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Bio Assessment of Sone River in Bhojpur Area and SomeOthers Rivers and Their Curative Measures

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ABSTRACT
In India Rivers are divided into two parts like, north Indian River and south Indian River. Some north Indian rivers are Indus, Ganga, Gomati, Damodar, Rihand, etc. Some south Indian rivers are Mahanadi, Godavari, Krishna, Cauvery, etc. In India, river plays an important role. Many people directly or indirectly dependent on rivers. Rivers not only important to human it is also important to animals and plants. Because river act as most biodiversity rich area. But nowadays Rivers become polluted by various ways. Mostly occurred by industrial effluents and heavy metals contamination. Metal directly or through drain enter into rivers. Metals like, Fe,Hg,Cd, Pb, Zn cause most pollution in rivers. Beside sewage water directly fall into rivers and ultimately pollutes river. This paper contains cause of river pollution, effects of river pollution and remedial measure of riverpollution.

Key words:*Heavy metals, Pollutants, Pesticides, Runoff, Anaemia, Food chain.*

INTRODUCTION
Water is essential for all aquatic and terrestrial animals and plants. Organic pollutants and heavy metals are the major source of pollutants in river (Goldar and Banerjee 2004). Chemical aspects and their interactions in polluted water had been discussed in the work of Dugan (1972). In river sources of Zn are painted idols immersion and electroplating industries (Boxallet al., 2000; Dean et al., 1972).There is a close relationship between Chemical oxygen demand (COD) and water and dissolved Oxygen act as an indicator of water pollution by Sharma (2018). Gandak river pollution at Samastipur was studied by Hakim (1984).Main source of river water pollution are organic pollutants and runoff from agricultural waste (Malik et al., 2014).Main cause of Gomti river pollution are domestic waste by Srivastava (2009).Singh and others (1997) report that due to heavy metals river Gomati sediments around the Lucknowurban centre are polluted. Most polluted river in India is Yamuna River and many industries are located on the bank of rivers (Malik et al., 2014). Son River water pollution mainly occurred by Paper Mill effluents and thermal power plant effluents (Ahirwar et al., 2015). Mula river pollution was reported by Sahu and others (2015).Fly ash-derived from river sediments was studied by Chander and others (1994).Due to municipal effluents, industrial effluents, agricultural runoff water quality is deteriorating in river (Akbal et al. 2011). Poor water quality reduces biodiversity (Cao et al., 1996).To

maintain quality of the river water Sewage treatment plants have been constructed (CSE India, 2007). From these Sewage treatment plants untreated sewage is discharged directly into the river (CSE India, 2007). Due to many problems like, maintenance issues, these Sewage treatment plants are unable to operate properly and it is the major threat to river water quality (Malik et al., 2014). River pollution affects food web and hamper public health (Ahirwar etal.,2015).

SOURCE OF POLLUTANTS IN RIVER: Generally pollutants comes from,

1) Agricultural wastes: Pesticides &fertilizerrunoff
2) Wastes from rituals: Organic wastes & chemicals
3) Domestic waste: Swashing of fertilizer bags & pesticide, soap, detergent, washing cattle, cow dung,container
4) Pharmaceuticals & other industries: Chemicals

WATER QUALITY PARAMETERS:

The aquatic ecosystems depend on the natural calamity of the water bodies. So, the each and every parameters of the water gives a sustainable life of aquatic organisms. The pH of the water indicates the acidic or basic, the dissolved oxygen and free carbon dioxide are correlate to the pH of the water. Here given table shows that the condition of some river of Indiancontinent.

