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Physicochemical and Biological Analysis of Gandak River at Sonepur

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Abstract – With growing urbanization and emergence of urban areas as growth centers combined with improved living standards, piped water supply with improving service levels has become integral part of basic civic amenity. Safe disposal of human excreta & wastewater is also necessary for health reasons. The options available for disposal of excreta are either on-site or off-site sewerage system. On site sanitation system, prevailing till date, in most of the towns, are individualistic system with inherent problems for collection & disposal of sludge & risks of contamination of ground water. Water carriage sewerage system, more or less, has come to be universally adopted for disposal of excreta.

Keywords: River, Pollution, Water Quality

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1. INTRODUCTION

The History of Bihar as a region is very rich and eventful. This is due to the fact that Bihar was a center of power, learning and culture. It has been a cradle of Indian civilization and the birth place of two of the major religions that have emanated from India: Buddhism and Jainism. Festivals and cultural activities are being celebrated throughout the year in the state. There is one Hindu festival that is uniquely Bihari, and that is the festival of Chhath. Mostly the people of North Bihar observe this. It is devoted to the worship of the Sun God. Specific events are being organised by different communities in different places in Bihar throughout the year such as Madhushravani (Social festival giving a message how to weave together religion and tradition in day-to-day life) in Mithilanchal, Bihula festival (family welfare) in Bhagalpur district, Sama-Chakeva (brother-sister relationships) in Mithila, etc. A huge fair is held at Sonepur which is a confluence point of the River Ganga & river Gandak in Kartik Poornima which is the largest fair of its kind in the world, for it is a fair especially for the trade of animals. Cattle, horses, camels and elephants can be seen in large numbers. It attracts a huge number of people, not only from all over Bihar, but also from other parts of India and foreign countries.

Therefore, it is reasonable to take a cognizance of all the design discharge values selected for these Bridges and the maximum discharge values observed at the gauge discharge site. It is indicated that while deciding the design discharge of the proposed Bridge, statistical processes for extrapolation of maximum discharges were used and the discharges observed in rivers Ganga and Gandak were considered while arriving at the design discharge for the proposed Bridge.

The design discharge for the proposed Bridge is finalised as 106,839 cum/ s. When compared to the design discharge of Mahatma Gandhi Setu of 96,277 cum/s, and the design discharge of rail cum road bridge at Patna, of 97,000 cum/s. the proposed design discharge appears within reasonable limits. However, further analysis is made to look in to the dependency on the computed design discharge. The observed highest discharges of rivers Ganga and Gandak are added and the design discharge of (81,839+25,000=) 1,06,839 cum/s is arrived at. Using the peak flood data, RITES worked out the 100 year flood frequency for the two rivers. Addition of the estimated discharges of the two rivers works out to (96,919+20,620=) 1,17,539 cum/s. If the flood peaks would coincide, then the above two values may have to be chosen for deciding the design discharge. However, the floods of rivers Ganga and Gandak do not coincide. As the catchments of the two rivers are far apart, and the time of travel of floods would also be different, the coincidence of the floods at the Bridge is normally not possible. Mahatma Gandhi Setu was designed for a discharge of 96,277 cum/s. There is no major contribution of discharge from any river between Mahatma Gandhi Setu and the proposed bridge. The hydraulic performance of Mahatma Gandhi Setu is quite satisfactory. Therefore, the design discharge of the proposed bridge could also be the same. However, with the projected increase in flood flows due to climate

change, which was estimated at 94,127 m3/s, the 106,839 m3/s is acceptable.

