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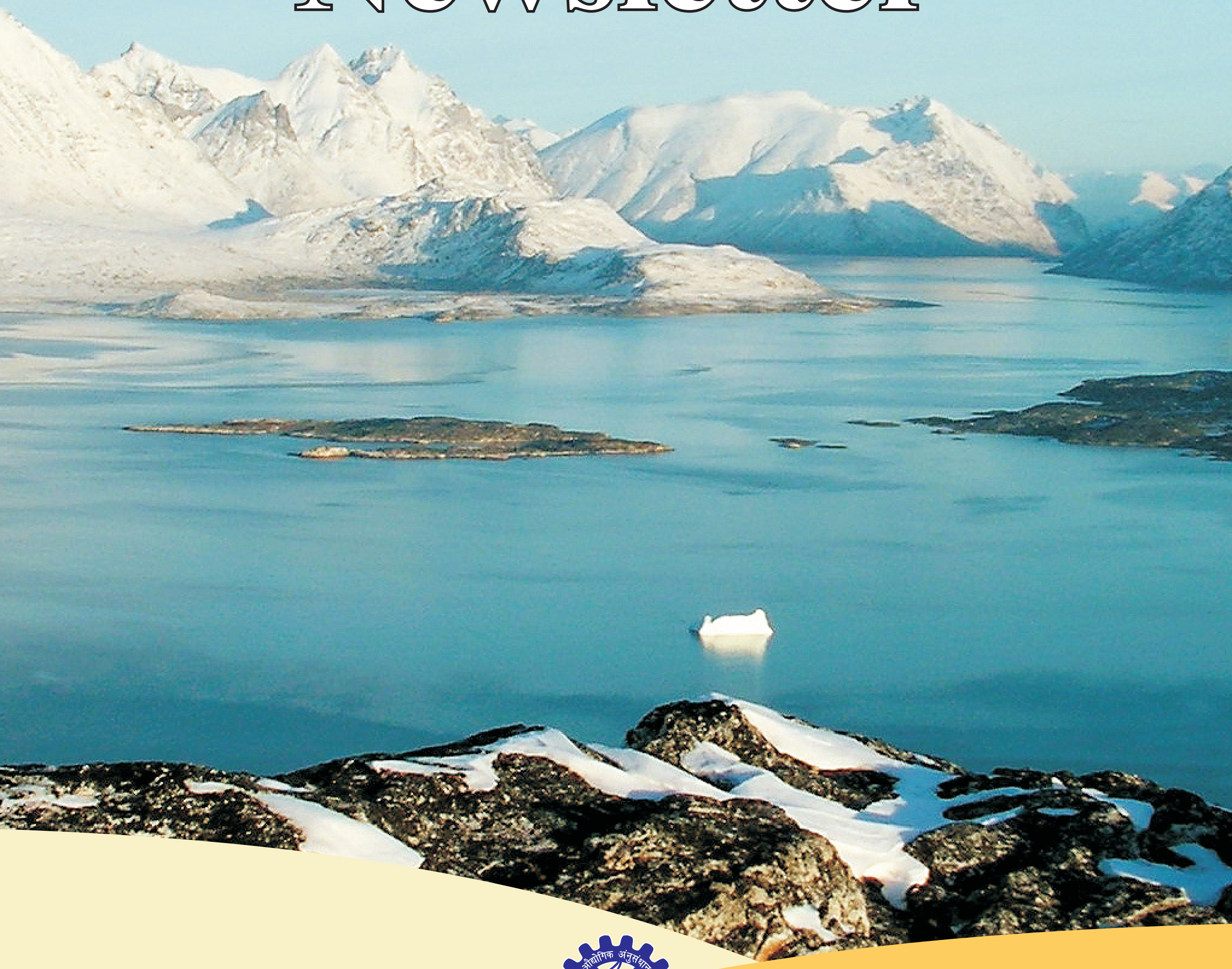

INDIAN INSTITUTE OF TOXICOLOGY RESEARCH

(Formerly Industrial Toxicology Research Centre, Lucknow)

IN THIS ISSUE

EDITORIAL

About 70% of the Earth's surface is covered by water, the most precious natural resource that exists on our planet. Even the fact that water is an essential life sustaining commodity, does not faze or deter human beings from exploiting it—this resource is being depleted at an alarming rate.

India is a country of religion and rituals. Rivers play an important role in performing these activities. A dip in the holy Ganges during the Maha Kumbh Mela festival will cleanse their souls of sin; the banks are also used for routine work (washing of clothes, bathing, etc) and for cremation. Many partially burnt bodies are pushed into the waters, ashes of the dead are scattered in the Ganges.

In many regions of India, river water is the main source of drinking water. India's 14 major, 55 minor and several hundred smaller rivers receive millions of litres of sewage, industrial wastes, and agricultural runoffs. Most of these rivers have been degraded to sewage drains with free flowing obnoxious effluents containing heavy metals (Zn, Cr, Cu, Ni, Co, As, Hg, Cd, and Pb) and pesticides (organochlorine: HCH and DDT) residues. Even though larger industries are using effluent treatment plants (ETF) however hundreds of smaller industrial units release untreated wastes directly into the municipal drains -- are a cause of grave concern. Populations in the towns and villages using these rivers as a source of water are facing serious health problems.

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ODDS & ENDS

Pesticide residues in river Yamuna and its canals in Haryana and Delhi, India

Organochlorine pesticides like HCH and DDT are ubiquitously found in all the components of the environment. Water of rivers and canals is used for drinking purposes in India, it becomes imperative to study the extent and magnitude of these restricted or banned pesticides in these water bodies.

Residues of organochlorine pesticides (OCPs) namely, isomers of HCH and endosulfan, DDT and its metabolites, (aldrin and dieldrin), were analysed in the river Yamuna. This glacier river, flowing through six Indian states has a 346 km stretch. Samples were colleted form Haryana –Delhi and the canals originating from it. â-HCH, p.p?DDT, p.p?DDE and p.p?DDD had maximum traceability in test samples (95–100%) followed by +- HCH, á-HCH and o.p?DDD (60–84%) and o.p?DDT, ä-HCH and o.p?DDE (7–30%) while aldrin, dieldrin, á and â endosulfan remained below detection limits (BDL). The concentration of ÓHCH and ÓDDT at different sites of the river ranged between 12.76–593.49 ng/l (with a mean of 310.25 ng/l) and 66.17–722.94 ng/l (with a mean of 387.9 ng/l), respectively. In canals the values were found between 12.38–571.98 ng/l and 109.12–1572.22 ng/l for ÓHCH and ÓDDT, respectively. Water of Gurgaon canal and Western Yamuna canal contained maximum and minimum concentration, respectively both of ÓHCH and ÓDDT residues.

