204 to 29489 mg/l with an average value of 2439 mg/l. It is observed that out of 30 priority drains, 6 drains like Bagad River, Shetla Bazar, Wazidpur nala, City Jail drain and Loni drain which are sewage and effluent receiving from paper, distillery, rubber, chemical, drugs, tannery and fertilizer industries are beyond the desirable limit (2100 mg/l, IS: 10500:2012), indicated under brackish water categories. Similarly, a general increase in TDS and salinity in study area is accounted by the presence of HCO_3^-, SO_4^{2-}, Cl^-, CaH, MgH, $NaCl^-$and Na^{2+} and they elevate the density of water (Nawlakhe *et al.*, 1975 and Jiban *et al.*, 2017)and attributed to evaporation from water table, irrigation return flows, and anthropogenic activities such as effluents from fertilizers, sugar, paper, distillery, tannery slaughterhouse industries etc. (Rashid Umar *et al.*, 2009). The Cl^- concentration in this study ranged from 12 to 1906 mg/l and it is observed that only 1 location like City Jail drain catchment area ofindustrial area Akrampur-Magarwara, Leather Technology Park and Common Effluent Treatment Plant (CETP), Banther in Unnao is beyond the standard (1000 mg/l, IS: 10500:2012), suggested definitely attribution to the industrial activities in the vicinity.

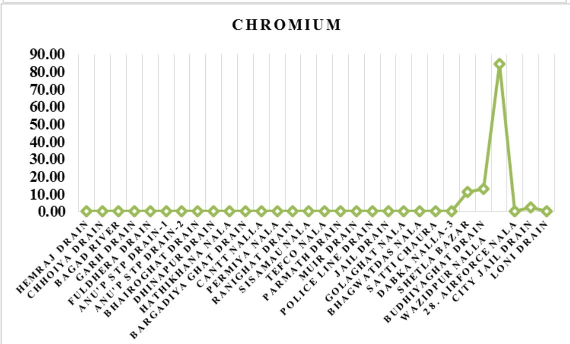
Ammonical Nitrogen (NH_3-N), Nitrate (NO_3)and Phosphate(PO_4) a levels in excess of the recommended limits may harm aquatic life and consumers. It is an indicator of pollution from the excessive usage of ammonia rich fertilizers. The concentration of NH_3-N, NO_3 and PO_4in this study ranged from 4 to 232 mg/l, 0.9 to 81 mg/l and 3.8 to 9 mg/l respectively. It is observed that out of 30 priority drains, NH_3-N in 5 priority drains like Permiya nala, Ranighat drain, Shetla Bazar, Budhiyagh at drain and Wazidpur nala are beyond the desirable limit (50 mg/l, IS: 10500:2012), indicated farmers using ammonia rich fertilizers in and around the Ganga basins.

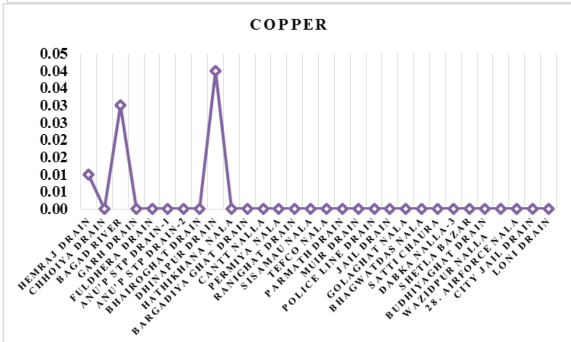
Bacteriological test is to detect the level of pollutions caused by living thing especially human who live or work in the are a especially upstream of the site. These tests are based on coliform bacteria as the indicator organism. The presence of these indicative organisms is evidence that the water has been polluted with faeces of humans or other warm-blooded animals. Total Coliform and Fecal Coliform were noticed in all the samples from 30 priority drains.