The River Son in the flood season in the early 1990s, returning to the main stream of the Ganga after the floods abated in October. They may become isolated in pools and river branches during the dry season (Reeves and Brownell, 1989). The Ganges River dolphins even disperse in the main channel of the Ganga in search of prey. Observations in Nepal show that they move in and out of tributaries of the Gandak, Kosi, and Karnali systems during high water seasons, probably spending low water seasons in deep pools of the tributaries. In the main rivers, a decrease in abundance during the summer would confirm a seasonal pattern of migration (Shreshtha, 1989). Relatively high densities of dolphins are found at sites where rivers join or just downstream of shallow stretches, in areas where the current is relatively weak, off the mouths of irrigation canals, and near villages and ferry routes. In the Indus, about 40%- 45% of the dolphin population is found at junctions of tributaries with the main river stream, at least during the dry season, presumably being attracted to these areas by concentrations of prey (Reeves and Brownell, 1989).

2. REVIEW OF LITERATURE:

Perhaps the most common of all fossil turtles are the batagurida from the Plio- pleistocene of Siwaliks in North India and Pakistan. Many of the forms are morphologically similar with the recent fresh water turtles except the fossils are somewhat larger in size and synonymous with them (Smith, 1931). Species represented include *Malanochelys triguger, Hardella thwjii, Batagur cautleyi, Batagur watsonii, Kachuga tentoria* and *Geoclemys hamiltoni* (Lydekker, 1886) and *Geoclemys sivalemis* (Tiwari and Badam, 1969). Fossils of *Kachuga* have been obtained from the pleistocene deposit of Siwalik hill and Narmada valley of India. Deraniyagala (1953) described *Lassemys punctata sinhaleyas* from Ratnapura of Sri Lanka.

Study on the distributional population pattern of animal in an area can be used not only to formulate conservation strategies; but also through more light on the taxonomic relationship among the distribution of turtles and tortoises which has been described by various groups of authors in India.

Gee (1954) surveyed the then Assam, Bihar, Bengal, Manipur, Orissa and Tripura in Indian continent as well as Maldives and enlisted the various animals including turtles. The turtles were *Eretmocleys Imbricata, Chelone mydas* and *Nicoira trijuga thermals.*

Daniel (1983) reported the Indian black turtle *{Melanochely trijuga)* to be a peninsular species, below 20°N latitude. However, survey revealed that it is distributed as far as in Northwest Bihar (Valmiki Nagar), West Champaram, (Moll and Vijaya 1986), Royal Chitwan National park in Nepal (Dinerrstein *et ah,* 1987) and Assam and Meghalaya in Northeastern India (Das, 1990).

In an extensive survey of Indian rivers and markets, 14 major rivers including the Ganga and its tributaries in India, 7 species and 10 subspecies of the genus *Kachuga* were recorded and established a close relationship of*Kachuga* to *Bataguy, Callage, Hardella* and *Morenia* (Moll, 1986). Rao and Singh (1984) attempted to look the morphology and the reproduction of these three species *Kachuga tentoria circumdata; K dhongoka* and *K kachuga* collected from the river Chambal and river Pali of National Chambal Sanctuary. Earlier Anderson (1876) attempted to project the females of these species as herbivorous, while the males are omnivorous. Occurrence of *K kachuga* in Burma (Gunther 1864, Theobald 1868) Krishna river (Gray, 1862) and in Godavari river in India, (Anderson 1878-79) were suggested. Occurence o f *Ksmithi* in the Ganges and the Brahmaputra drainages of Nepal, India and Bangladesh was highlighted (Das, 1995). *Kachuga smithipallidipes* collected in the Gandak river, Bherihari wild life sanctuary of west Champaran district of Bihar and *Kachuga smithii smithii* from die Indus, Ganges and the Brahmaputra drainage of Pakistan, India and Bangladesh respectively were described (Das, 1995).