Environ Monit Assess, Nov. 28 2007(online)

Enrichment and fractionation of heavy metals in bed sediments of River Narmada, India

A metal fractionation study on bed sediments of river Narmada in central India has been carried out to examine the enrichment and partitioning of different metal species between five geochemical phases (exchangeable fraction, carbonate fraction, Fe/Mn oxide fraction, organic fraction and residual fraction). The river receives toxic substances through a large number of tributaries and drains flowing in the catchment of the river. The toxic substances of particular interest are heavy metals derived from urban runoff as well as municipal sewage and industrial effluents. Heavy metals entering the river get adsorbed onto the suspended sediments, which in due course of time settle down in the bottom of the river. In this study fractionation of metal ions has been carried out with the objective to determine the eco-toxic potential of metal ions. Although, in most cases (except iron) the average trace/heavy metal concentrations in sediments were higher than the standard shale values, the risk assessment code as applied to the present study reveals that only about 1–3% of manganese, <1% of copper, 16–19% of nickel, 4–20% of chromium, 1–4% of lead, 8–13% of cadmium and 1–3% of zinc exist in exchangeable fraction and therefore falls under low to medium risk category. According to the Geo-accumulation Index (GAI), cadmium shows high accumulation in the river sediments, rest of other metals are under unpolluted to moderately polluted class.

Environ Monit Assess, June, 2008

Perfluorooctane surfactants in waste waters, the major source of river pollution

Perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS) are persistent and widely distributed in the environment. Recently, the discharge of municipal waste water has been shown to be an important route of such perfluoroalkyl surfactants into the aquatic environment. The aim of this study was to assess the mass flow of PFOA and PFOS from typical waste water treatment plants (WWTPs) into surface waters. Samples were collected at different stages of treatment of four WWTPs in Northern Bavaria, Germany, and from the rivers receiving the treated waste waters (WW). The outflow of PFOA from the WWTPs to the rivers was 20-fold higher than the inflow to the plants; about a tenth was removed with the sludge. For PFOS, the increase from inlet to outlet was about 3-fold; almost half of it was retained in the sludge. Both surfactants were released into river water from the WWTP of a medium-sized city with domestic, industrial and commercial waste waters; in domestic waste waters the surfactants were found at much lower levels.

Chemosphere, May 2008.

The use of an electronic nose to characterize emissions from a highly polluted river

The Riachuelo–Matanza basin area (2.240 km2) is located in Buenos Aires province, Argentina. This area is affected by intensive and extensive agricultural activities, and bears almost 3,000,000 inhabitants and more than 10,000 industries, that release their effluents to the main collector of the basin, the Riachuelo river. It is a highly polluted area and the quality of water, soil and air is severely impaired causing chronic health problems. As part of an interdisciplinary study undertaken by local institutions to reach an environmental quality diagnosis and analysis of the pollutants dynamics in the basin system, the air immediately above the water in several points at the Riachuelo river mouth was measured, with an electronic nose. Water quality parameters simultaneously collected at the same sites were analyzed and correlated with the electronic nose response. This study is only exploratory and focuses on the viability of using an electronic nose to locate conflictive emissions throughout a given zone.

Sensors and Actuators B: Chemical, April 2008

The use of fish community structure as a measure of ecological degradation: A case study in two tropical rivers of India

Fish community structure and water chemistry of two tropical rivers of West Bengal, an eastern province of India, were studied for two annual cycles (January 2003–December 2004) and a higher degree of pollution was found in one river (the Churni) than in the other river (the Jalangi). This was reflected in the water quality as well as in fish community structure of the rivers. We observed that 63.6% of fish species appeared to have been eliminated from the polluted Churni river since 1983 in 20 years. For the protection of fish biodiversity and enhancement of fish production, a rational management program should be implemented for the Churni river.

Biosystems, July-August 2007.

Assessment of bacterial indicators and physicochemical parameters to investigate pollution status of Gangetic river system of Uttarakhand (India)

River Ganga is the largest river of Indian subcontinent and it originates in the state of Uttarakhand. Because of its importance in Indian culture and dense population residing at banks, it faces several forced and unforced human activities. In the present study, Gangetic river system of Uttarakhand (India) was studied in detail for quality of water. Samples were collected from 32 different sites and physicochemical and microbiological analysis was performed during summer, rainy and winter seasons. These samples were subjected to bacteriological analysis, i.e. total viable count, total coliform count and faecal streptococcal count. The physicochemical analysis of the water samples includes pH, temperature, specific conductance, total dissolved solids (TDS), dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD). The bacterial genera were identified on the basis of their morphological and physiological characteristics. The present study confirmed the presence of bacterial indicators of faecal origin at various altitudes in every stretch of Gangetic river system. The results of bacteriological analysis of water revealed that the situation is alarming. The lower regions of Gangetic river system of Uttarakhand facing severe anthropological activities, mostly due to religious belief were heavily polluted. A huge bacterial gene pool was obtained after this study which was indicative of immense bacterial diversity in the region.

Ecological Indicators, September 2008.

Water quality management in the lower stretch of the river Ganges, east coast of India: an approach through environmental education

The lower tidal stretch of the river Ganges, known as Hugli (ca. 280 km), flows southward before entering the Bay of Bengal forming a vast mangrove-enriched estuarine delta called Sunderbans. Hugli estuary is a typical example of tide-dominated sink for contaminants from multifarious sources. This major important river is subjected to anthropogenic stress due to the socio-economic importance of these areas based on growth of industry, agriculture, aquaculture, port activities, fishing and tourism. The living resources have been degraded recently due to increases in population pressure, pollution and natural resource consumption to the extent of overexploitation. The present paper critically examines the physicochemical characteristics and level of dissolved heavy metals at three ecologically distinct zones along the course of the river – Babughat located in the eastern part of the metropolitan megacity Calcutta (140 km upstream from seaface), Diamond Harbor (70 km upstream from sea face) and Gangasagar positioned at the mouth of the Ganges estuary.

Physicochemical characteristics of this partially mixed estuary are largely influenced by the interaction of seawater and discharge of riverine freshwater, annual precipitation and surface runoff. The levels of salinity, total dissolved solids, hardness and conductivity showed an increasing downward trend. Marked increase in biochemical oxygen demand (BOD) values (2.20–5.95 mg/l) was recorded in Babughat whereas correspondingly low values (0.75–2.82 mg/l) were noticed at Gangasagar. This can be attributed mainly due to huge organic load of untreated sewage from the twin city Howrah and Calcutta situated in the east and west of the river. Spatiotemporal distribution of heavy metals reveals a wide range of variations reflecting input of huge anthropogenic inputs associated with a number of physical and chemical processes. Levels of metals registered a seasonal pattern, with an increase during late monsoon months (September–October), a period characterized by low salinity and relatively low pH of the water. Elevated levels of dissolved Hg and Pb were also recorded in Babughat, with values ranging from 0.16 to 0.95 ì g/ml and 0.017 to 0.076 ì g/ml, respectively, this high values for Hg can be attributed to the discharge from pulp and paper manufacturing units and to atmospheric input and runoff of automobile emission for Pb.

It was revealed that the socio-economic development of Calcutta, the most potential economic zone in India situated on the east bank of Hugli river, has had a significant impact on the water quality of this major river. The deterioration of water quality is directly related to non-functioning and malfunctioning of wastewater treatment plants and lack of environmental planning and coordination. To restore the ecological stability and economic vitality of this river, the following measures have been suggested: (i) strong vigilance programme is to be undertaken towards installation and maintenance of the wastewater treatment plants to check the flow of persistent contaminants in the river water and (ii) execution of legislation and mass awareness programmes are to be enacted to restore the sound health of the river. The authors urge that environmental education should be used as an effective tool for water resource management dealing with intricate and complex problems in the interaction between nature, technology and human beings.