Analysis revealed that among Organo-Chlorine Pesticides (OCPs) like, α-Hexachlorocyclohexene (HCH), β-HCH, γ-HCH, Aldrin, Dieldrin, α-Endosulfan, β-Endosulfan, Dichlorodiphen-yltrichloroethane (OP'DDT, PP'DDT) and Dichlorodiphenyldichloroethane (PP'DDE) and Organo-Phosphorous Pesticides (OPPs) like, Monochrotophos, Dimethoate, Chloropyriphos, Malathion, Methyl Parathion and Ethion of drains. Except α-HCH, Aldrin, Dieldrin, α-Endosulfan, β-Endosulfan and OP'DDT, remaining β-HCH, γ-HCH, δ-HCH, PP'DDT and PP'DDE varied from BDL to 0.20, BDL to 7.00, BDL to 0.90, BDL to 0.14 and BDL to 0.22 ng/l respectively. Similarly, except Monochrotophos (BDL to 0.14 µg/l), remaining Dimethoate, Chloropyriphos, Malathion, Methyl Parathion and Ethion are lie Below Detectable Limit (BDL). In this studied can be said without doubt that, the Endosulfan is not used by the farmers for agricultural purpose in the catchment area of drains. But, among the DDT metabolites, DDE, in drains, was the most frequently detected metabolite of DDT in drains. The dominance of the parent compound over their degradation products (metabolites) in the sewage suggests the recent use of DDT. Although India banned DDT for agricultural use in1989, it is still used in the public health sectors for malaria control (Anonymous, 2003) besides agricultural usage. The signature of recently used DDT is evident in Ganga basin.









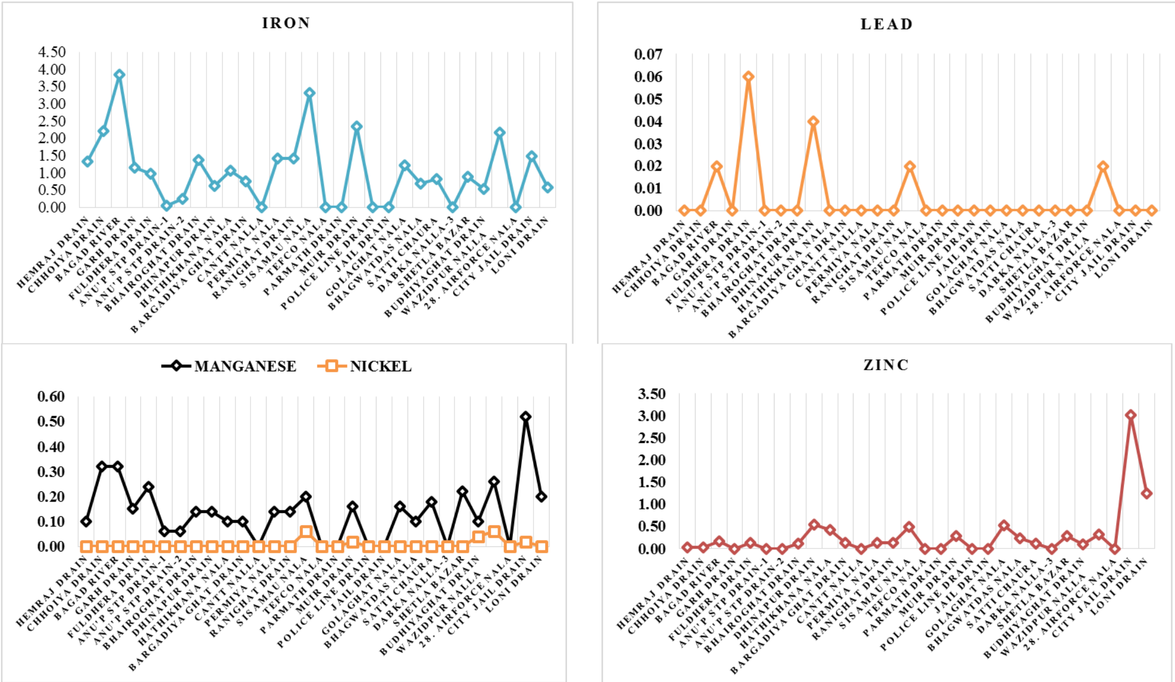


Figure6. *Variation of Heavy Metals in drains in Phase-I, Segment-B*

The aquatic environment is frequently the ultimate recipient of heavy metal pollution (Obasohan *et al.*, 2006).In the present investigation, except Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Nickel and Zinc, remaining Mercury, Antimony, Cobalt, Selenium and Vanadium are goes under BDL.