Table -1: Survey result of Sabarmati river shows highly polluted

Sl no	Parameter	Results (Sample taken from Sabarmati river)	Standard (Inland surface water)
1	pH	6.75	5.5 - 9
2	Total suspended solids	530.00 mg/l	100 mg/l
3	Total dissolved solids	367.00 mg/l	NA
4	C.O.D	720 mg/l	250 mg/l
5	B.O.D	288 mg/l	30 mg/l
6	Oil& Grease	8 mg/l	10 mg/l

Source: CPCB2014,Survey of Sabarmati River carried out by Paryavaran Mitra

Table -2: Sewage Waste management in the river Ganga

	2009	2012
Sewage generation (MLD)	2638	2732
Treatment Capacity (MLD)	1174	1208
Gap (MLD)	1464	1514
% Gap :Treated VS Untreated	55	55

Source: CPCB 2009 and 2013

Table -3: River Ganga Sewage treatment plants

State	No of Sewage treatment plants inspected	Installed capacity	Actual utilized capacity	Total no of Sewage treatment plants notin operation	Sewage treatment plants exceeding BOD/CODlimits
Uttarakhand	4	54	-	0	2
Uttar Pradesh	8	358	287	1	4
Bihar	5	140	100	1	1
West Bengal	34	457	214	13	3
Total	51	1009	602	15	10

Source: CPCB, Pollution Assessment: River Ganga, Central Pollution Control Board MoEF July 2013.

SOME MAJOR RIVERS IN INDIA:

Yamuna river: From Yamnotri glacier, Yamuna river originates and this river covers Rajasthan, Uttar Pradesh, Himachal Pradesh , Delhi , Haryana , Madhya Pradesh (Ravindra et.al,2003) .On the banks of Yamuna river electroplating industries are situated and high amount of Cr directly fall into this river (Malik et.al, 2014) . Metals enter the environment through aquatic life systems surrounding the river and makea big threat to human health. (Malik et.al, 2014).Jain (2004), in a metal fractionation study of bed sediments of the riverYamuna,

Brahmaputra river: By discharge, Brahmaputra river is the largest river in world and in Tibet this river is known as Tsangpo (Borthakur et al.,2016). Guwahati city is situated on the bank of river Brahmaputra (Borthakur et al.,2016) .In Brahmaputra river, mean PH is 9.37 ,mean

DO is 10.76 mg/l, (Kotoky and Sarma, 2017). The main cause of this river pollution are discharging of sewage, washing of clothes, agricultural runoff and specially municipal runoff that pollutes the river daily (Kotoky and Sarma, 2017). Crude oil also pollutes river Brahmaputra (Kotoky and Sarma, 2017).

Son river: Son river originates from Amarkantak Plateau and this river is tributary of river Ganga(Sinha andSharma,2003) .Main cause of Son river pollution are metal pollution (Ahirwar et al., 2015).In Son river TDS, hardness are found more than permissible limit (Ahirwar et al., 2015).In river Son, mean PH is 7.194, mean TDS is 898.5mg/l, mean Fe is 0.2484 mg/l, mean Cr is 0.0026, mean Mg is 14.5 mg/l, meanNa is 76.24 mg/l (Ahirwar et al.,2015)

Brahmani river: In Brahmani river, mean pH is 7.6, mean fluorine is 0.49 mg/l , mean alkalinity 48.48 mg/l, mean nitrate is 4.18 mg/l (Nath et.al, 2018) .This river is polluted day by day. Main cause of Brahmani river pollution are anthropogenic activities and agricultural

runoff, industrial discharge and turbidity, Nitrate are found more than permissible limit and it affects fish diversity (Das et al.,2016)

Mahanadi River: This river rises in Chhattisgarh basin. Cuttack city is located on the bank of Mahanadi delta (Unni and Pawar 2000).Main cause of Mahanadi river pollution are domestic waste discharge, Rourkela steel plant effluents, biomedical waste(Panigrahi and Patra2013).Water of Mahanadi River turning towards eutrophication (Das and Panda2010) .Low diversity of plankton is observed in Mahanadi River (Panigrahi and Patra 2013). In the polluted area of Mahanadi, Cyanophyceae are found in large number while Chlorophyceae are found very less number (Panigrahi and Patra2013).