Journal of Cleaner Production, November 2007.

Persistent organochlorine pesticide residues in soil and surface water of northern Indo-gangetic alluvial plains

This study reports the concentration levels and distribution pattern of the organochlorine pesticide (OCPs) residues in the soil and surface water samples collected from the northern Indo-Gangetic alluvial plains. A total of 31 soil and 23 surface water samples were collected from the study region in Unnao district covering an area of 2150 km^2 and analyzed for aldrin, dieldrin, endrin, HCB, HCH isomers, DDT isomers/ metabolites, endosulfan isomers (á and â), endosulfan sulfate, heptachlor and its metabolites, á-chlordane, ã-chlordane and methoxychlor. In both the soil and surface water samples â- and ä-isomers of HCH were detected most frequently, whereas, methoxychlor was the least detected pesticide. The results showed contamination of soil and surface water of the region with several persistent organic pesticides. The total OCPs level ranged from 0.36–104.50 ng g^{-1} and 2.63–3.72 ì g L^{-1} in soil and surface water samples, respectively.

Environ Monit and Assess, 2007, 125/ (1-3), 147-155.

India's rivers are drowning in pollution

Half of the city (New Delhi) receives raw sewage flows into Yamuna river, makes it polluted. The government has spent nearly $500 million trying to clean up the river, most of it going to waste-treatment stations, yet pollution levels more than doubled from 1993 to 2005. And they continue to rise. The problem is that 11 of the city's 17 sewage-treatment plants are underutilized; a quarter of them run at less than 30 percent capacity. That's because the city's sewer system is so corroded and clogged it can't deliver to the treatment plants the waste of the 55 percent of New Delhi's 15 million inhabitants who are connected to the sewage system. And even if the plants were fully utilized, there would still be the waste from 1,500 unplanned neighborhoods, where sewage "finds its way into the drains and the river," says Arun Mathur, head of the Delhi Jal Board, the government agency responsible for the city's water supply.

The Centre for Science and Environment says that nearly 80 percent of the river's pollution is the result of raw sewage. Combined with industrial run off, that comes to more than three billion liters of waste per day, a

quantity well beyond the river's assimilative capacity. The Yamuna, which flows 855 miles from the Himalayas into the Ganges, isn't India's only polluted river. Eighty percent of the country's urban waste goes directly into rivers, many of which are so polluted they exceed permissible levels for safe bathing.

Waterborne diseases are India's leading cause of childhood mortality. Shreekant Gupta, a professor at the Delhi School of Economics who specializes in the environment, estimates that lost productivity from death and disease resulting from river pollution and other environmental damage is equivalent to about 4 percent of gross domestic product. "Some of this feeling of euphoria," he says of India's 9 percent growth rate, "gets a bit dampened thinking of environmental degradation." Sheila Dikshit, New Delhi's chief minister, says the government simply followed the recommendations of outside consultants who encouraged the building of expensive sewage-treatment plants but didn't anticipate the surge in migration of rural poor to New Delhi. But not everything can be blamed on consultants. An obfuscating web of political appointees, civil servants and weak elected officials has made accountability almost impossible. At least eight city, state and federal agencies oversee various aspects of the Yamuna's cleanup, alternately competing for funds and sometimes passing the buck when public anger reaches a boiling point. Shreekant Gupta argues that a clean river is a public good for which people should have to pay. But New Delhi's citizens aren't charged sufficiently for the millions of gallons of waste they flush daily. "Our municipal finances are in a mess," he says, "because we essentially don't raise money from property taxes and user charges, the two sustainable sources of revenue."

http://money.cnn.com/magazines/fortune/fortune_archive/2007

Madras develops nanoparticles to fight pesticide residues

India is one of the largest pesticide producers in Asia, India has made some mark in controlling pests, but in return has ruined its water resources. Even though nationwide data does not exist, isolated studies have started showing how groundwater and river systems are contaminated with pesticide residues, not removable by standard water filters. Now, a team of researchers from IIT-Madras has developed nanoparticles that can eliminate one of the most difficult-to-remove class of chemicals in pesticides called organochlorine. Almost every organochlorine studied has been seen to cause some environmental or human health hazard and includes notorious pesticides like DDT, endosulfan, dioxin, HCH (hexachlorocyclohexane) and aldrin. “Even though some of these pesticides have been banned, they are very much present in the environment. For instance, endosulfan has an environmental lifetime of 100 years,” says T. Pradeep, professor of chemistry at IIT Madras. His nanoparticles, mostly from gold, silver, copper and several oxides, are effective on endosulfan even at very low concentration. “Efficient chemistry at low concentration is important so that even if one molecule of the pesticide passes by, it gets removed by the nanoparticle,” adds Pradeep. With an Indian and US patent in hand, Pradeep has licensed part of his work to Eureka Forbes Ltd, makers of vacuum cleaners and water purifiers, which in June 2007 introduced a novel nanosilver filter in some brands. “We wanted to productize and demonstrate our technology and create some excitement. So we took up initial industrial development at IIT,” notes Pradeep. But any technology of this kind, he believes, needs to go the “real sufferers in rural areas”. His current nanoparticl es are effective on four most common organochlorine pesticides (OCPs) – DDT, endosulfan, malathion, and chlorpyrifos.

More than 40% pesticides used in India belong to the organochlorine category, known for their resistance to environmental degradation. There has been no national study yet but some patchy studies are being undertaken. For instance, a study by the Industrial Toxicological Research Centre (ITRC) in Lucknow published in the international journal Bulletin of Environmental Contamination and Toxicology in May 2007 shows high level residues of OCPs in fish from the Gomti river. Another Council of Scientific and Industrial Research-commissioned study on groundwater sources by ITRC in Kanpur shows beyond permissible levels of DDT, HCH and endosulfan, according to Kunwar P. Singh, one of the lead researchers. A 2005-study on Ludhiana and Muktsar districts of Punjab, now expanded to other neighbouring regions, by the National Geophysical Research Institute (NGRI) in Hyderabad showed WHO-exceeding levels of OCPs like endosulfan, DDT, malathion and others. “We do not have national data; it's only recently that the Department of Science and Tehcnology has initiated such studies,” said Gurunadha Rao, a scientist at NGRI.