In this study, the concentration of both Arsenic and Cadmium are ranged from BDL to 0.02 mg/l. But, concentration of Cadmium is observed in Wazidpur nala only (Figure 6). Similarly, concentration of Arsenic also observed in Hemraj drain, Chhoiya drain and Garh drain only (Figure 6). The concentrations of heavy metals have changed with decrease in Cadmium and increase in Iron (BDL to 3.85 mg/l) and Lead (BDL to 0.06 mg/l), suggesting the contamination from an accidental release of industrial waste.

Further, higher levels of Chromium detected in drains like Shetla Bazar, Budhiyaghat drain, Wazidpur nala and City Jail drain(Figure 6). The concentration of Chromium ranged from BDL to 84.56 mg/l and beside the drain like Wazidpur nala was at levels 43 times higher than the general standard for discharge of environment pollutant in public sewers (2.0 mg/l).The reason forhigher values of Chromium may be ascribed to thedisposal of sewage wastes and wastes from householdactivities (Lokhande and Keikar, 1998).

During the investigation, the concentration of Zinc and Copper in drains of the Phase-I, Segment-B varied from BDL to 3.02 mg/land BDL to 0.03 mg/l respectively. Industries like metallurgic operations involving zinc and use of commercial products containing zinc and the use of commercial products such as fertilizers and wood preservatives that contain zinc as well as agricultural activity(fertilizers and micronutrient fertilizer) is major source for high concentration of Zinc in the sewage of the study area (Figure 6). Tolosana and Ehrlich (2000) found that the effluent from medical institutions in South Africa contained high levels of copper. The concentration of Copper is observed in Hemraj drain and Bagad river only, beside the Bagad river which is effluent receiving from paper, distillery, rubber, chemical, drugs, tannery and fertilizer industries, suggested the contaminate from effluent only.

Manganese is used in industrial processes and in various consumer products. The sources of Manganese in sewage are effluents from alloy, steel and iron production (Jaques, 1987 and Moore, 1991). The concentration of Manganese is observed in all drains of Phase-I, Segment-B except drains which are dry and tapped during investigation and raged from 0.10 to 0.52 mg/l, confirmed the higher concentration of Manganese in Chhoiya Drain, Bagad River, Fuldhera Drain, Bhairoghat Drain, Dhinapur Drain, Sisamau Nala, Dabka Nalla-3, Shetla Bazar, Budhiyaghat, Wazidpur Nalla, City Jail Drain and Loni Drain were carrying mixed pollution sources (Figure 6). But, concentration of Nickel ranged from BDL to 0.06 mg/l and observed in only 5 drains like Sisamau nala, Muir drain, Budhiyaghat drain, Wazidpur nala andCity Jail drain(Figure 6).

4. Conclusion

Out of 46 monitored drains in various locations of Phase-I, Segment-B, identified only 30 priority drains which are having flow equal to or more than 1MLD as well as directly discharged into main stem of Ganga River. Flow of 701 MLD with 70.19 TPD of organic load in terms of BOD from 30 priority drains during post monsoon, 2016 have pH value within the standards. But, concentration of DO in all drains were not traceable.

The range of BOD and COD values varies from 4 to 870 mg/l and 24 to 2796 mg/l respectively. It is observed that BOD in 16 priority drains and COD in 11 priority drains were beyond the standards, clearly indicated sources of pollution is discharge of sewage and other anthropogenic activities. Values of TSS were found ranging from 2 to 5274 mg/l with an average value of 510 mg/l and it is observed that, 14 drains are beyond the desirable limit, indicated intrusion from anthropogenic waste. Similarly, TDS values were found ranging from 204 to 29489 mg/l and it is observed that, 6 drains are beyond the desirable limit, indicated under brackish water categories. The Cl^- concentration in this study ranged from 12 to 1906 mg/l and it is observed that only 1 location like City Jail drain catchment area ofindustrial area Akrampur-Magarwara, Leather Technology Park and Common Effluent Treatment Plant (CETP), Banther in Unnao is beyond the standard, suggested definitely attribution to the industrial activities in the vicinity. The concentration of NH_3-N, ranged from 4 to 232 mg/lmg/l and it is observed that, NH3-N in 5 priority drains are beyond the desirable limit, indicated farmers using ammonia rich fertilizers in and around the Ganga basins.

