Introduction

About water issues

Water is crucial resource for all existence on this earth as well as an essential part of the global ecological system. Water quality and quantity problems are a major concern in all the countries. Nevertheless, specific situation of water issues can differ from region to region and from country to country.

Water availability

Water stocks on earth can be divided into two categories i.e. salt water and fresh water. The total volume of water on earth is about 1386 million cubic km. Only 2.5 per cent of the total volume of water is fresh water and less than 1 per cent of all fresh water is directly available for human use. From a global point of view, water is unevenly distributed, with great natural variations in availability at the local level. Drought and desertification are day-to-day realities for many people and have a devastating impact on people's livelihoods. Availability of water for purposes like drinking, irrigation and industrial use are the major concerns.

Agenda 21 of the World Commission on Sustainable Development in June 1992 recognized that the objective of water management is to maintain adequate supplies of water of a good quality for the entire population, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water-related diseases. Agenda 21 has identified the following key action areas for the freshwater sector.

- Drinking water supply and sanitation for urban and rural development.
- Water for sustainable food production.
- Protection of water resources, water quality and aquatic ecosystems.
- Water resource assessment including evaluation of impacts of climate change on water resources.
- Integrated water resources development and management.

Water Pollution

Water resources in most developing countries are being polluted beyond their capacity to sustain traditional uses because of high population growth rates. Increasing urbanization and industrialization have exacerbated the situation by creating very large point sources of pollution. Major centers of population and rural agro-industry have seriously damaged surface water quality, even in very large rivers and groundwater has also been contaminated. The major threats to oceans are marine pollution, over-exploitation of living marine resources and coastal habitat loss. Different sectors of human activity cause marine and coastal degradation. Globally, dumping and spills by ships and sewage are a large

source of contamination of marine and coastal environment. In addition, agricultural nutrient run-off and atmospheric inputs, derived from vehicle and industrial emissions, are major sources of contamination. The principal water sources for direct human use are lakes, rivers, soil moisture and the relatively shallow groundwater basins. These principal water sources are a very small proportion of the total volume of water on earth (0.01 per cent). Sources of pollution include untreated sewage, chemical discharges, petroleum leaks and spills, dumping of waste in old mines and pits and agricultural chemicals and manure that are washed off or seep downward from farms. Around the world, 261 river basins are shared by two or more countries. More than half the world's major rivers are 'seriously depleted and polluted, degrading and poisoning the surroundings ecosystems, threatening health and livelihood of people who depend on them'. Groundwater reservoirs, also referred to aquifers, are also vulnerable for the threats of contamination and overuse.

Causes of water pollution

Causes of water pollution can be classified under two broad categories , **'point source'** which occurs when harmful substances are emitted directly into a body of water and **'nonpoint source'** which delivers pollutants indirectly through transport or environmental change. An example of a point source of water pollution is a pipe from an industrial facility discharging effluent directly into a river. An example of a nonpoint-source of water pollution is when fertilizer from a farm field is carried into a stream by rain (i.e. run-off). Point-source pollution is usually monitored and regulated, though political factors may complicate how successful efforts are at true pollution control. Nonpoint sources are much more difficult to monitor and control, and today they account for the majority of contaminants in streams and lakes.

Other causes of pollution of water could be **pesticides** and **fertilizers** which run-off from fields into local streams and rivers. Many causes of pollution, including sewage, manure, and chemical fertilizers, contain "nutrients" such as nitrates and phosphates. Deposition of atmospheric nitrogen (from nitrogen oxides) also causes nutrient-type water pollution. In excess levels, nutrients over-stimulate the growth of aquatic plants and algae. Excessive growth of these types of organisms clogs our waterways and blocks light to deeper waters while the organisms are alive; when the organisms die, they use up dissolved oxygen as they decompose, causing oxygen-poor waters that support only diminished amounts of marine life. **Oil, gasoline and additives** also contribute to water pollution, caused by oil spills as well as by drips of oil, fuel, and fluid from cars and trucks, dribbles of oil spilled onto the ground at the filling station and drips from industrial machinery. These sources and more combine to provide a continual feed of petroleum pollution to all of the world's waters, imparting an amount of oil to the oceans every year. **Mining** is also a source of water pollution as the mining process exposes heavy metals and sulfur compounds that were previously locked away in the earth. Rainwater leaches these compounds out of the exposed earth, resulting in "acid mine drainage" and heavy metal pollution that can

continue long after the mining operations have ceased. The action of rainwater on piles of mining waste (tailings) also transfers pollution to freshwater supplies. In the case of gold mining, cyanide is intentionally poured on piles of mined rock (a leach heap) to chemically extract the gold from the ore. Some of the cyanide ultimately finds its way into nearby water. Huge pools of mining waste "slurry" are often stored behind containment dams. If a dam leaks or bursts, water pollution is guaranteed. **Chemical and industrial processes** also contribute heavily to water pollution. Central Pollution Control Board found that groundwater was unfit for drinking in all 22 major industrial zones it surveyed as a result of hazardous liquid waste—solvents, heavy metals, and radioactive materials released on the ground seeping directly into deep groundwater. Another major cause of water pollution is **sewage.** In developing countries, an estimated 90 per cent of wastewater is discharged directly into rivers and streams without treatment. Even in modern countries, untreated sewage, poorly treated sewage, or overflow from under-capacity sewage treatment facilities can send disease-bearing water into rivers and oceans. Leaking septic tanks and other sources of sewage can cause groundwater and stream contamination.