Eureka is interested in taking this technology to rural population but the high cost of manufacturing could hinder the outreach for some time. “We intend to take this up as a no-loss, no-profit venture but that will have to wait until production goes up (and cost comes down),” says Abhay Kumar, general manager of water technologies division at Eureka in Bangalore. A community water purifier prototype, using nanotechnology filter, is under construction. It is scheduled to be installed in Kasargod district, one of the endosulfan-affected areas in Kerala, by March. “This effort has to multiply, through all possible channels – industry, non-governmental organization and most importantly, government machinery,” says Pradeep, whose interaction with the Central water resources ministry turned out to be a one-way affair. Under the US Clean Water Act of 1972, the extent of contaminants in a glass of water is decreasing, but the number of contaminants entering potable water is increasing, says Pradeep. Experts believe eventually nanomaterial is the way to purify not only water but even ambient air indoors. “Many of these organics are extremely stable in the environment. Hence, chemistry of novel materials is the need,” argues Pradeep. Given India's poor global ranking in drinking water quality (a 2003 UN report ranked India 120 among 122 nations in quality of water), the international aid agency World Vision India (WVI), headquartered in Hyderabad, is involved in some water purification progammes. “We are keen to find out how we can adapt this nanotechnology for rural masses,” says Franklin Joseph, director, Humanitarian and Emergency Affairs. WVI, which has a collaboration with Eureka, is now entering into an agreement with the Water and Process Technologies division of General Electric Company to use their reverse osmosis technology, suitable for removing salt and fluoride from water. Pradeep's group has also developed a pesticide test kit, slated to enter the market this year. One of the early proponents of nanotechnology for water purification when he came to IIT Madras 14 years ago from Purdue University in Indiana, US, Pradeep now has a slew of new nano materials that could free water from heavy metals like lead and mercury and other OCPs. But his worry is: How do we develop a mechanism to take such technologies to the masses?

http://www.livemint.com/2008/01/07133544/IIT-Madras-develops-nanopartic.html

Water quality assessment of an untreated effluent impacted urban stream: the Bharalu tributary of the Brahmaputra river, India

Guwahati, the lone city on the bank of the entire midstream of the Brahmaputra river, is facing acute civic problem due to severe depletion of water quality of its natural water bodies. This work is an attempt towards water quality assessment of a relatively small tributary of the Brahmaputra called the *Bharalu* river flowing through the city that has been transformed today into a city drainage channel. By analyzing the key physical, chemical and biological parameters for samples drawn from different locations, an assessment of the dissolved load and pollution levels at different segments in the river was made. Locations where the contaminants exceeded the permissible limits during different seasons were identified by examining spatial and temporal variations. A GIS developed for the watershed with four layers of data was used for evaluating the influence of catchment land use characteristics. BOD, DO and total phosphorus were found to be the sensitive parameters that adversely affected the water quality of *Bharalu*. Relationship among different parameters revealed that the causes and sources of water quality degradation in the study area were due to catchments input, anthropogenic activities and poor waste management. Elevated levels of total phosphorus, BOD and depleted DO level in the downstream were used to develop an ANN model by taking total phosphorus and BOD as inputs and dissolved oxygen as output, which indicated that an ANN based predictive tool can be utilized for monitoring water quality in the future.

Environ Monit and Assess, 2007, 130/ (1-3), 221-236.

An assessment of plankton population of Cauvery river with reference to pollution.

Studies on plankton of river Cauvery water, Mettur, Salem district, Tamil Nadu was made to assess the pollution of water from January 2003 to December 2003. The qualitative and quantitative evaluation of the variation in river water showed high quantity of phytoplankton and zooplankton population throughout the study period and rotifers formed dominated group over other groups of organisms. The present study revealed that the water of river Cauvery is highly polluted by direct contamination of sewage and other industrial effluents.

J Environ Biol. 2007, 28(2):523-6.

Water pollution has become an accidental weapon against tribal peoples: Dongria Kond of Niyamgiri hills, India

The Dongria Kond have farmed the Niyamgiri hills for centuries. It is their only home. About thirty rivers have their springs in the Niyamgiri hills, which supply hundreds of thousands of people, including the Dongria Kond, with drinking water and irrigation. This precious water, and the people it sustains, is under threat from a British company with aspirations to mine the hills for bauxite. The company, Vedanta, has already built an aluminum refinement plant at the base of the hills. Already, 25,000 people living around the refinery have been affected by water and air pollution. When the plant is fully operational, the problems will intensify. The refinery will extract and consume vast volumes of water from the nearby rivers. Heavy metals and chemicals will seep into the groundwater and devastate the water quality across huge areas, threa-tening the health, and the harvest, of the Dongria Kond. The Indian government has not issued a mining licence for Vedanta to operate in the Niyamgiri hills, and so activity has slowed for now. But Vedanta's subsidiary company, Sterlite Industries, has been invited to apply. If it is granted a licence and work begins, the water quality in the Niyamgiri hills will plummet. The Dongria Kond, who have no other supply, will be forced to bath in pollution and to drink contaminated water.

http://www.straightgoods.ca/ViewFeature8.cfm?REF=178

Assessment of heavy metal pollution in surface water

Ganga, the most sacred and important river of India, is regarded as the cradle of Indian civilization. About 2506 km of the river stream gives life to twenty-nine cities, seven towns and thousands of villages which are contaminating the river by over 1.3 billion L waste water per day. Among the inorganic contaminants of the river water, heavy metals are getting importance for their non-degradable nature and often accumulate through tropic level causing a deleterious biological effect. Anthropogenic activities like mining, ultimate disposal of treated and untreated waste effluents containing toxic metals as well as metal chelates from different industries, e.g. tannery, steel plants, battery industries, thermal power plants etc. and also the indiscriminate use of heavy metal containing fertilizers and pesticides in agriculture resulted in deterioration of water quality rendering serious environmental problems posing threat on human beings. A total of 96 surface water samples collected from river Ganga in West Bengal during 2004-05 was analyzed for pH, EC, Fe, Mn, Zn, Cu, Cd, Cr, Pb and Ni. The pH was found in the alkaline range (7.21-8.32), while conductance was obtained in the range of 0.225-0.615 mmhos/cm. Fe, Mn, Zn, Ni, Cr and Pb were detected in more than 92% of the samples in the range of 0.025-5.49, 0.025-2.72, 0.012-0.370, 0.012-0.375, 0.001-0.044 and 0.001-0.250 mg/L, respectively, whereas Cd and Cu were detected only in 20 and 36 samples (0.001-0.003 and 0.003-0.032 mg/L). Overall seasonal variation was significant for Fe, Mn, Cd and Cr. The maximum mean concentration of Fe (1.520 mg/L) was observed in summer, Mn (0.423 mg/L) in monsoon but Cd (0.003 mg/L) and Cr (0.020 mg/L) exhibited their maximum during the winter season. Fe, Mn and Cd concentration also varied with the change of sampling locations. The highest mean concentrations (mg/L) of Fe (1.485), Zn (0.085) and Cu (0.006) were observed at Palta, those for Mn (0.420) and Ni (0.054) at Berhampore, whereas the maximum of Pb (0.024 mg/L) and Cr (0.018 mg/L) was obtained at the downstream station, Uluberia. All in all, the dominance of various heavy metals in the surface water of the river Ganga followed the sequence: Fe > Mn > Ni > Cr > Pb > Zn > Cu > Cd. A significant positive correlation was exhibited for conductivity with Cd and Cr of water but Mn exhibited a negative correlation with conductivity.