Kachuga sylhetensis (Jerdon, 1870) was reported from the Khasi, Garo hills areas of Assam, (India) and Bangladesh. Male are much smaller with long tail than the females. *Kachuga tecta* (Gray, 1831) collected from backwater of the Ganga river, a small pond near Lucknow, U.P. and considered to be the most common turtle in Bangladesh (Khan, 1982). *Kachuga tentoria* (Gray, 1834) is restricted to drainages of rivers flowing into the Bay of Bengal of India, Nepal and Bangladesh. This species was collected from Bihar, Utter Pradesh (U P) and Bangladesh (Khan, 1982). *Kachuga tentoria* was collected from Mahanadi river (Orissa) drainage as well as in Krishna drainage in Southward (Gray, 1834). Earlier records of *Kachuga tentoriaflaviventer* collected from Katamiaghat Gharial sanctuary, an impoundment of the Ganga River are available (Gunther, 1864). Vijaya (1982) found nests of this turtle on the soft, clayey riverbank soil along the Rapit River near Gorakhpur. This species inhabits in the northern tributaries of the Ganges and possibly the Ganges proper from Bihar eastward. Collections of *Kachuga tentoria circumdata* (13 females) from Chambal River in the Morena district of Madhya Pradesh (MP) and 11 males from the Yamuna River in the Etowah district of UP were reported (Mertens, 1969).

Ghosh and Mandal (1988) described the nesting and artificial hatching of the endangered river terrapin *Batagur baska* (IUCN Red Data Book) in the Simdarban tiger reserve, West Bangal. Its biology and exploitation has been reviewed (Moll, 1976; Tikadar & Sharma, 1985). This species is found in the Hooghly

River and was over exploited in Bengal in the mid-19th century. In the recent past *Kachuga tectum* and *K.t. circumdata* from the river Sabarmati, Mahi and Tapi of Gujrat was evaluated by Vyas and Patel (1989).

3. RIVERS BIOLOGICAL EXPRESSION

The Ganges is one of the major rivers of the Indian subcontinent, flowing east through the Gangetic Plain of northern India into Bangladesh. The 2,510 km river rises in the western Himalayas in the Uttarakhand state of India, and drains into the Sunderbans delta in the Bay of Bengal. The Ganges Basin drains 1,000,000-square-kilometre and supports one of the world's highest densities of humans. The river has been declared as India's National River.

After flowing 200 km through its narrow Himalayan valley, the Ganges debouches on the Gangetic Plain at the pilgrimage town of Haridwar. Further, the river follows an 800 km curving course passing through the city of Kanpur before being joined from the southwest by the Yamuna at Allahabad. Joined by numerous rivers such as the Kosi, Son, Gandaki and Ghaghra, the Ganges forms a formidable current in the stretch between Allahabad and Malda in West Bengal. On its way it passes the towns of Kanpur, Soron, Kannauj, Allahabad, Varanasi, Patna, Ghazipur, Bhagalpur, Mirzapur, Ballia, Buxar, Saidpur, and Chunar.

The Ganges Basin with its fertile soil is instrumental to the agricultural economies of India and Bangladesh. The Ganges and its tributaries provide a perennial source of irrigation to a large area. Chief crops cultivated in the area include rice, sugarcane, lentils, oil seeds, potatoes, and wheat. Along the banks of the river, the presence of swamps and lakes provide a rich growing area for crops such as legumes, chillies, mustard, sesame, sugarcane, and jute. There are also many fishing opportunities to many along the river, though it remains highly polluted.

Tourism is another related activity. Three towns holy to Hinduism – Haridwar, Allahabad, and Varanasi – attract thousands of pilgrims to its waters. Thousands of Hindu pilgrims arrive at these three towns to take a dip in the Ganges, which is believed to cleanse oneself of sins and help attain salvation. The rapids of the Ganges also are popular for river rafting, attracting hundreds of adventure seekers in the summer months.

4. POLLUTIONS

The major polluting industries on the Ganga are the leather industries, especially near Kanpur, which use large amounts of Chromium and other chemicals, and much of it finds its way into the meager flow of the Ganga.

Also, inadequate cremation procedures contributes to a large number of partially burnt or unburnt corpses floating down the Ganga, not to mention livestock corpses.