Total Coliform and Fecal Coliform were noticed in all the samples from 30 priority drains during the investigation.

Except α-HCH, Aldrin, Dieldrin, α-Endosulfan, β-Endosulfan and OP'DDT, remaining β-HCH, γ-HCH, δ-HCH, PP'DDT and PP'DDE varied from BDL to 0.20, BDL to 7.00, BDL to 0.90, BDL to 0.14 and BDL to 0.22 ng/l respectively. Similarly, except Monochrotophos (BDL to 0.14 µg/l), remaining Dimethoate, Chloropyriphos, Malathion, Methyl Parathion and Ethion are lie Below Detectable Limit (BDL). In this studied can be said without doubt that, the Endosulfan is not used by the farmers for agricultural purpose in the catchment area of drains.

During the investigation, the concentration of both Arsenic and Cadmium are ranged from BDL to 0.02 mg/l. Higher levels of Chromium detected in drains like Shetla Bazar, Budhiyaghat drain, Wazidpur nala and City Jail drain. The concentration of Chromium ranged from BDL to 84.56 mg/l and beside the drain like Wazidpur nala was at levels 43 times higher than the general standard for discharge of environment pollutant in public sewers (2.0 mg/l). Further, the concentration of Zinc and Copper in drains varied from BDL to 3.02 mg/l and BDL to 0.03 mg/l respectively. Industries and agricultural activity (fertilizers and micronutrient fertilizer) is major source for high concentration of Zinc in the sewage of the study area. The higher concentration of Manganese is observed in Chhoiya Drain, Bagad Drain, Fuldhera Drain, Bhairoghat Drain, Dhinapur Drain, Sisamau Nala, Dabka Nalla-3, Shetla Bazar, Budhiyaghat, Wazidpur Nalla, City Jail Drain and Loni Drain of Phase-I, Segment-B and confirmed the discharge effluent from Industries.

Acknowledgment

The authors thank to Central Pollution Control Board providing facilities to undertake the work. The study were carried out by CPCB under the WQM-II.

Photos

Photo1. *Upstream of Gangotri Temple*

Photo2. *Devprayag, Sangam of Alaknanda and Bhagirathi*

Photo3. *Confluence of Chhoiya drain having maximum flow in Phase-I, Segment-B*

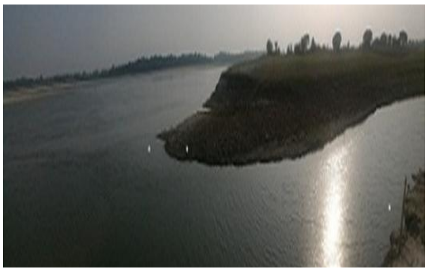


Photo4. *Confluence of Loni drain having maximum Organic Load and TSS*

Photo5. *Confluence of Wazidpur Nalla having maximum BOD, COD and TDS*

Photo6. *Bagad River having lentic*

Photo7. *Confluence of Parmath drain having dry*

Photo8. *Confluence point of Tefco Nalla having partly tapped*

Photo9. *Confluence point of City Jail drain having maximum Cl-*

Photo10. *Shetla Bazar Nalla having maximum NH3-N*

Photo11. *Confluence point of Budhiyaghat drain having maximum PO4*

Photo12. *Confluence point of Permiya nala*

Photo13. *River water backflow into Dabka Drain at Confluence point*

Photo14. *Confluence point of Dhinapur drain having milky color*

Photo15. *Confluence point of Muir drain*

REFERENCES

[1] Obasohan S, Oransaye, Obano EE (2006). Heavy metal concentration in Malapterurus electricus Chrysichthys nigrodigitatus from Ogba River in Benin City, Nigeria. Afr. J. Biol., **5(10):** 974-982.

[2] Moore, J. W., (1991). Inorganic contaminants of surface water: Research and monitoring priorities. Springer-Verlag, New York, USA.

[3] Jaques, A. P. (1987). National inventory of sources and emissions of manganese. Report EPS 5/MM/1. Ministry of Supply and Services, Canada.

[4] Tolosana, S and Erhlich, R (2000). Composition of liquid effluent discharged by medical institutions in Cape Town. S. Afr. J. Sci., 96 (8), 417-420 (4 pages).