Int. J. Environ. Sci. Tech., 5 (1), 119-124

Estuarine capacity in removal of trace metals from contaminated river water, Southern Caspian Sea

Flocculation of dissolved Cd, Cu, Ni, Pb, Mn and Zn with initial concentrations of 1, 2.5 and 5 mg/L in Tadjan River water during mixing with the Caspian Sea water has been studied in order to determine estuarine capacity to remove dissolved metals in the accidental contamination of the river. The flocculation process was investigated on a series of mixtures with salinities ranging from 0.1 to 11 p.p.t. The flocculation rates were indicative of the nonconservative behaviour of Cd, Cu, Ni, Pb, Mn and Zn during estuarine mixing. The order of the final flocculation rate of dissolved metals at 1, 2.5 and 5 mg/L of initial metal concentrations in the river water is as follows:Cu (99%)>Cd (95%)>Zn (88%)>Mn (85%)>Pb (83%)>Ni (73%), Cu(95.6%)>Pb (92.4%)>Cd (90%)>Zn(88.4%)>Mn (81.6%)>Ni(78.8%) and Cd (100%)>Cu(88%)>Ni (85.2%)>Pb (84%)>Zn (83.2%)>Mn (81.2%), respectively. The results also revealed that removal of dissolved metals is not influenced by pH changes and precipitation processes. The flocculation rates revealed that the overall dissolved metal pollution loads may be reduced to about 70% up to about more than 90% during estuarine mixing of Tadjan River with the Caspian Sea water.

Water and Environment Journal 22 (2008) 193–198

Pollution, Indifference Taint India's Sacred River

The Indian city of Kanpur is an anomaly — an industrial city that lies on the banks of a river that is revered as a goddess. Kanpur is the largest city in the state of Uttar Pradesh, and it sits on the higher, southern bank of the Ganges River. But Kanpur's burgeoning industry pours pollution into the sacred river, making it dirty, unappetizing and synonymous with pollution in residents' eyes. Twenty years ago, the Indian government began a massive program to clean up the river, but for many, Kanpur is proof that those efforts failed. In 1986, Prime Minister Rajiv Gandhi announced a massive Ganga Action Plan to clean up the river. The basic idea made sense: Intercept and treat pollution before it is discharged into the Ganges. Politicians and engineers in Delhi designed sewage treatment plants, but they then expected states and cities to find the money to operate and maintain them. Myriad problems — from inconsistent electricity to indifferent local authorities and residents — stunted the plan. Today, the Ganges at Kanpur is besieged by pollution, including toxic chromium, from local tanneries. The local sewage treatment plant sits idle, and residents suffer from various skin ailments, among other health problems.

http://www.npr.org/templates/story/story.php?storyId=16709008

DID YOU KNOW ?

- World Water Day - 22 March
- Water born diseases like hepatitis, amoebic dysentery, typhoid, cholera and cancer are leading cause of mortality.

RIVER POLLUTION CAUSES AND CONSEQUENCES

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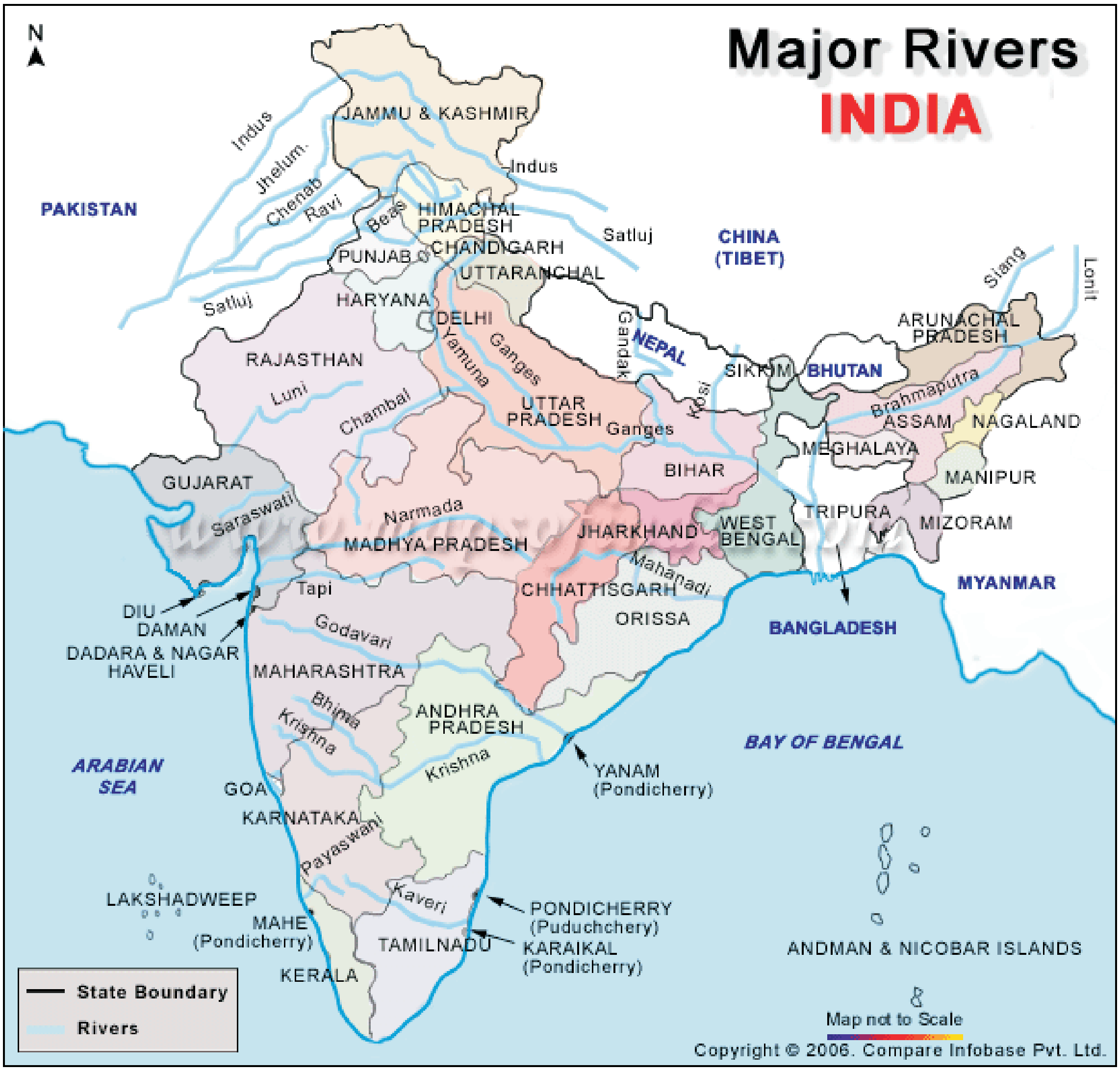
The word pollution is adaptation of the Latin word ``Pollutionem'' meaning contamination. A flexible definition of the word aquatic pollution can be "any effect of human activity which alters the natural conditions of the aquatic environment". About 97% of the earth's water supply is in the ocean, which is unfit for human consumption and other uses because of its high salt content. The remaining 2% is locked in the polar ice-caps and only 1% is available as fresh water in rivers, lakes, streams, reservoirs and ground water which is suitable for human consumption.

