Motherhood International Journal of Multidisciplinary Research & Development
A Peer Reviewed Refereed International Research Journal
Volume IV, Issue II, February 2020, pp. 21-31
ONLINE ISSN-2456-2831

IMPACT ASSESSMENT OF MUNICIPAL AND INDUSTRIAL WASTE DISCHARGES ON WATER QUALITY OF UPPER STRETCH OF RIVER GANGA FROM DEOPRAYAG TO HARIDWAR

[1]Dr. S.B Sharma & [2]Ravita
[1]Professor & Dean, [2] Research Scholar, Faculty of Science
Motherhood University, Roorkee, Uttarakhand

ABSTRACT

The River Ganga is one of the most important river systems of India. It originates from the Gangotri glacier at Gomukh in the Himalayan Mountains at an elevation of 7138m abovemean sea level in the Uttarkashi district in the state of Uttarakhand (India). At its source the river is called the Bhagirathi. It descends down to the valley to Deoprayag, where the Alaknanda, another hill stream rising from the Bhagirath Kharak and the Satopanth twin glaciers joins it. After the confluence with Alaknanda, the combined stream is called the Ganga. After covering a distance of about 220km in the Himalaya, it enters the plains at Hardwar and meanders over a distance of about 2290km across Uttar Pradesh, Bihar and West Bengal, before it joins the Bay of Bengal through a large number of deltaic branches flowing in India and Bangladesh

Keywords: River Ganga, heavy metals, Himalayan Mountains

Introduction

The River Ganga occupies a unique position in our country. It has served as the cradle of Indian civilization and is interwoven with India's history, culture, religion and philosophy. A large number of tributaries of varying dimensions merge their identity with this mighty river, which is respectfully worshipped by millions of Indians. Ganga and its tributaries constitute one of the largest river systems in the world. Besides being a source of supply of drinking water to the people inhabiting the cities, towns and villages situated on its banks, it is also being used for navigation, irrigation, bathing, washing, fishing and for industrial purposes.

The melt water of the glaciers in the upper Himalayas maintains a perennial supply of water in the River Ganga. The climate of the region is characterized by moderate type of subtropical monsoonal climate. It has a cool dry winter season from October to March, a hot dry summer season from April to June and a warm rainy season from July to September. The average annual rainfall over the Ganga basin varies from 780mm in the upper part,1040mm in the middle course and 1820mm in the lower delta of Bangladesh (Krishna Murti, 1991). Most of the rainfall occurs during the Southwest monsoon season.

The River Ganga is the life-line of India and provide food, water and shelter to millions of Indians. The water of the River Ganga has traditionally been regarded as an inexhaustible gift of nature. However, during last few decades, rapid development of agriculture and industry in the Indian sub-continent have, however, put severe strains on the river and, to an extent, have resulted in degradation of its quality. Despite the mineral ingredients and micro-flora and fauna present in it, the self-purification power of the Ganga is not limited. Depleted every day by our need for irrigation and drinking water, assailed constantly by the discharge of industrial effluents and municipal waste, the dumping of human and animal bodies and the residues of burning ghats, the river has developed dangerous levels of toxicity in certain stretches. At several places the river has been converted into a network of cesspools and drains by the industries and municipalities ..

The River Ganga holds deep religious significance in India with thousands thronging the Ganga's ghats (banks) every year to bathe and offer prayers. But the alarming levels of pollutants and sewage waste that are discharged into it every day by industrial units and several towns situated on its banks, have made it one of the most polluted rivers in the world. A recent report by the Central Pollution Control Board declared that the Ganga water is unfit for bathing, let alone drinking directly. Recently the National Green Tribunal, the apex environmental monitoring body, also directed Jharkhand, West Bengal and Bihar to deposit Rs. 25 lakhs each for not taking adequate steps to curb pollution in the Ganga. Despite launching several clean-up programmes like the Ganga Action Plan I and II and the present government's Namami Ganga project, little groundwork has been done to restore the river's lost glory (Rivers in India: A Reality Check, The Hindu, 5th June 2019). The quality of the river water is degrading day by day due to the discharge of partially treated or untreated municipal waste and industrial influents.

