IMPACT OF INDUSTRIAL EFFLUENTS ON FRESH WATER

Fresh water as a commodity generates concern being an exhaustible resource and due to the environmental issues related to its degradation. With a phenomenal development of water resources since independence, India has successfully met water requirements for different usages. Preserving the quality and availability of freshwater resources however, is becoming the most pressing of many environmental challenges on the national horizon. Perhaps, because water is considered a cheap readily available resource, people fail to realise just how much stress human demands for water are placing on natural ecosystems. The rush to industrialize has resulted in the discharge of partially treated or raw wastes into the surrounding water bodies since the development of treatment facilities has not kept pace with the rate at which the wastes are generated by the industries. The stress on water resources is from multiple sources and the impact can take diverse forms. The growth of urban megalopolises, increased industrial activity and dependence of the agricultural sector on chemicals and fertilisers has led to the overcharging of the carrying capacity of our water bodies to assimilate and decompose wastes. Different regulations put in place to protect the marine environment and other water bodies have not been effective in controlling the indiscriminate dumping of effluent into open water bodies. These effluents contain substances that range from chlorides, phosphates, oil and grease, nitrates, heavy metals, among others. The levels of the concentrations in these effluents, especially of heavy metals, have been found to be above acceptable and permissible levels. Industries are the major sources of pollutants in all environments and various levels of the pollutants are discharged into the environment either directly or indirectly.

a) **Tannery Industrial Effluents as Source of Water Pollution:** The direct discharge of effluents from tanneries into bodies of water has become a growing environmental problem. Most of these waste waters are extremely complex mixtures containing inorganic and organic compounds. The tannery operation consists of converting the raw hide or skin into leather, which can be used in the manufacture of a wide range of products. Chemical impurities mostly comprise of the following dissolved substances:- inorganic salt cations , anions, dissolved oxygen (DO)and total dissolved solids (TSS). Toxic metals especially Chromium and Iron are carried by waste water flow from tanning industries to rivers, streams and lakes, and result in pollution of the water bodies with regards to the physic- chemical properties. The levels of effluent samples from tanneries in of Kanpur and Agra reveal that all tanneries are the major sources of high chromium, sulphate, and nitrate and dissolved oxygen. Another study conducted reveals that untreated waste-water from Challawa and Sharada industries which are being discharged into Challawa river is the major factor responsible for its contamination and thus regular monitoring is needed since the river is used for various purposes including irrigation, fishing and domestic water supply.

b) **Textile Industrial Effluents as Source of Water Pollution:** Dyes of various types are used in textile industries. During the dyeing process a substantial amount of dyes and other chemicals are lost in the waste water. Textile industry can be categorized in

to three *viz*., cotton, woolen and synthetic depending upon the raw material used. The water consumption depends upon the processing operations employed during the conversion of raw fiber to textile. Textile industries are major sources of these effluents due to the nature of their operations, heavy metal contamination of an area was linked to industrial effluents.

c) **Palm Oil Effluent as a Source of Water Pollution:** Palm oil mill effluent is an important source of inland water pollution when released into local rivers or lakes. Beside the main product; that is, the crude palm oil (CPO), the mill also generates many by-products and liquid wastes, which may have a significant impact on the environment. Palm oil mill effluent (POME) is one of the major sources of pollutants produced during oil processing. In a study carried out in Nigeria, the characteristic problem associated with Palm oil mill effluents are high level of pH, dark color, BOD, COD and suspended solids (SS). When these chemicals present in water bodies are used by both plants and animals, bioaccumulation can results in their systems.

d) **Soap and Detergent Industrial Effluent as Sources of Water Pollution:** Industrial effluents from soap manufacturing industries are known to contain complex chemicals most of which are very toxic and capable of destroying the microbial habitats in a serious adverse way. For example, characterization of the composite waste-water from both soap and food processing plants indicated that the waste is highly contaminated with organic compounds as indicated by COD and BOD values.

e) **Brewery and Soft Drink Effluents as Sources of water Pollution**: Waste water from brewery industry originates from liquors pressed from grains and yeast recovery and has the characteristic odour of fermented malt and is slightly acidic. Brewery effluents, high in carbohydrate; nitrogen and the cleaning and washing reagents, have been proved as water pollutants.