River are the major source of water, and water is essential for the ecosystem and has been termed as ``Elixir of life''. Even since the civilization man has used water for his economic gains and sustenance. The rivers sustained domestic discharges, agricultural runoffs and industrial releases. Variety of pathogens, chemicals such as heavy metals, pesticides, disinfectants and their by products, dyes etc. contaminate the water bodies directly or indirectly through anthropogenic activities. Exposure of them through water has been reported to cause diarrhoea, gastroenteritis, cholera, typhoid, tuberculosis, meningitis, polimylitis, encephalitis, hepatitis, amoebiasis giardiasis, schistosomiasis, skin rashes and many other diseases.

Pollution in Indian rivers

India has 14 major rivers each having catchment area of 20,000 sq. km and above while it has 44 medium rivers with a catchment area between 2000-20,000 sq. kms. It also has 53 small rivers each with 2000 sq. km or fewer catchment areas (Nath, 1999) which generally originates from coastal mountains. With the rapid industrializations and urbanizations during past 50 years most of our rivers are subjected to indiscriminate discharge of effluents affecting water quality and aquatic life. Fig. 1 to 6 and Table 1 represent the sources of river pollution, whereas Table 2 shows the major Physico - Chemical characteristics of untreated wastes of some industries releases in river. Singh *et al.*, (1999 a, b) have shown tremendous impact of pollution on Ganga river water as reflected by high BOD, COD, chloride, hardness, specific conductivity, alkalinity, nitrate, phosphate and Free CO_2 and low dissolved oxygen and pH. The impact was however localized and water retains its original characters after passing few hundred meters which recover from high stress of organic pollution. They have also reported that higher values of BOD and COD were observed at the outfall region of effluents. Minimum BOD and COD were found near Kanpur.

Dhanapkiam *et al.*, (1999) have stated that the waters in Cauvery river having low oxygen and relatively high values of alkalinities, hardness, chlorides, nitrates, phosphates, BOD and sodium potassium were the indication of polluted water and the river was not fit for industrial use and drinking purpose are suggested that the industrial effluents should be treated fully and diluted before draining into the Cauvery river. Pandey, 1999; Tyagi 2001 has been reported that Chaliyar river (Calicut), the Mahi river Vardodrra the Ganga at Kanpur the Yamuna near Delhi and the Son is Bihar have all been the main target of water pollution during the recent past.



Major rivers in India.

Table 1 Source of Pollutants in Indian River.

Name of River	Source of Pollution
1. Yamuna New Delhi	DDT Factory, sewage, Indraprastha power
2. Kalil at Meerut (U.P.)	Sugar Mills, Distilleries, paint soap, silk, yarn, tin, and glycerin industries.
3. Bajora at Bareilly (U.P.)	Synthetic rubber factories.
4. Ganga at Kanpur (U.P.)	Jute, chemical, metal and surgical Industries, tanneries, mills and great bulk of domestic sewage of highly organic nature.
5. Gomti of Lucknow (U.P.)	Paper and pulp mills sewage.
6. Siwan (Bihar)	Paper, sulphur, cement, sugar mills.
7. Damodar between Bakare and Panchet and thermal power station.	Fertilizers, fly ash from steel mills, suspended coal particles from washeries
8. Sone at Dalmianagar (Bihar)	Cement, pulp and paper mills.
9. Hooghly near Calcutta	Power stateion, paper pulp, jute, testile,chemical mills, paint, varnishes, metal, steel hydrogenated vegetable oils rayon and soap, match shellac and polythene industries and sewage.
10. Bhadra (Karnataka)	Pulp, paper and steel industries.

11. Cooum, Adyar and Buckingham	Domestic sewage and automobiles
12. Canvery (Tamil Nadu)	Sewage, tanneries, distilleries, paper and rayon mills.
13. Godavari	Paper mills.
14. Kulu (between Bombay and Kalyan)	Chemical factories, rayon mills and tanneries.
15. Suvaon (in Balrampur in U.P.)	Sugar Industries.
16. Cooum (Channai)	Automobile work shop and domestic sewage.
17. Ami (Basti) (U.P.)	Paper pulp mills.

Figure 1 industrial effluent, 2 funeral process, 3 Socio – cultural activities, 4 disposal of carcass, 5 washing activities, 6 sewage disposal, and 10 pesticide application.

Table 2 Major physico-Chemical characteristics of untreated wastes of some industries releases in river.

Industry	Physico-Chemical Characteristics
1. Thermal power plants	Heat, heavy metals, dissolved solids, and inorganic compounds.
2. Pesticides	Aromatic compounds, acidity and high organic matter.
3. Pickles	High suspended solids, colour and organic matter.
4. Synthetic mills	Zinc, toxic substances, sulphides and high pH.
5. Organic chemical Industry	Toxic compounds, phenols, high alkalinity.
6. Explosives	Alcohols, metals-TNT and organic acids.
7. Distilleries	Very high COD, Low pH, high organic matter, high suspended and dissolved solids Containing nitrogen, high potassium.
8. Tanneries	Calcium Chromium, high salt content, Colour, dissolved and suspended matter.
9. Photographic products	Organic and inorganic reducing agents, silver and alkalies.
10. Rubber Industry	Chlorides, suspended and dissolved solids high BOD and variable pH.
11. Steel mills	Acids, phenols, Cyanogen, Low pH, alkali, Lime stone, oils, fine suspended solids, cyanides, Iron, salts, sulphides, oxides of Cu, Hg and Cd.
12. Cotton Industry	Sodium, Organic matter, colour, high pH and fibries.
13. Oil refineries	Acids, alkalies, phenols tarury or resinous materials and petrolium oils.
14. Metal Plating	Metallics toxic cyanides, Cd, Cr, Zn, Cu, Al and low, pH.
15. Fertilizers	High pH, high NH_3, high Fluoridies, nitrogen, organic matter, phosphorus, potassium, and oxides of sulphur.
16. Mining	Chlorides, Ferrous sulphate, suspended solids, heavy metals, H_2S, etc.
17. Soap and detergents	Tertiary ammonium compounds, alkalies, rise in pH, fatty acids.
18. Pulp & paper	Suspended solids, low pH, high BOD, dissolved substances, sulphides, sulphites, bleaching, liquors, organic acids.

Management of river water quality

It is essential in the proper management of river that their area under control includes the whole of drainage area of one or more rivers and their tributaries. Without this, it is impossible to fully control river water quality (Toms, 1975). To avoid depletion or degradation of riverine environment, careful planning and designing ecologically sound management plan is the only answer. For conserving river water resources, a positive and meaningful approach must be followed pertaining to quality and quantity evaluations of all the rivers minor as well as major. The survey should also be a scientific assessment of the needs of various interests like irrigation, navigation, fish culture, industrial, recreational, power generation and domestic needs.

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CURRENT CONCERNS

All the major rivers of India are facing acute water pollution problem. There are regulations sets by agencies like CPCB, BIS for the measure and control of water pollution. Even than there is a great concern, due to improper implementation, lack of awareness among peoples. There is a demand of the today is that each and every person must contributes for the protecting our most precious natural water resources, single step of ourselves can help to overcome from water pollution.

REGULATORY TRENDS

The national Water Policy of 1987 recognizes that water is a prime natural resource and a basic need of human life. The planning and development of water and related land resources of the Sate shall be directed to improve in the quality of life as well as contributions to environmental quality. The Central Pollution Control Board (CPCB) regulates water quality in India has classified water standards based on five broad categories of use.