The Ganga Basin, the largest river basin of the country, houses about 40 percent of population of India. During the course of its journey, municipal sewages from 29 Class-I cities (cities with population over 1,00,000), 23 Class II cities (cities with population between 50,000 and 1,00,000) and about 48 towns, effluents from industries and polluting wastes from several other non-point sources are discharged into the river Ganga resulting in its pollution. The NRCD records put the estimates of total sewage generation in towns along river Ganga and its tributaries as 5044 MLD (Million Litres per Day). According to the Central Pollution Control Board Report of 2001, the total wastewater generation on the Ganga basin is about 6440 MLD.

Urban filth and industrial pollution are scientific causes, but environmentalists believe that apart from industrial pollution and sewage, the increase in number of slaughterhouse, dhobi ghats, crematoria and slums are the major sources of pollution in these rivers. Every year, religious idols are immersed in rivers which lose a little more of their life as they are choked yet again.

The Central Government, by a notification dated 20.2.2009, as set up 'National Ganga River Basin Authority' (NGRBA)as an empowered planning, financing, monitoring and coordinating authority for the Ganga river, in exercise of the powers conferred under the Environment (Protection) Act,1986. The Prime Minister is ex-officio Chairperson of the Authority, and it has as its members, the Union Ministers Concerned and the Chief Ministers of states through which Ganga flows, viz., Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal, among others. The objective of the Authority is to ensure effective abatement of pollution and conservation of the river Ganga by adopting a holistic approach with the river basin as the unit of planning. The functions of the Authority include all measures necessary for planning and execution of programmes for abatement of pollution in the Ganga in keeping with sustainable development needs.

River Basin will be the unit of planning and management. This is an internationally accepted strategy for integrated management of rivers. Accordingly, a new institutional mechanism in the form of National Ganga River Basin Authority (NGRBA) will spearhead river conservation efforts at the national level. Implementation will be by the State Agencies and Urban Local Bodies.

North Bihar, a rich agricultural area, has many industries associated with agricultural products. There are numerous sugar factories scattered throughout the area. Many rice and edible oilmills also dot the landscape. It also has some sundry, but important, manufacturing plants, for example the Button Factory at Mehsi (East Champaran), and the old and renowned rail wagon manufacturing plant, the Arthur Butler & Co, at Muzaffarpur. Immediately after independence however, a major industrial complex grew around Barauni. The industrial plants located there are: the Fertilizer Factory, the Oil (petroleum) Refinery Plant, and the Thermal Power Station. Recently, a Thermal Power Plant has also begun operation at Kanti, in the Muzaffarpur district along its border with East Champaran.

Regarding commerce and North Bihar, mention must be made of the gigantic annual cattle fair at Sonpur in the Saran district, close to the confluence of the Gandak and Ganges rivers. The fair is held around the religious festival of Kartik Purnima - full moon in the month of Kartik in the Hindu lunar calendar (corresponding to some time in Oct-Dec in the Gregorian calendar), which marks the end of the holy month of Kartik. Kartik Purnima in 1998 falls on Nov 4. This fair is reputed to be one of the world's largest such fair, where not just cattle but also exotic animals and horses and elephants are traded in large number. It attracts a large number of tourists from many countries. The Government of Bihar, through their Department of Tourism, provides many amenities for their boarding and lodging.