WATER RESOURCES- INDIAN SCENARIO:

Discharge of untreated domestic wastewater is a predominant source of pollution of aquatic resources in India. Urban centres contribute more than 25% of the sewage generated in the country. The smaller towns and rural areas do not contribute significant amounts of sewage due to the low per capita water supply. Wastewater generated normally percolates into the soil or evaporates.

The CPCB conducted a survey in 1994- 95 (CPCB 2000a, CPCB 2000b) on water supply and wastewater generation, collection, treatment and disposal in 299 class I cities and 345 class II towns of the country. The survey findings indicated that, most cities did not have organised wastewater collection and treatment facilities. The status of wastewater generation, collection, and treatment in urban areas is as given in Table 1.

Table 1 Status of wastewater generation (w/w), collection, and treatment in class I cities and class II towns (million litres pes day)

Type	Numbe of r cities/ towns	w/w generated (mld)*	w/w collected (mld)	%age of w/w collected	w/w treated (mld)	%age of w/w treated (of collected)	%age of w/w treated (of total)
Class I cities	299	16662.5	11938.2	72	4037.2	33.8	24
Class II towns	345	1649.6	1090.3	66	61.5	5.6	3.7
Total	644	18312.1	13028.5	71	4098.7	31.5	22.4

* Also includes information gathered on industrial wastewater. Source CPCB 2000a

It also emerged that the class I cities and class II towns of Maharashtra, Delhi, Uttar Pradesh, West Bengal, and Gujarat contribute 59% of the total wastewater generated in the country. The infrastructure to collect and treat wastewater in these states is as given in Table 2.

Table 2 Status of wastewater (w/w) generation, collection, and treatment in major contributing states (million litres pes day)

State	Numbe of r Type	w/w generated cities/towns	w/w collected (mld)*	%age w/w (mld)	w/w treated collected	%age w/w (mld)	treated
Gujarat	Class-I	21	1175.8	936.7	78.6	676	51.3
	Class-II	27	191.2	137.8		25	
Maharashtra	Class-I	27	3593.4	3139	85.6	481.4	13.3
	Class-II	28	160.4	73.8		18	
Uttar Pradesh	Class-I	41	1557.7	1048.9	66.7	246.2	13.4
	Class-II	45	275.5	174		-	
West Bengal	Class-I	23	1623.1	1183	72.2	-	-
	Class-II	18	66. 9	36. 7		-	
Delhi	Class-I		2160	1270	58.8	1270	58.8
Total		231	10804	8000	74.04	2716.6	25.14

* Also includes information gathered on industrial wastewater. Source CPCB 2000a

Furthermore, the facilities constructed to treat wastewater do not function properly and remain closed most of the time due to improper design and poor maintenance, together with a non-technical and unskilled approach.

Inefficient Resource Utilisation

Water has conventionally been considered as a free commodity. Distribution losses of treated water range between 25% and 40%; losses in irrigation are even to the extent of 45% due to seepage and excess application and storage losses are estimated to be about 15% (MoWR 1999). Industrial output per unit of water withdrawal in India is only $5 per cubic metre as against output at $25 and $32 for such developed countries as Japan and Sweden. Even in the domestic sector, areas with high per capita water availability are known for poor water utilisation. The subsidy regime in the domestic sector further leaves the service providers with insufficient funds for proper upkeep of the system and finally affects the quality of service and its efficiency.

Water quality:

The major rivers of the country have generally retained pristine water quality in the less densely populated upper stretches where the likelihood of getting affected by man's interference is minimal. As the rivers enter the plains, these start getting exploited for irrigation and receiving pollution discharges due to human activities such as intensive agriculture, use of fertilisers and insecticides, domestic sewage, industrial effluents etc. Thus in the middle stretches, the rivers are most affected both, due to increased water requirement for various consumptive and non-consumptive uses, and degraded water quality. Increased quantity of wastes of a more complex nature finds way into the river and tends to deteriorate the water quality. This makes the situation grave especially during the lean flow season when the amount of dilution water available is less.