Ganga River: Levels of coliform bacteria in River Ganga are in excess of 2 lakh (Mallikarjun Y (2003). 260 mld of industrial wastewater, 9000 tonnes of pesticides used within the Ganga basin for agriculture purpose, solid waste, directly enter into the river every day (Srivastava et al., 2016). In River Ganga, season wise COD value varies from 12.5 mg/l to 65 mg/l (Srivastava et al., 2016). High amount of COD in River Ganga indicates contamination of water though domestic sewage and other effluent (Srivastava et al., 2016). In River Ganga season wise variation of chloride from 14 mg/l to 25 mg/l. (Srivastava et al., 2016). In protein metabolism sulphate is essential components (Srivastava et al., 2016). Concentration of sulphate varies season wise are 25 mg/l to 38 mg/l (Srivastava et al., 2016). Total hardness in river Ganga varies from 114 mg/l to 184 mg/l. (Srivastava et al.,2016). In Kanpur River Ganga is highly polluted due to discharge of sewage and industrial discharge plating industries. (Srivastava et al.,2016). A study reveals that in 2006 river Ganga had demonstrated coliform counts up to 100,000,000MPNper100mlandBOD levels averaging over 40 mg/l in Varanasi (Agarwal, 2015) . High levels of mercury present in some fish muscles in Ganga river (Agarwal, 2015)

Cauvery river: Cauvery river rises from Brahmagiri hill (Mathivananet .al, 2005). PH value in Cauvery river varies from 6.5 to 9.4(Begum et al., 2008). In Salem district due to highly discharge of industrial effluents the planktonic population is highly influenced (Mathivanan et .al, 2005). Various types of heavy metals have been identified in Cauvery river, like Cr, Co, Cu, Mn, Ni, Zn, Pb(Begum et al.,2008). In river water high amount of Pb has been identified and high amount of Co has been identified in plankton which is presence in Cauvery river (Begum etal.,2008).

Gomti river: Gomti river, carries pollution load from industrial wastes and agricultural areas of eastern Uttar Pradesh (Gupta and Subramanian, 1994). Riverine suspended load have important role of buffering heavy metal concentrations by adsorption or precipitation (Fo¨restner, U., Mu¨ller, 1973). In river Gomti, bacterial contamination were observed with over 83 coliform/100 ml (Singh et al., 2005) . In Gomti river water samples, concentrations of Cadmium and copper were found negligible while other metals, like Cr,Fe,Mn, Ni, Pb, Zn were found in the range of Cr 0.0013–0.0057 mg/l, Fe 0.034–0.117 mg/l (Singh et al., 2005) . Average total Concentrations found for trace metals in the sediments are Cd 0.34–8.38 mg/g, Cr 2.22-19.13 mg/g, Cu 0–35.03 mg/g, Fe 1606–3142 mg/g, Mn82.6–263.1 mg/g, Ni 6.5–29.8 mg/g, Pb6.3–75.3mg/g and Zn 3.1–101.7 mg/g (Singh et al., 2005) . Heavy metals concentrations in sediments were found higher than those obtained in river water (Singh et al., 2005).

Chambal River: Metal effluents discharges into rivers cause dangerous effects to the health (Tavares and Carvalho, 1992). In environment metals are released by natural processes and anthropogenic sources, (Reddy and Baghel, 2010). Magnesium, calcium, manganese and iron contribute hardness of water (Shrivastava and Patil, 2002). Barrett (1953) has reported that soft waters are less productive than hard waters from fisheries point of view .In Chambal river BOD value from 0.60 mgl-1 - 5.67 mgl-1, dissolved oxygen (mgl-1) 4.86- 14.59, free carbon dioxide (mgl-1)0.00- 16.50, total alkalinity (mgl-1) 70.00-290.00, total hardness (mgl-1) 42.00-140.00, chlorides (mgl-1) 15.62-80.94, Turbidity (NTU) 1.00-178.00), electrical conductivity (µS cm-1) 100.00-884.00, Total dissolved solids (mgl-1) 260.00-500.00, pH7.6-9.33, ammonia (mgl-1) 0.00-0.56 1, sodium(mgl- 1) 14.30-54.40 (Saksena and Rao, 2008)

Bandi River: The textile dyeing situated at Pali has been discharging wastes effluents in the Bandiriver (Rathore 2011). Bandi river Water quality is severely polluted (Rathore 2011). Water quality deterioration has adverse effect on human beings and also aquatic ecosystem (Chinda et al.2004; Ugochukwo 2004; Emongor et al. 2005). Textile dyeing industries depend on groundwater and chemical analysis results of sample waters reveal that industries uses alkaline groundwater of electrical conductivity varies from moderately to fresh saline (Rathore, 2012) . Textile industries have production capacities ranging between 725 (10,000 m) to 3625 kg (50,000m) of cloth / day and requirement of water varying from 30 to 275 m3/day and averages 120 m3/day. Wastewater volume varies from unit to unit and ranges from 41 to 76 L/ kg of cloth processed with average of 55L/kg (Rathore, 2012).