During festival seasons, people take a holy dip in the river water and also use it for drinking irrespective of its water quality.

It is paradox that a river which is a part of cultural heritage of India was put to abuse by discharging untreated effluents from tanneries, distilleries, sugar factories, paper mills and domestic sewage all along its course. Identifying the magnitude of pollution, the Central Pollution Control Board together with State Board and fourteen universities presented a unique report titled "Basin, sub-basin inventory of water pollution - Ganga basin" (CBPCWP, 1984). Based on this report, Ganga Action Plan was envisaged to mitigate pollution load of this river system. This mighty river flows through Uttar Pradesh, Bihar, and West Bengal, finally joining Bay of Bengal as Bhagirathi-Hooghly system near Ganga Sagar. Near Farakka the main river divides into two arms. The left arm knows as Padma, runs towards Bangladesh while the right arm Bhagirathi flows in southern direction. From Nabdweep onwards, it is known as Hooghly which, ultimately flows into Bay of Bengal about 145 km downstream of Calcutta.

The Bhagirathi Hooghly riverine system has been the lifeline of west Bangal which, helped urbanization and industrialization of the twin cities, Calcutta and Howrah on either side. There are hundreds of industries located along the banks of the Hooghly. Besides, a number of drains collecting sewage joins to this river. Near Calcutta and howrah, the rivers receives 346 outfalls which carry 120 million and 50 million gallons of domestic and industrial waste (Datta, 1984). The total pollution load by industrial waste indicates that 1.41 lakh kg per day BOD entered into the river Hooghly in 1970 as compared to the value of 1.18 lakh per day in the year 1969 (NEERI, 1970). Realising the magnitude of pollution load due to urbanization and industrial growth, Calcutta Metropolitan Development Authority has taken up studies in stretch between Kalyani and Birlapur regarding physico-chemical features and major groups of plankton (CMDA Reports 1978-82). Besides, there are some notable works carried out on this river by various investigators concerning physico-chemical features, plankton and heavy metal toxicity on fish populations (Ghosh et at., 1985; Dutta, 1984; Nandy et al., 1983). A perusal of the data reveal that no attempt has been made to interrelate various limnological features on the biological or functional aspects of the river system.

Studies on water quality of river Ganga in various stretches have been conducted by several workers. Out of the 2525 km length, ranging from the Gangotri in the Himalayas to the Ganga Sagar where the Ganga empties into the Bay of Bengal, the worst polluted stretch is

almost 600 km long. In the plains the main sources of pollution are urban liquid waste, large scale wallowing of cattle and throwing of dead bodies into the river. In addition the increasing surface run-off from cultivated land on which the cultivators use pesticides, insecticides, fertilizers and manure and a similar run-off from grounds where urban solid wastes and industrial wastes have been dumped, are responsible for the degradation of the river. The untreated city sewage remains the worst pollution. The cultural and religions factors in polluting Ganga and its main tributary Yamuna is also note worthy. This is increased especially during Kumbh and other auspicious occasions when millions of people believing in Ganga's perpetual sacredness bath in Ganga. The staggering increase in the coliform count during such mass bathing is to be seen to be believed. This phenomenon, defiling of the sacred river by the very people who worship her, is ironic.

It is recognized that the reach of the river Ganga from Kannauj to Buxar in the lean season is not even fit for bathing purposes at several places. From Haridwar to Kannauj and from Buxar to Farakka it is not fit for drinking water purposes in the lean season. This is due to various reasons including the fact that the cities located near the banks of the Ganga and its principal tributaries are not adhering to the sewage disposal regulations by effective treatment to render it harmless. Many industries located along the river are not treating the effluents before these are discharged into the river. There are some 100 cities located on the river Ganga, with over 30 having a population of more than one lakh. These contribute heavily to the pollution load. Ecology of river Ganga from Patna to Farakka was studied by Bilgrami and Dutta (1985).