River Water Quality

The ambient and water temperature showed a close proximity relation. Maximum ambient temperature (18°C) was recorded at Sohgi-Barwa Ghat while the minimum (9°C) was recorded at Rewa Ghat. The water temperature fluctuated between 13.2°C – 17.2°C. The turbidity was measured in NTU (Nepheloturbidity unit). Minimum turbidity (6 NTU) was recorded at Bagha- I while the maximum (43.5 NTU) at Konhara Ghat, Hazipur. The turbidity value was 35.5 NTU at the Confluence point. Gandak River carry high amount of silt and this apparently accounts for the higher turbidity value of the river. Total dissolved solids ranged from 152.4 – 356 mg/l or ppm. Lower values were recorded at Bagha- I while the higher value was recorded at Susta Ghat. TDS value at the Confluence point was 169 ppm. Conductivity of water depends upon the concentration of ion and nutritional status of the water body. It ranged from 246.3 – 578.9 ppm. Maximum value was recorded at Susta Ghat and the minimum at Chhitauni Bridge. At the Confluence point, the value was 273.9 ppm. PH of River water ranged from 7 – 8 i.e. from neutral to slightly alkaline. Dissolved oxygen content is an indicator of healthy aquatic systems. DO level was minimum at Valmikinagar Ghat (6.5 ppm) and the maximum was recorded at Raj bariya Ghat (10.8 ppm), while at the Confluence point, it was 10.6 ppm. Free-carbon dioxide concentration was minimum (42 ppm) at Triveni Ghat and maximum (112 ppm) at Valmikinagar Ghat. At the Confluence point, the F-CO2 value was 50 ppm. Carbonate alkalinity was found absent at all the investigated sites. Bicarbonate alkalinity was recorded at all the sites. It ranged from 34 – 106 ppm. All the sites, more or less, showed the same range of bicarbonate alkalinity. Total hardness values ranged from 134 – 180 ppm. The minimum value was recorded at Valmikinagar and maximum at Kalyanpur Ghat. At the Confluence point, the value was 150 ppm. Its range of variation was not significant from the chemical pollution point of view. Chloride is one of the important indicators of water pollution. The chloride values were lower ranging from 3.99 – 10.99 ppm. Phosphate-phosphorus and Nitrate-nitrogen values were very low in concentration. Phosphate-phosphorus values ranged from 0.033 – 0.05 ppm and nitrate-nitrogen values from 0.027 – 0.031 ppm. Chemical Oxygen Demand (COD) was higher at Rewa Ghat (25 ppm) and at Konhara Ghat (34 ppm) i.e. Towards lower reaches of the river (downstream) and close to the confluence point. A higher value of COD indicated the presence of higher amount of algal biomass and organic.

5. GANDAK RIVER WATER QUALITY:

The ambient and water temperature showed a close proximity relation. Maximum ambient temperature (18°C) was recorded at Sohgi-Barwa Ghat while the minimum (9°C) was recorded at Rewa Ghat. The water temperature fluctuated between 13.2°C – 17.2°C. The turbidity was measured in NTU (Nepheloturbidity unit). Minimum turbidity (6 NTU) was recorded at Bagha- I while the maximum (43.5 NTU) at Konhara Ghat, Hazipur. The turbidity value was 35.5 NTU at the Confluence point. Gandak River carry high amount of silt and this apparently accounts for the higher turbidity value of the river. Total dissolved solids ranged from 152.4 – 356 mg/l or ppm. Lower values were recorded at Bagha- I while the higher value was recorded at Susta Ghat. TDS value at the Confluence point was 169 ppm. Conductivity of water depends upon the concentration of ion and nutritional status of the water body. It ranged from 246.3 – 578.9 ppm. Maximum value was recorded at Susta Ghat and the minimum at Chhitauni Bridge. At the Confluence point, the value was 273.9 ppm. pH of River water ranged from 7 – 8 i.e. from neutral to slightly alkaline. Dissolved oxygen content is an indicator of healthy aquatic systems. DO level was minimum at Valmikinagar Ghat (6.5 ppm) and the maximum was recorded at Raj bariya Ghat (10.8 ppm), while at the Confluence point, it was 10.6 ppm. Free- carbon dioxide concentration was minimum (42 ppm) at Triveni Ghat and maximum (112 ppm) at Valmikinagar Ghat. At the Confluence point, the F-CO2 value was 50 ppm. Carbonate alkalinity was found absent at all the investigated sites. Bicarbonate alkalinity was recorded at all the sites. It ranged from 34 – 106 ppm. All the sites, more or less, showed the same range of bicarbonate alkalinity. Total hardness

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CONCLUSION:

Activated Sludge Process (AEROBIC PROCESS) is the most used biological waste water treatment process in the developed and developing countries. Due to aerobic process in Activated Sludge Process, plant has less odor/vector nuisance in compare to anaerobic type process as mentioned above.

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