The Central Pollution Control has been monitoring water quality of national aquatic resources in collaboration with concerned State Pollution Control Boards at 507 locations, of which 430 stations are under MINARS (Monitoring of Indian Na- tional Aquatic Resources), 50 stations are under GEMS (Global Environmental Monitoring Systems) and 27 stations under the YAP (Yamuna Action Plan). The polluted stretches identified in some of the major rivers are based on regular monitoring. The water quality and desired water quality have been classified as A, B, C, D, and E, which reflect the best use of the water.

The water quality monitoring results obtained during 1998 indicate that organic and bacterial contamination still continue to be critical sources of pollution in Indian aquatic resources. BOD concentrations below 3 mg/l were observed in 61% of the samples as against 65% in 1997. BOD between 3 to 6 mg/ l was observed in 24% of the samples as against 28% in 1997 and BOD exceeding 6 mg/l was observed in 14% of the samples, which is the same as in 1997. The number of observations having high coliform density increased in 1998 against 1997. The Yamuna river is the most polluted in the country having high BOD and coliform in the stretch between Delhi and Etawah. Other severely- polluted rivers are the Sabarmati at Ahmedabad, Gomti at Lucknow, Kali, Adyar, Cooum (entire stretches), Veghai at Madurai, and Musi d/s of Hyderabad.

CWC's studies on chemical composition of groundwater in phreatic zones have revealed that in many cases anomalously high concentrations of nitrates, potassium and even phosphates are present in contrast to their virtual absence or low concentration (nitrate and potassium < 10 mg/l) in semi-confined and confined aquifers. The unsystematic use of synthetic fertilisers coupled with improper water management has affected the groundwater quality in many parts of the country. The statewise brief account of the incidence of groundwater pollution also reflects the occur- rence of high concentrations of heavy/toxic metals, fluoride and nitrates at different locations around the country. The presence of zinc in shallow aquifers of Delhi is reported at places located close to areas of intensive agricultural practices coupled with extensive use of chemical fertilisers.

Even with strong legislative provisions such as the Water (Prevention and Control of Pollution) Act and the Environment Protection Act, since 1974 and 1986 respectively, 851 defaulting industries were located along the rivers and lakes in 1997. The Water Cess Act, 1977 has also failed to act as a market based instrument in reducing the quantity of polluted discharges.

Conservation Strategy: The current institutional arrangement for managing water resources in India involves various government agencies. At the central level, the Ministry of Water Resources (MoWR) is responsible for developing, conserving and managing water as a national resource covering areas as diverse as irrigation, ground water exploitation, drainage and flood control. The MoWR functions through the Central Water Commission, National Water Development Agency and Central Ground Water Board. The Ministry of Environment and Forests (MoEF) is the nodal agency for water quality and environmental matters.

Water supply in urban and rural areas is coordinated by the Ministries of Urban Affairs and Rural Development, respectively. Besides, water is also a subject of several other ministries and departments such as the Ministry of Agriculture, Power, Health and Family welfare, Surface Transport and the Inland Waterways Authority.

- The National Water Policy, 1987, formulated by the Government of India accords top priority to drinking water supply in the allocation of water resources for various beneficial uses. After drinking water, the list includes irrigation, hydropower, navigation and industrial and other uses. The policy also addresses issues such as planning of water resource development projects, max- imising water availability, water pricing, water quality, water zoning for proper management of resources and other issues.
- The government explicitly enacted the *Water (Prevention and Control of Pollution) Act, 1974,* with the primary objective of preventing and controlling of water pollution. The Water Act established the Central Pollution Control Board and the state pollution control boards for its implementation. The Water Act empowers the state pollution control boards to lay down and maintain location and source specific standards for discharge of wastewater. The actual provisions for enforcement such as penalties, imprisonment etc. are confined to

source- specific standards for individual polluters.