Some pollution specific studies conducted on river Ganga include physico chemical characteristics of river Ganga in Kanpur region (Pande and Pande, 1980), effect of tannery waste disposal on the quality of river in the region (Chandra and Krishna, 1984), chemical quality of Ganga water and their effect on water use (Handa et al., 1993). A short term study on the pollution status of river Ganga in Kanpur has been conducted by Chattopadhya et al. (1984). A similar study was also conducted earlier by Saxena et al. (1966). Characterization of waste water of Kanpur city was carried out by Sehgal and Siddiqi (1969) to evaluate the design criteria for waste management programme. Ray and David (1966) made an attempt to see the effect of industrial wastes and sewage upon the chemical and biological composition of the river Ganga while David and Ray (1960) described the processes responsible for tannery and textile wastes and their effect on the quality of water of river Ganga.

In the city limit of Allahabad again degradation in water quality is observed due to the discharge of untreated waste. The quality of water is quite unsatisfactory and treatment is necessary before using for drinking and other domestic purposes. Pollution studies of river Ganga at Sangam during Ardha Kumbha has been reported by Upadhyay et al. (1982) and status of pollution at Sangam and its adjoining rivers at Allahabad by Singh et al. (1988, 1989). The effect of mass bathing on water quality of Sangam before, during and after Maha Kumbh mela at Allahabad have been studied by Singh et al. (1989). The studies on water quality of Ganga river from Kare-Manikpur to Phaphmau (Allahabad) have been reported by Sinha et al. (1989).

Agarwal et al. (1976) studied the physico-chemical and bacteriological characteristics of the river Ganga at Varanasi. Bacteriological studies conducted near the ghats of Varanasi indicated the BOD ranges between 2.1-7.8 mg/L and fecal coliform counts between 500-23000 per 100 mL. This state of affairs caused concern in the people who understood the risks of the rising level of river pollution. Mathur et al. (1987) conducted a study on river Ganga at Varanasi with special emphasis on heavy metal pollution. Recently Mishra et al (1992) have reported that about 85% of the total pollution of the river at Varanasi is due to the disposal of sewage into the river. The major amount of the wastewater flows through the main sewer outfall downstream of the city whereas most of the remaining flow enters through other major outlets. From the point of view of industrial pollution, the situation has not been very bad at Varanasi because toxic pollutants are stated to be either absent or present only in insignificant quantities in the water of the bathing areas (Mishra et al., 1992).

The quality of river Ganga at Patna, the most populated city of Bihar state, has been reported by Rao et al. (1990) with special reference to domestic waste and major industries of the area. The over all values of DO and BOD indicate that the river water in Bihar could be used as drinking water source without conventional treatment but with disinfection and also suitable for bathing, swimming and recreation. They further reported that the amount of dissolved oxygen throughout the river in Bihar was above 70% saturation and well within the requirements of propagation of fish. Further detailed studies on Physico-chemical characteristics of river Ganga from Mirzapur to Ballia have been studied by Shukla et al. (1989). Their study reveals that the Ganga water quality was quite good at the point where it enters the city and get highly polluted at midstream as a result of assimilation from a number of sewage and industrial drains. The downstream water at Varanasi was observed highly polluted in comparison to all other sites, this

is due to discharge of sewage mixed with industrial effluents through Rajghat nala, however the water quality at Ballia was recorded fairly clean. Ecology of river Ganges from Patna to Farakka was studied by Bilgrami and Datta (1985).

Sinha et al. (1993) conducted some studies in Rae-Bareli district and reported that deterioration in water quality of the river Ganga in Rae-Bareli district is due to ageold practice of mass bathing, washing of cloths, cremation and dumping of garbage into the river. Other studies on river Ganga include pollution status of the river water in West Bengal (Sengupta et al., 1988). A comprehensive survey of the Ganga basin conducted by Central Pollution Control Board, New Delhi revealed that the river, despite its extra ordinary resilience, is heavily polluted at several places. Such a situation calls for immediate action, specially, because of the fact that 80% of the diseases are water borne.

Problems of water pollutionhave not only surfaced but also begun to assume seriousdimensions in certain stretches of the long course of theRiver Ganga. In Himalayan stretch too its tributaries are adversely affected by various human activities. Several examples highlighting the pollutionstatus of the River Ganga have been reported (Jain, 1999, 2002).