Periyar River: Periyar river water is slightly acidic nature. In river Periyar dissolved oxygen is in the permissible limit (BIS 10500-1991: 5-6 mg/l) except several sampling sites. Water is high conductivity which may cause due to the presence of high ions concentration in the river. Nitrate- n concentration in river Periyar is within the permissible limit (BIS 10500-1991: 45mg/l).COD, fluoride; phenol, total dissolved solids, and iron present in river Periyar are well above the permissible limit. Sulphate, chloride, total hardness, Magnesium has concentrations within the permissible limit (E and Madhu. 2014). Overall water quality index of periyar river was calculated as 24.76 which is categorised as „poor" water class (index value between 0-45) (E and Madhu. 2014). In the downstream of river water quality index is reduced (E and Madhu.2014).

Mithi River: In River Mithi many elements are normally present in low concentrations (Singare et al., 2012). Heavy metals are a type of trace elements that create definite health hazards when it is taken up by plants (Singare et al., 2012). Group of heavy metals includes, Cr, Cd, Ni, Zn, Cu, Pb, Fe, etc (Singare et al., 2012). Aluminium concentration present in river MithiRiver ranging from 5-61, 11-182 and 8-213 µg/Lat different sampling stations (Singare et al., 2012). Cr concentration present in river Mithi river ranging from 9-212, 6-414 and 16-455 µg/L at different sampling stations (Singare et al., 2012). Hg concentration present in river Mithi River ranging from8- 281, 5-60 and 3-31 at different sampling stations (Singare et al., 2012).

Kali River: Toxic elements enter into aquatic environment through a variety of routes therefore; it affects human health (Bao et al., 2012). Heavy metals like Pb, Mn, Fe and Cr

cause dangerous effect to aquatic ecosystems and human health (Panakkal and Kumar, 2014). Heavy metal concentration of Kali river are, Fe in Pre- monsoon 1.77±0.87 and Post-monsoon 1.53±0.75, Cr in Pre-monsoon 0.09±0.03 and Post-monsoon 0.06±0.02, Cd in Pre-monsoon 0.08±0.03 and Post-monsoon 0.06±0.03, Zn in Pre-monsoon 29.71±7.59 and Post-monsoon 24.71±6.42, Pbin Pre- monsoon 0.19±0.13 and Post-monsoon 0.13±0.07 (Mishra et al.,2015)

Narmada River: Water quality is deteriorated mainly by human activities like, discharge of industrial effluents, disposal of dead bodies, sewage wastes which may cause ecological damage and also serious health hazards (Meitei et.al. 2004). In agriculture, many fertilizers are used and these fertilizers also contribute to river pollution because rainwater drains these chemicals directly into the rivers (Katakwar, 2016). In Narmada river adjacent area local people suffering from a various health problems like, gastric ulcers, skin problems, diarrhoea, stomach problems (Katakwar, 2016). People lives surrounding the area also suffering from respiratory problems and also odor pollution (Katakwar,2016).

Damodar river: In this country most polluted river is Damodar river (Banerjee et al.,2003). Different industrial health hazards, bacteriological pollution, Chemical pollution cause Damodar riverpollution (Banerjee et al .,2003). In Damodar water, coliform bacterial count is higher due to waste disposal from cement, coal- washing plants and other industries (George et al., 2010). Due to this chemical oxygen demand, dissolved and suspended solids, hardness are high (George et al., 2010). In Damodar pH of the water varied from 7.4to 8.0 in summer and 7.8 to 8.9 in monsoon (Banerjee and Niyogi). In summer range of hardness values varied from 133 mg/Lto 327 mg/L (Banerjee and Niyogi)**.** In summer conductivity varies between 59 mmhos/cm to 78 mmhos/cm and in monsoon it varies from 94 mmhos/cm to 140 mmhos/cm (Banerjee and Niyogi).In summer, Chromium level varies between 30µg/L to 146 µg/L and in monsoon it varies between 67 µg/L to 160 µg/L (Banerjee and Niyogi**)**. In summer copper level varies between 10 µg/L 36 µg/L and in monsoon it varies from 14 pgd to 56µg/L (Banerjee and Niyogi). In summer, lead level varies between38 µg/L to 96 µg/L and in monsoon it varies from 67 µg/L to 146 µg/L**.** (Banerjee and Niyogi)**.**