[5] Lokhande, R. S and Keikar, N (1998). Studies on heavy metals in water of Vasai Creek, Maharashtra. IJEP. **19(9):** 664-668.

[6] Anonymous (2003). Global report on regionally based assessment of persistent toxic substances. Geneva, Switzerland: UNEP Report on Chemicals.

[7] Rashid Umar, Izrar Ahmed, Fakhre Alam and Mohammad Muqtada Khan (2009). Hydro-chemical characteristics and seasonal variations in groundwater quality of an alluvial aquifer in parts of Central Ganga Plain, Western Uttar Pradesh, India, Environ Geol, 58:1295-1300.

[8] Nawlakhe, W. G., Kulkarni, D. N., Pathak, B. N and Bulusu, K. R (1975). Defluoridation of Water by Nalgonda Technique Indian Journal of Environmental Health, 17(1): 26-65.

[9] Davis, S. N. and Dewiest, R. J. M (1966). Hydrogeology. Wiley, New York.

[10] Jiban Singh, M., Biswas, M. K., Suneel Dave and Akolkar, A. B. (2017). Study of Groundwater Salinity in Few Districts Adjoining River Ganga in

[11] Uttar Pradesh - A Case Study, Int. J. Curr. Res. Biosci. Plant Biol. 4(9): 29-41.

[12] Rahashyamani Mishra, Rajesh Kumar Prajapati, Virendra Kumar Dwivedi and Arpana Mishra (2011). Water Quality Assessment of Rani Lake of Rewa (M.P.), India., GERF Bulletin of Biosciences., 2(2): 11-17.

[13] Rajkumar, N. S., Nongbri B. and Patwardhan A. M., (2003), Physico-chemical and microbial analysis of Umiam (Barapani) lake water, Indian Journal of Environ. Prot., 23(6): 633-639.

[14] Gupta A., Mishra K.., Kumar P., Singh C., and Srivastava S., (2011), Impact of religious Activities on The Water Characteristics Of Prominent Ponds at Varanasi (U.P.), India, Plant archives, 11(1): 297-300.

[15] Seema Tiwari (2015), Water Quality Parameters –A Review, IJESIRD, I(9): 319-324.

[16] Tamot, P and Bhatnagar, G.P., (1988), Limnological studies of upper lake Bhopal', S.K. Kulshreshtha, (ED.) Proceedings of national symposium, Past present and future of Bhopal lakes, 37-40.

[17] Acharyya, S. K and Shah, B. A (2007). As-contaminated groundwater from parts of Damodar fan-delta and west of Bhagirathi River, West Bengal, India: influence of fluvial geomorphology and Quaternary morphostratigraphy. Environmental Geology, **52**:489- 501.

[18] Ahmed, S., Gilerson, A., Zhou, J., Chowdhary, J., Ioannou, I., Amin, R., Gross, B. and Moshary, F (2006). Evaluation of the impact of backscatter spectral characteristics on Chl retrievals in coastal waters. In Remote Sensing of the Marine Environment, *Goa*, **6406**:64060A, doi:10.1117/12.694177.

[19] Bhargava, D. S. (1982). Purification power of the Ganges unmatched., L.S.T. Bull., 34:52.

[20] D'Herelle, F (1930). The bacteriophage and its clinical applications. Springfield, Ill: Charles C Thomas.

[21] D'Herelle, F (1917). Sur un microbe invisible antagoniste des bacilles dysentériques. C R Acad Sci (Paris), **165**:373-375.

[22] Hankin, M. E (1896). L'action bactericide deseaux de la Jumna et du Gange sur le vibrion du choléra, Ann Inst Pasteur (Paris), **10**: 511-523.

[23] Hankin, M. E (1896). Les microbe's des rivers de l'Inde. Ann Inst Pasteur (Paris), **10**:175-176.

[24] Nelson, E. C. (http://www.hitxp.com/articles/science-technology/sacred-mystery-secrets-ganga-ganges/).

[25] Subramanya, K (1997). Flow in Open Channels, 2nd Edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi.

[26] Subramanya, K (2005). 1000 solved problems in fluid Mechanics, Tata McGraw- Hill Publishing Company Ltd., New Delhi.

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