More than 2,900 million liters of sewage and 700 million liters of industrial effluents join the river on daily basis. One hundred and ninety four major drains along the river stretch also discharge approximately 9,300 million liters of waste per day (CPCB, 2017*)*. In addition, there are thousands of villages along the 2,525 km of the river course, which are all characterized by lack of hygiene and sanitation facilities resulting in discharge of untreated waste. Solid waste, including plastics, also makes its way into the river *(*Lebreton et al., 2017*)*. Floating of dead bodies, animal carcasses, mass bathing, and other ritualistic practices also contribute their significant share. To assimilate such a huge amount of waste, river does not have sufficient ecological flow owing to various hydropower stations, irrigation canals, and water abstraction for drinking, industrial and commercial purposes. Reduction in southwest monsoonal rainfall over the Ganga basin is also a reality *(*Paul et al., 2016*)*. All this has led to the situation where Ganga can no longer be able to provide its ecosystem services to the full extent.

The concern over India are large and major problem on people's health is due to drinking of contaminated water due to disposal of untreated or partially treated municipal and industrial waste discharges into fresh water ecosystem. The municipal and industrial waste discharges contain high amount of organic pollution load and toxic metals and contaminate fresh water

bodies.The dissolved constituents and suspended particles of the municipal sewage and industrial effluents affect the quality of water in addition to reduced clarity.There is also a great danger to man and livestock particularly from the metal contents which are toxic to human beings.

According to a report of Water Resource Planning Commission, the GAP and NRCP has shown some positive results in the water quality over pre-GAP period. The report also suggested that the water which is being supplied for drinking purposes should be tested regularly to see its suitability for drinking purpose.

Water pollution of rivers in India has now been reaching to a point of predicament due to unplanned urbanization and rapid growth of industrialization and municipal sewage.Various fragmented studies concerning the water quality of River Ganga are available,but there is a need for a detailed study for identification and characterization of waste discharges directly discharged into River Ganga so that a proper management / action plan can be chalked out to maintain its quality. India's rivers are heavily polluted and cleaning them has been the subject of multiple regulatory and legislative initiatives.

Keeping in view the above points, the present study will be carried out on the upperstretch of River Ganga (hilly region) from Deoprayag to Haridwar. The watershed area lies entirely in themountainous zone. The area is typified by foldedstructures and varied lithology with older rocks occupyingthe upper structural levels. The major rock formationsin the watershed are phylites.

The study will involve identification and characterization of different municipal and industrial waste directly discharged into River Ganga from Deoprayag to Haridwar.Impact of these waste discharges on water quality of River Ganga will be studied through comprehensive field and laboratory investigations and a suitable management / action plan will be suggested to maintain the quality of water. This willprovide necessary information to guide current andfuture decision-making.

4. Experimental Methodology

i) Survey of the Study Areaand Identification of Municipal and Industrial Drains

Survey of the River Ganga will be carried out from Devprayag to Haridwar identify total 90 drain 65 are taped and 25 drain are not taped and directly discharge into River Ganga.

ii) Characterization of Waste Discharges

The physico-chemical parameters (Colour, Odour, Temperature, Turbidity, pH, Electrical Conductance, Total Dissolved Solids, Suspended Solids, Alkalinity, Hardness, Sodium,

Potassium, Calcium, Magnesium, Chloride, Sulphate, Nitrate, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, etc.) and heavy metals (Iron, Manganese, Copper, Nickel, Chromium, Lead, Cadmium, Zinc, etc.) will be analysed in all the municipal and industrial waste discharges using Standard Methods for the Examination of Water and Wastewater (APHA, 2005).

iii) Impact Assessment of Waste Discharges on Water Quality of River Ganga

In order to study impact of waste discharges on water quality of River Ganga, water samples will be collected from different location from Deoprayag to Haridwar on alternate month for a period of two years by dip or grabsampling method. All the samples will be collected from 15 cm depth using standard water sampler in clean narrow-mouth polyethylene bottles fitted with screw caps.