Mathabhannga river: In August the range of pH was 6.6 and in February it was 8.2(Chandra

and Panigrahi, 2014). This indicates water was acidic and alkaline in nature (Chandra and Panigrahi, 2014). PH value was minimum due to rainfall in monsoon (Chandra and Panigrahi, 2014). DO was maximum in winter because of less degradation and least DO was found in May 4.5mg/l (Chandra and Panigrahi, 2014). The Hardness value was minimum in December as 172mg/l and maximum was in June 272 mg/l (Chandra and Panigrahi, 2014). Higher TDS concentration was in summer but lower in January (Chandra and Panigrahi, 2014). Nitrate was rich in October 2.04mg/l and least in August1.45mg/l (Chandra and Panigrahi, 2014). The COD value maximum in September 602 mg/l and the minimum in January 411mg/l (Chandra and Panigrahi, 2014)

Musi River: In Musi River total alkalinity ranging between 324 mg/l to 112 mg/l (Cheepi, 2012). Total Hardness in Musi River ranging between 248 mg/l to 306 mg/l (Cheepi, 2012). Calcium concentration in Musi River ranging between 160 mg/l to 174mg/l (Cheepi, 2012).

Remedial measures of river pollutions: Solid wastes should be disposed after treatment and must be banned plastic bags (Srivastava, 2014). Industrialists should responsible that water must be treated before falling into river (Srivastava, 2014). Increase Community awareness programme (Das et al., 2016). Before reaching the pollutants into river the drainage water should be treated and proper management requires those drainsdirectly enter into the river (Sadhana and Raj, 2013). Must be installed sewage treatment plant and after treatment this water should be used for domestic purpose (Sadhana and Raj, 2013). For evaluation of contamination quality of waste water effluent mustbe checked time to time (Lokhandeet .al, 2011). Plastic bags should be avoided (Panigrahi 2012). Always clean up beaches and also waterways (Panigrahi 2012). Proper disposal of toxic chemicals shouldbe maintained (Panigrahi2012).

CONCLUSIONS

India is river rich country. River is the main lifeline of this country. Many cities are located on the bank of rivers. River plays crucial role for biodiversity. In river food chain occurs by algae, small animals, insects, small fish and large fish. But the pollution of river is increasing day by day. Pollution occurs by not only discharge of effluents but also various anthropogenic effect. Heavy metals such as Pb, Cd, and Zn enter into fish body. Due to pollution poor water quality of river is shown. Pollution affects whole biodiversity on aquatic ecosystems. Many fishes are died due to effects of heavy metals pollution on river. Due to discharge of heavy metals contamination eutrophication occurred. Many species of river are extinct due to pollution and ultimately it leads to loss of biodiversity. Plantation of trees on the bank of river is the effective solution to reduce river pollution. To overcome river pollution plastic should be banned as it affects food chain. If we not aware about river pollution in future it will seriously affect human population.