- *The Environment Protection Act, 1986*, is an umbrella act providing for the protection and improvement of environment and for matters connected therewith. It authorises the central government to intervene directly in order to protect the environment and also allows public interest litigation for the same purpose. The nature of penalties under this act is similar to those authorised under the Water Act.
- The government has also introduced, as a supplementary measure, major economic incentives for pollution abatement, besides the 'command and control' regulatory mechanism. The *Water Cess Act* was introduced in 1977, empowering the state pollution control boards to levy a cess on local authorities supplying water to con- sumers and on consumption of water for certain specified activities. The Act also provides for a rebate on the cess payable if the local authority or industry concerned installs a plant to treat sewage or trade effluent. The cess rates were increased three fold in February 1992. A rebate of 25% on the cess payable has been provided to those industries whose wastewater discharge does not exceed the quantity declared by them and which also comply with the effluent standards prescribed under the Water Act and the Environment Protection Act.
- Under the 1994 EIA notification, an *Environmental Impact Assessment* has been made mandatory for 30 categories of development activities involving investments of more than Rs 500 million and above and environ- mental clearance for activities is given by the MoEF.
- Under the *National River Action Plan (NRAP)*, certain stretches of major rivers with high or intermediate levels of pollution were identified by the CPCB. Sewage col- lection and treatment works being created to reduce the pollution load to these rivers include schemes for better sewage inter- ception and diversion, construction of sewage treatment plants, provisions for low cost sanitation and other schemes. In the first phase, in the GAP (Ganga action plan), 29 towns were selected along the river and 261 schemes of pollution abatement sanctioned. At present, 156 towns are being considered under the NRAP, out of which about 74 towns are located on the river Ganga, 21 on the river Yamuna, 12 on the Damodar, 6 on the Godavari, 9 on the Cauvery, 4 each on Tungbhadra and Satlej, 3 each on the Subarnarekha, Betwa, Wainganga, Brahmini, Chambal, Gomti, 2 on the Krishna and one each on the Sabarmati, Khan, Kshipra, Narmada, and Mahanadi (MoEF 1999) (Photo 11.3).
- To focus on urban lakes subjected to an- thropogenic pressures, the *National Lake Conservation Plan (NLCP), 1993* was prepared. Bhoj Lake of Madhya Pradesh is already getting assistance under funds provided by OECF, Japan.
- Under the World Bank aided Industrial Pollution Control project there is a provi- sion of loan and grant assistance to proposals of construction of Common Effluent Treatment Plants (CETP) for the treatment of effluents from a cluster of industries particularly of small scale (CPCB 1999c).

Policy Gaps: The major bottleneck in an effective policy formulation and implementation is the current institutional set-up involving vari- ous government agencies. Further, there is a separation of responsibilities on the basis of water quality and quantity. As many as eight agencies are involved in collecting data on the following water-related parameters: quality of surface

water, ground water quality, monitoring of drinking water quality, sanitation and drinking water supply. Such a fragmentary approach, both at the central and state levels, results in duplication and ambiguity of functions and discourages unitary analysis of this scarce resource. For ance, the CPCB monitors the water quality at 507 locations and the CWC separately measures water quality at another 300 locations (TERI 1998). How- ever, co-ordination between the two agencies in fixing the monitoring locations and defining monitoring protocols is missing.

- Water being a state subject, the states are empowered to enact laws or frame policies related to water. Even then, only some of the states have set up organisations for planning and allocating water for various purposes. Though water policy for the country has been prepared by the Ministry of Water Resources (MoWR), only four of the states have their own respective state water policies.
- A proper legal framework for regulating withdrawals of groundwater is not in place. Though efforts have been made to check the overexploitation of groundwater through licensing, credit or electricity restrictions, these restrictions are directed only at the creation of wells. Even the licenses do not monitor or regulate the quantum of water extracted.
- The water cess in industries, is potentially an effective instrument for inducing abate- ment, but the rates of raw water are so low that the rebate has been as much of an incentive so far. Market-based instruments to encourage resource conservation mainly in the agriculture and domestic sector have not been really tried. This accompanied with the subsidy regime in these sectors has resulted in poor resource usage efficiency.
- It was realised during the later stages of implementation of the Ganga Action Plan, that the local authorities were not able to operate and maintain these assets due to inadequate resources and skills. The level of commitment required from the state agencies was also missing. The pollution arose from a number of diffused sources either urban or rural.