In the field, temperature, pH and conductance will be measured by means of portable meters. For other parameters, samples will be preserved by adding an appropriate reagent and water samples will be brought to the laboratory in sampling kits maintained at $4^{o}C$ for detailed analysis. Physico-chemical analysis will be conducted following Standard Methods for the Examination of Water and Waste Water (APHA, 2005). All chemicals and reagents to be used in the analysis will be of analytical grade. Double-distilled water will be used throughout the study. All glassware and other sample containers will be thoroughly cleaned and finally rinsed with double-distilled water several times prior to use.

iv) Management / Action Plan to Maintain the Water Quality of River Ganga

Management / Action Plan will be proposed covering the following components: i) Source control including municipal and industrial wastes, ii) River catchment / basin management, iii) Flood plain zoning and iv) Issues relating to environmental flow and irrigation practices.

5. Significance of Work

The present study will be carried out on the upperstretch of River Ganga (hilly region) from Deoprayag to Haridwar. The study will involve identification and characterization of different municipal and industrial wastes directly discharged into River Ganga from Deoprayag to Haridwar.Impact of these waste discharges on water quality of River Ganga will be studied through comprehensive field and laboratory investigations and a suitable management / action

plan will be suggested to maintain the quality of water. This willprovide necessary information to guide current andfuture decision-making.

References:

APHA (2005), Standard Methods for the Examination of Water and Waste Waters, American Public Health Association, Washington, DC.

Bilgrami, K. S. and Dutta, M. (1985), Ecology of River Ganges, Impact of Human Activities and Conservation of Aquatic Biota (Patna to Farakka), Allied Press, Bhagalpur, India.

CBPCWP (1984), CBPCWP (1984), Basin, Sub-Basin Inventory of Water Pollution. The Ganga Basin, Part I and II, CBPCWP, New Delhi.

Calcutta Metropolitan Development Authority (1978), Water Quality of the Hooghly Estuary, 1976-77, Calcutta.

Calcutta Metropolitan Development Authority (1979), Water Quality of the Hooghly Estuary, 1977-78, Calcutta.

Calcutta Metropolitan Development Authority (1981), Water Quality of the Hooghly Estuary, 1979-80, Calcutta.

Calcutta Metropolitan Development Authority (1982), Water Quality of the Hooghly Estuary, 1979-80, Calcutta.

Calcutta Metropolitan Development Authority (1982), Water Quality of the Hooghly Estuary, 1980-81, Calcutta.

Chandra, S. and Krishna, G. (1984), Effect of tannery waste disposal on the quality of the river Ganga at Kanpur, Poll. Res., 2, 63-64.

Chattopadhya, S. N., Routh, T., Sharma, V. P., Arora, H. C. and Gupta, R. K. (1984), A short term study on the pollutional status of river Ganga in Kanpur region, Indian J. Environ. Hlth., 26, 244-257.

CPCB (2017), Central Pollution Control Board Report, Identified and priority drains in phase / segment wise, Personal Communication (2017).

David, A. and Ray, P. (1960), Some measurements of toxicity of tannery and textile wastes and their components to fish bioassay, Ind. J. Fish., 7, 423-442.

Dutta, S. C. (1984), Perils of pollution in the metropolis, Sci. & Culture, 50(6), 178-181.

Ghosh, B. B., Mukhopadhyay, M. K. and Bagchi, M. M (1985), Status of zinc pollution in the Hooghly estuary and the related toxicities to fish and fish food organisms, Proc. National Seminar on Pollution Control and Management.

Handa, B. K. and Bhatia, S. S. (1993), Quality of Ganga river and its tributaries for irrigation use in U.P., Seminar on Ganga in the Service of Nation, Sep. 12-13, UOR, Roorkee.

Jain, C. K. (1999), Adsorption of zinc on bed sediments of river Ganga, Technical report, CS(AR)9, National Institute of Hydrology, Roorkee, India.

Jain, C. K. (2002), A hydro-chemical study of a mountainous watershed: the Ganga, India, Water Research, 36, 1262-1274.