REFERENCES

- Agarwal, P.K., 2015. A review of Ganga river pollution-reasons and remedies. Journal of Indian Water Resources Society, 35(3),pp.46-52.
- Ahirwar M.K , Gupta G.S, Kirar.N, Ahirwar.P (2015) Study of Heavy Metal Pollution from Effluent of Orient Paper Mill, Amalai, International journal of innovative research & development, pp 28- 38.
- Ajibola, V. O., Funtua, I. I. and Unuaworho1, A. E (2005). Pollution studies of some water bodies in Lagos, Nigeria. Caspian J. Env. Sci., 3,49-54.
- Akbal, F.,Gurel, L., Bahadir, T., Guler, I., Baken, G. and Bayukgungor, H. (2011).Multivariate Statistical Techniques for the Assessment of Surface Water Quality at the Mid Black Sea Coast of Turkey. Water Air Soil Pollut, 216,21-37.
- Akhand, A., Chanda, A., Sanyal, P. and Hazra, S., 2012. Pollution load of four heavy metals in water, sediment and benthic organisms in the Kulti River of Sundarban fed by metropolitan sewage. Nature, Environment and Pollution Technology, 11(1),pp.153-156.
- Al-Mohanna, M.M.: Residues of some heavy metals in fishes collected from (Red Sea coast) Jizan, Saudi Arabia. J. Environ. Biol., 15: 149 – 257(1994).
- Ansari A.A, Singh I.B, TobschallH.J (1999) Status of anthropogenically induced metal pollution in the Kanpur-Unnao industrial region of the Ganga Plain, India Environmental Geology 38 (1), pp25-33.

- Banerjee K,Banerjee R,Sen A,Mukhopadhyay S,SenACh,Singh D, Mandal B. Damodar river pollution and health hazards. J Indian Med Assoc. 2003 Feb;101(2):104, 106,108.
- Bakshi and Panigrahi, 2012 . Studies on pollutional load and its effects on the diversity of fish and fish food organisms in Churni River, West Bengal - A Survey. Environ. Life Sci.101-109
- Barrett, P.H.: Relationship between alkalinity and absorption and regeneration of added phosphorus in fertilized trout lakes. Trans Am. Fish. Soc., 82, 78-90 (1953).

  Bao, L.J. Maruya, K.A. Snyder, S.A. and Zeng,E.Y.(2012).China'sWaterPollution by Persistent Organic Pollutants. Environ. Pollut., 163, 100–108.
- Begum A, Ramaiah M, Khan I, VeenaK.Heavy metal pollution and chemical profile of Cauvery River water. Journal ofChemistry.2009;6(1):47-52.
- Biswas, B. C., Panigrahi. A. K. (2014) Study of water Quality parameters in relation to pollutional load and fish-faunal diversity of Mathabhanga-Churni river in IndoBangla Region, Bioglobia, Vol-1, Issue-Oct, 2014, ISSN:2349-5626.
- Biswas, B. C., Panigrahi. A. K (2014) Effect of pollutional load on aquatic organisms in Nabaganga River, Jhrnidah, Bangladesh. Metro journal of modern science, Vol 1, ISSN: 2348-5701.
- BorthakurT.A, KumarD,Singhal A (2016) Assessment of water quality of river Brahmaputra in Guwahati of Assam, conferencepaper.
- Boxall A.B.A., Comber S.D., Conrad A.U., Howcroft J., Zaman N., (2000) Inputs, monitoring and fate modelling of antifouling biocides in UK estuaries. MarinePollution Bulletin 40:898-905.
- Chander DVR, Venkobacher C, Raymahashay BC (1994) Retention of fly ash-derived copper in sediments of the PanduRiver near Kanpur, India.EnvironGeol 24:133–139
- Cheepi, P., 2012. Musi River pollution its impact on health and economic conditions of downstream villages- a study. IOSR Journal of Environmental Science, Toxicology and Food Technology, 1(4), pp.40-51.
- Chinda, A.C., Braide, A.S. andSibeudu,
  O.C. (2004), Distribution of hydrocarbons and heavy metals in sediments and a crustacean (shrimps-Penaeusnotialis) from the bonny/new calabar estuary Nigeria delta. Ajeam-Ragee, 9, pp 1-14.
- CPCB 2009 and 2013, Pollution Assessment: River Ganga, Central Pollution Control Board MoEFJuly.
- CPCB 2014, Survey of Sabarmati river carried out byParyavaranMitra.
- CSE India, Sewage Canal: How to Clean the Yamuna,2007
- Das M.K, Samanta. S,Sajina, A. M., Sudheesan D, Naskarm, Bandopadhyay M.K, Paul S.K, Bhowmick S,Srivastava
  P.K (2016) fish diversity, community