Sl. No.	Designated-Best-Use	Class of water	Criteria	Some Examples from Indian River
1.	Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organis m MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20°C 2mg/l or less	Beas at Manali Himachal Ravi at Madhopur, Himachal
2.	Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less	Ganges at Rishikesh, Uttar Pradesh Tapi at Nepanagar, Madhya Pradesh
3.	Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less	Achankoli at Thumpaman Kerala Cauvery at Napokulu Barrage, Karnataka
4.	Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less	Brahmani at Panposh, Orissa Brahmaputra at Dibrugarh Assam
5.	Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH betwwn 6.0 to 8.5 Electrical Conductivity at 25°C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l	Mahi at the Confluence of River Chap, Gujurat Sabarmati at Miroli Village Gujurat

BIS 10500 STANDARDS FOR DRINKING WATER WATER PURIFIERS

Sl. No.	Standard	Specification & salient features
1.	IS 10500:1991	
2.	IS 14724:1999	Water purifiers with UV disinfect systems th at rid water of water born pathogens and suspended matter for drinking water purposes.
3.	IS 7402:1986	Filters system that remove bacteria and suspended matter but not dissolved solids or chemicals E.g. ceramic candle filters.
4.	IS 9310:1979	Specification for water purifier (electrically heated). Covers potable water purifier used for consumption in dispensaries hospitals and preparation of medicines. Labels should contain instructions to boil water for 30 min.
5.	IS 14543:2004	Packaged drinking water standard. There should not be any pesticides and heavy metals. TDS & salts should be within prescribed limits. No microbial contaminants.

Essential Characteristics

Sl. No.	Characteristic	Requirement.(desirable)	Permissible limit in the absence of an alternative source
1.	Color-Hazen units, maximum	5	25
2.	Odor	Unobjectionable	Unobjectionable
3.	Taste	Agreeable	Agreeable
4.	Turbidity,Ntu ,Max	5	10
5.	pH value	6.5 to 8.5	No relaxation
6.	Total Hardness as CaCo3,max mg/l	300	600
7.	Iron as Fe,max mg/l	0.3	1.0
8.	Chlorides as Cl,max mg/l	250	1000
9.	Residual free Chlorine as Cl, min	0.2	- -

Desirable Characteristics

10.	Dissolved Solids, mg/l, max	500	2000
11.	Calcium as Ca, mg/l,max	75	200
12.	Copper as Cu, mg/l,max	0.05	1.5
13.	Manganese as Mn, mg/l,max	0.10	0.3
14.	Sulphate as So4,mg/l,max	200	400
15.	Nitrate as No3,mg/l,max	45	100
16.	Fluoride as F, mg/l,max	1.5	1.9
17.	Phenolic compounds, mg/lit, max	0.001	0.002
18.	Mercury as Hg, mg/lit max	0.001	No relaxation
19.	Cadmium as Cd, mg/lit , max	0.01	No relaxation
20.	Selenium as Se, mg/lit, max	0.01	No relaxation
21.	Arsenic as As, mg/lit, max	0.01	No relaxation
22.	Cyanide as Cn, mg/lit, max	0.05	No relaxation
23.	Lead as Pb, mg/lit, max	0.05	No relaxation
24.	Zinc as Zn, mg/lit, max	5.0	No relaxation
25.	Anionic detergents, mg/lit, max	0.2	1.0
26.	Chromium as Cr, mg/lit, max	0.05	No relaxation
27.	Polynuclear Hydro carbons	--	--
28.	Mineral oil, mg/lit ,max	0.01	0.03
29.	Pesticides, mg/lit, max	Absent	0.001
30.	Alkalinity, mg/lit ,max	200	600
31.	Aluminum as Al, mg/lit, max	0.03	0.2
32.	Boron as B, mg/lit, max	1.0	5.0

Bacteriological Standards:

For water in a distribution system – (i) E Coli count in 100 ml of any sample must be zero (0). (ii) Coliform organisms should not be more than 10 per 100 ml in any sample. (iii) Coliform organisms should not be present in 100 ml of any two consecutive samples or more than 5% of the samples collected for the year.

ON THE LIGHTER SIDE

Cold Water

A man went to visit his 90 year old grandfather in a very secluded rural area of the state he lived in.

After spending the night, his grandfather prepared breakfast for him consisting of eggs and bacon. He noticed a film like substance on his plate and he questioned his grandfather, "are these plates clean?"

His grandfather replied, "Those plates are as clean as cold water can get them, so go on and finish your meal".

That afternoon, while eating the hamburgers his grandfather made for lunch, he noticed tiny specks around the edge of his plate and a substance that looked like dried egg yokes, so he ask again, "Are you sure these plates are clean"?

Without looking up from his hamburger, the grandfather says, "I told you before; those dishes are as clean as cold water can get them. Now don't ask me about it anymore!"

Later that afternoon, he was on his way out to get dinner in a nearby town. As he was leaving, his grandfather's dog started to growl and wouldn't let him pass so he said, "Grandfather, your dog won't let me out".

Without diverting his attention from the football game he was watching on TV his grandfather shouted, "Cold Water, Go lay down!"

ON THE WEB

http://www.indiawaterportal.org/

This website gives information regarding water quality, policies, etc.

www.csshome.com/WaterMarine

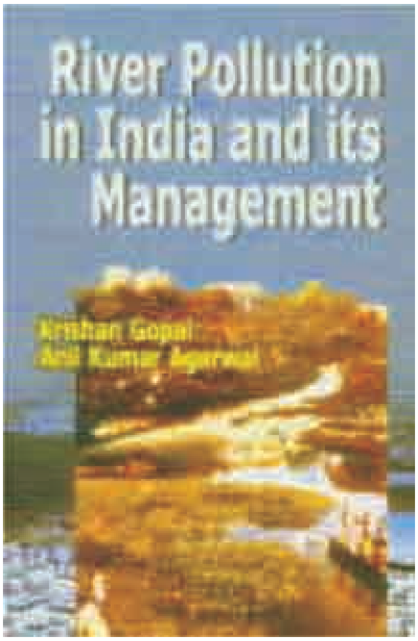
Help protect our oceans and rivers. Funding projects worldwide.

www.indiastat.com/

Environment and Pollution Related News.

BOOK STOP

River Pollution in India and Its Management Editors: Krishna Gopal and Anil Kumar Agarwal



Publisher: A P H Pub., 2003

ISBN: 81-7648-445-8.

The book depicts the most important aspects of pollution, conservation and management of riverine environment/resources with particular reference to biotic and abiotic factors. It contains research papers and review articles describing scientific as well as developmental aspects of conservation and management of aquatic resources. With emphasizing the multidisciplinary approach of the knowledge on ecosystem, the enormous wealth of variety of life and their associations, application of technology and implications in practice, the book will be of immense use to everyone associated with biodiversity and resource management. It will also serve as reference book for researcher, policy makers and regulatory agencies.