Krishna Murti, C. R. (1991), Some physical features of the Ganga basin. In: Krishna Murti C. R., Bilgrami, K. S., Das, T. M. and Mathur, R. P. (editors), The Ganga - a scientific study, The Ganga Project Directorate, New Delhi, India.

Lebreton, L.C.M., Zwet, J.V., Damsteeg, J.W., Slat, B. and Andrady, A., (2017), J. Reisser, Nat. Commun., 8, 1-10.

Mathur, A., Sharma, Y. C., Rupainwar, D. C., Murthy, R. C. and Chandra, S. (1987), A study of river Ganga at Varanasi with special emphasis on heavy metal pollution, Poll. Res., 6, 37-44.

Mishra, V. B., Mishra, S. K. and Upadhyay, S. N. (1992), Theme Paper Presented at Seminar on Pollution Control in River Cities of India - A Case Study of Ganga at Varansi, Jan. 14-17, Sankat Mochan Foundation, Varanasi.

Nandy, A. C., Bagchi, M. M. and Majumdar, S. K. (1980), Ecological changes in the Hooghly estuary due to water release from Farakka barrage, Mahasagar, 16(2), 209-220.

NEERI (1970), National Environmental Engineering Research Institute, Annual Report, 1969-70.

Pande, P. K. and Pande, G. N. (1980), Physico-chemical characteristics of river Ganga at Kanpur, J. Inst. Engrs., 61, 28-30.

Paul, S., Ghosh, S., Oglesby, R., Pathak, A., Chandrasekharan, A. And Ramsankaran, R. (2016), Sci. Rep. 6, 1-10.

Rao, S. N., Chaubey, R. and Srinivasan, V. K. (1990), Ganga water quality in Bihar, Indian J. Environ. Hlth., 32, 393-400.

Ray, P. and David, A. (1966), Effects of industrial wastes and sewage upon the chemical and biological composition and fisheries of the river Ganga at Kanpur, Env. Health, 8, 307-339.

River in India: A Reality Check, The Hindu, 5th June 2019.

Saxena, K. L., Chakrabarty, R. N., Khan, A. Q., Chattopadhya, S. N. and Chandra, H. (1966), Pollution studies of the river Ganges near Kanpur, Env. Health, 8, 270-285.

Sehgal, J. R. and Siddiqi, R. H. (1969), Characterization of wastewater from Kanpur city, Env. Health, 11, 95-107.

Sengupta, B., Laskar, S., Das, A. K. and Das, J. (1988), Inorganic pollutants of Ganga water in the region of Berhampore to Katwa, West Bengal, Indian J. Environ. Hlth., 30, 202-208.

Shukla, S. C., Tripathi, B. D., Kant, R., Deepa Kumari V. and Panday, V. S. (1989), Physico-chemical and biological characteristics of river Ganga from Mirzapur to Ballia, Indian J. Environ. Hlth., 31, 218-227.

Singh Singh, J. P., Yadava, P. K. and Singh, L. (1988), Pollution status on Sangam and its adjoining rivers before Kumbh Mela at Allahabad, Indian J. Environ. Prot., 8 (11), 839-842.

Singh, J. P., Yadava, P. K. and Singh, L. (1989), The assessment of water quality of Sangam and its adjoining rivers Ganga and Yamuna after Mahakumbh Mela at Allahabad, Indian J. Environ. Prot., 9 (5), 372-375.

Sinha, A. K., Srivastava, R. K., Pande, D. P. and Modak, D. P. (1989), Water quality characteristics of Ganga river from Kare-Manikpur to Phaphamau - A case study, Indian J. Environ. Prot., 9 (11), 845-852.

Sinha, A. K., Srivastava, S. and Srivastava, K. N. (1993), Quality of river Ganga water in Rae-Bareli district, Proceedings of the Seminar on Ganga in the Service of Nation, Sep. 12-13, UOR, Roorkee.

Upadhyay Upadhyay, R., Dubey, A. P. and Pande, G. N. (1982), Monitoring of pollution at Sangam during Ardha Kumbha, Poll. Res., 1, 1-2.