  structure and ecological integrity of river BrahmaniJ. Inland Fish. Soc. India, 48(1), pp01-13
- Das .M and Panda.T (2010)Water Quality and Phytoplankton Population in Sewage Fed River of Mahanadi, Orissa, India. J Life Sci, 2(2), pp81-85
- D. Banerjee and B.K. Niyogi. Aquatic and Sedimentological Analysis Of The Damodar River Within The Stretch Of Asansol To Durgapur. Department of Environment and Water Management B.B. College, Asansol 713 303, India.
- Dugan, R. 1972. Biochemical Ecology of Water Pollution. Plenum Publishing Co.Lt.d. NewYork.
- Dwivedi A.K (2017) Researches in water pollution: A review International Research Journal of Natural and Applied Sciences,pp 118-142.
- Fo¨restner, U., Mu¨ller, G., 1973. Heavy metal accumulation in river sediments: a response to environmental pollution. Geoforum 14,53–61.

- Goldar B, Banerjee N (2004) Impact of informal regulation of pollution on water quality in rivers in India Journal of Environmental Management 73, pp 117– 130.
- Gupta, L.P., Subramanian, V., 1994. Environmental geochemistry of the river Gomti: a tributary of Ganges river. Environ. Geol. 24,235–243.
- Jain, C.K., 2004. Metal fractionation study on bed sediments of river Yamuna, India. Water Res. 38,569–578.
- James, R., Sampath, K. and Alagurathinam, S.: Effects of lead on respiratory enzyme activity glycogen and blood sugar levels of the teleost, Oreochromis mossambicus (Peters) during accumulation and depuration. Asian Fish. Sci., 9: 86 – 99 (1996).
- J. George, S.K. Thakur, R.C. Tripathi, L.C. Ram, A. Gupta & S. Prasad (2010) Impact of coal industries on the quality of Damodar river water, Toxicological & Environmental Chemistry, 92:9, 1649-1664, DOI: 10.1080/02772241003783737
- Hakim, M.Y.H.1984. Impact of pollution on the ecosystem of BurhiGandakriver near Samastipur town, North Bihar. pp. 83-88. In: B.D. Tripathi (eds.), River Ecology and Human Health. NECA,Varanasi.
- Kisi O, Parmar K.S (2016), Application of least square support vector machine and multivariate adaptive regression spline models in long term prediction of river water pollution. Journal of Hydrology 534, pp104–112.
- Kotoky P , Sarma B (2017) Assessment of Water Quality Index of the Brahmaputra River of Guwahati City of Kamrup District of Assam, India International Journal of Engineering Research & Technology (IJERT) , pp536-540.
- Kshirsagar A. D, GunaleV.R (2011) Pollution status of river Mula (Pune city) Maharashtra, India J. Ecophysiol. Occup. Hlth. 11, pp81-90.
- Kshirsagar, A.D. and Gunale, V.R., 2011. Pollution status of river Mula (Pune city) Maharashtra, India. Journal of Ecophysiology and Occupational Health, 11(1-2),pp.81-90.
- Lakshmi. E, G. MadhuAn Assessment of Water Quality in River Periyar, Kerala, South India Using Water Quality Index. IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR- JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 8 Ver. II (Aug. 2014), PP 11-16.
- Lokhande R. S,Singare P.U, Pimple D.S (2011) Pollution in Water of Kasardi River Flowing along TalojaIndustrial Area of Mumbai, India World Environment 1(1),pp 6-13.
- Malik D, Singh S, Thakur J, Singh R K, Kaur A, Nijhawan S (2014) Heavy Metal Pollution of the Yamuna River: An Introspection . Int.J.Curr.Microbiol.App.Sci 3(10), pp856-863.
- Mallikarjun Y (2003) Pollution Levels in Ganga Alarming,The Hindu Mathivanan V, Vijayan. P, SabhanayakamS, Jeyachitra. O (2007).An assessment of plankton population of Cauvery river with reference to pollution. Journal of Environmental Biology, pp524-526.
- McKim, J. M., Christensen, G. M. and Hunt, E. P.: Changes in the blood of the brook trout Salvelinusfontinalis after short- term and log-term exposure to copper. J. Fish. Res. Board Can., 27: 1883-1889 (1970).
- Meitei NS, Bhargava V, Patil PM. Water quality of Purna River in Purnatown,