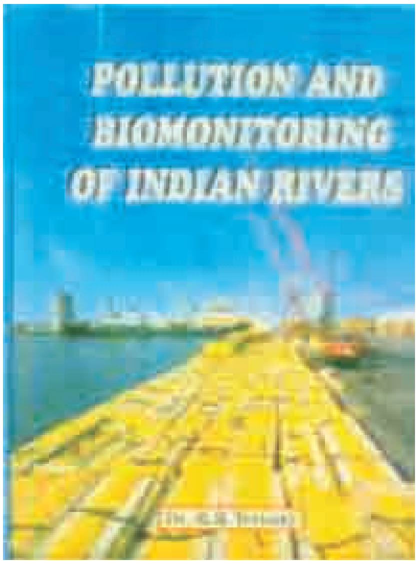
Pollution and Biomonitoring of Indian Rivers

Editor: R.K. Trivedy

Publisher: ABD, 2000

ISBN: 81-85771-12-X.

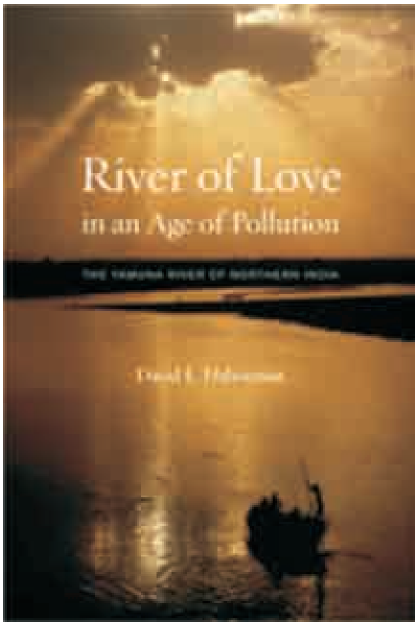
The present volume is a compendium of recent research on ecological studies on Indian rivers with emphasis on pollution and biological monitoring. A large number of rivers like Ganga, Damodar, Purma, Kuttiadi, Narmada, Saraswati, Khan, Satlaj, Chambal, Yanuna, Bhadra, Mayurakshi, Sabarmati, Shankha, Panchganga, Krishna, Shivnath, Koyana and Dikhow. River of Assam



are prominent rivers covered in the volume. Studies on major rivers are reported from different states. A number of rivers have been studied on different locations in different states.

The book shall be highly useful to researchers of this field, Pollution Control Boards, Environmental Engineers, Students and Teachers of Environmental Sciences and NGO's working in this field

River of Love in an Age of Pollution: *The Yamuna River of Northern India*



Author: David L. Haberman

Publisher: University of California Press, 2006

ISBN: 978-0-520-24789-5

Celebrated as an aquatic form of divinity for thousands of years, the Yamuna is one of India's most sacred rivers. A prominent feature of north Indian culture, the Yamuna is conceptualized as a goddess flowing with liquid love—yet today it is severely polluted, the victim of fast-paced industrial development. This fascinating and beautifully written book investigates the stories, theology, and religious practices connected with this river goddess collected from texts written over several millennia, as well as from talks with pilgrims, priests, and worshippers who frequent the pilgrimage sites and temples located on her banks. David L. Haberman offers a detailed analysis of the environmental condition of the river and examines how religious practices are affected by its current pollution. He introduces Indian river environmentalism, a form of activism that is different in many ways from its western counterpart. *River of Love in an Age of Pollution* concludes with a consideration of the broader implications of the Yamuna's plight and its effect on worldwide efforts to preserve our environment.

Water Contamination and Health (Environmental Science and Pollution Control

Editor: Rhoda G.M. Wang

Publisher: CRC, 1994

ISBN-10: 0824789229

This volume examines every potential means of exposure to water contaminants, provides in-depth discussions on toxicology, and explains up-to-date techniques for evaluating human health risk. It develops a methodology for assessing the cumulative absorbed dose of contaminants through all routes of exposure, including ingestion, inhalation and dermal. Federal and state efforts to monitor and treat water are examined.

MINI PROFILE OF ENDOSULFAN

Synonyms: Endosol, Thiosulfan, Devisulphan, Cyclodan

CASRN: 115-29-7

Molecular Formula: C_9-H_6-Cl_6-O_3-S

Molecular Weight: 406.93

Properties: Color/Form: Brown crystals, Odour: Similar to terpene, Boiling Point: 106 ^{0}C at 0.7 mm Hg, Melting Point: 106 ^{0}C, Corrosive to iron, Octanol/Water Partition Coefficient: log Kow = 3.83 (alpha), Density/Specific Gravity: 1.745 @ 20 ^{0}C, Sol in Xylene, Kerosene, Chloroform, Acetone, & Alcohol, Vapor Pressure: 6.2X10-6 mm Hg @ 20 ^{0}C.

Uses: Non-systemic insecticide and acaricide.

Environmental Quality Standard:

Permissible Exposure Limit: TWA: 0.1 mg/m^3

Threshold Limit Values: TWA (8 hr): 0.1 mg/m^3

Recommended Exposure Limit: TWA (10 hr): 0.1 mg/m^3

Toxicity Data:

LD_{50} Rat oral 18 mg/kg

LD_{50} Mouse oral 7360 ug/kg

LD_{50} Dog oral 76,700 ug/kg

LD_{50} Cat oral 2 mg/kg

LD_{50} Rabbit oral 28 mg/kg

LD_{50} Hamster oral 118 mg/kg

Route	Symptoms	First Aid	Target Organ
Inh & Ing	Headache, giddiness, nervousness, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort in the chest	Move person to fresh air. If person is not breathing, give artificial respiration, preferably by mouth-to-mouth, if possible. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person	
Cont	May cause irritation to eyes and skin.	Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes.	Skin & Eyes

Irritancy & Sensitization: Skin, Eye and Respiratory Irritations.

Treatment & Antidotes: There is no specific antidote. Diazepam I.V. is the drug of choice. Barbituric acid derivatives such as Phenobarbital may be used additionally. A neuromuscular blocking agent may be used if convulsions persist. This type of drug may be used only if complete control of respiration can be maintained. Epinephrine derivatives are absolutely contraindicated.

Handling and Storage: Wear protective clothing, rubber gloves, pesticide approved respirator and eye protection when handling this product. Keep containers closed if not used. Keep away from humidity and heat. Do not handle/store near food, drink and feedstuff. Keep out of reach of children.

Warning: Endosulfan is a central nervous system stimulant absorbable by mouth, inhalation or through contact with skin. It may cause convulsions.

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Toxic Chemicals	____________	____________	____________
Environment	____________	____________	____________
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Signature:

Please mail to the attention of Dr. (Mrs.) F.N. Jaffery, Scientist in charge, ENVIS Cenre,
Indian Institute of Toxicology Research
Post Box# 80, Mahatma Gandhi Marg, Lucknow- 226 001 India.
Phone : (0522) 2284 591, Fax : (0522) 2628227 Email: itrc@itrcenvis.nic.in
web : http//www.itrcenvis.nic.in

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database on chemicals

Information collection, collation and dissemination

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Preparation of monograph on specified chemicals of current concern

Publishing Abstract of Current Literature in Toxicology

for further details do write to

Scientist in Charge

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