Impact of water pollution on health and environment

Human infectious diseases are among the most serious effects of water pollution, especially in developing countries, where sanitation may be inadequate or non-existent. **Waterborne diseases** occur when parasites or other disease-causing microorganisms are transmitted via contaminated water, particularly water contaminated by pathogens originating from excreta. These include typhoid, intestinal parasites, and most of the enteric and diarrheal diseases caused by bacteria, parasites, and viruses. Among the most serious parasitic diseases are amoebiasis, giardiasis, ascariasis, and hookworm. **Water-based diseases** are somewhat similar to water-borne diseases but are not typically an effect of water pollution. They come from infectious agents that naturally spend part of their life cycles in water. Humans can become infected when they drink or come in contact with the water that serves as home to these organisms. One of the most widespread examples in this category is schistosomiasis, which currently infects 200 million people in 70 countries. Similarly, diseases like malaria and dengue fever are spread by insects that breed or feed near water.
Effects of water pollution on the environment include nutrient pollution which is the most widespread, chronic environmental problem in the coastal ocean. The discharges of nitrogen, phosphorus, and other nutrients come from agriculture, waste disposal, coastal development, and fossil fuel use. Once nutrient pollution reaches the coastal zone, it stimulates harmful overgrowths of algae, which can have direct toxic effects and ultimately result in low-oxygen conditions. Certain types of algae are toxic. Overgrowths of these algae result in "harmful algal blooms," which are more colloquially referred to as "red tides" or "brown tides." Zooplankton eat the toxic algae and begin passing the toxins up the food chain, affecting edibles like clams, and ultimately working their way up to seabirds, marine mammals, and humans. The result can be illness and sometimes death. The toxins found in brown-tide algae are strong enough that fishers can get skin lesions from exposure and

coastal homeowners can be sickened from just the airborne toxins associated with a nearby brown tide. Developed countries have started monitoring for toxic algal blooms, closing fisheries as necessary. This has reduced the incidence of related human illness but has had the obvious economic cost of lost income for fishers and related businesses. Nutrient-pollution-driven blooms of non-toxic algae and seaweed can also cause problems by reducing water clarity, making it hard for marine animals to find food and blocking the sunlight needed by sea grasses, which serve as nurseries for many important fish species. When the algal overgrowths finally die, they sink to the bottom and begin decomposing. This process uses oxygen from the surrounding water. In some cases, the decomposition process takes enough oxygen out of the water that the level falls too low to support normal aquatic life and the region becomes a coastal dead zone.

Other sources of pollution like sewage, chemicals, industrial waste, oil spills kill marine life and thus, destroy biodiversity. A newly emerging threat is the hormone-disrupting character of many chemicals. More generally, the effects of hormone-disrupting chemicals include interrupted sexual development; thyroid system disorders; inability to breed; reduced immune response; and abnormal mating and parenting behavior. In humans, endocrine disruptors are thought to lead to degraded immune function, mental impairment, decreased fertility, and increases in some types of cancers.

Water pollution in India

The increasing population along with the associated developmental activity has played havoc with freshwater sources the world over and India is no exception. The estimated utilizable freshwater resources of the country - both surface and groundwater put together are 1086 km^3 and are expected to be able to meet the demands up to the year 2050. The water quality of the surface water sources is, however a cause of grave concern as in most of the rivers and lakes it does not even meet the bathing quality standards let alone those for human consumption.

Most rivers are facing a water shortage and that is a major problem, heightening the pollution level. In the last 20 years, the area under agriculture has been augmented with increased irrigation drawn from our rivers. The use of fertilisers and pesticides has increased in a big way and this in turn has pushed up the demand for water for irrigation. With the population explosion, urban centres are spreading and there is greater generation of waste water. Municipalities, do not have the resources to treat waste water. According to CPCB, of the 17,600 million litres of waste water generated in the country every day, only 4,000million litres are treated. Vast quantities of untreated waste water are getting into our water bodies and the environment.

Of the 45,000 km length of our rivers, 6,000 km have a bio-oxygen demand (BOD) above 3mg/l (milligrams per liters), which means they are unfit for drinking and the Yamuna, a

critically sick river, a BOD of 35 to 40 mg/l. The coliform content in the Yamuna is as high as in raw sewage and for all practical purposes the Yamuna is dead. In Punjab and Haryana where the sewage is farmed, 90 per cent of the waste water is used for irrigation and does not get into the water system. In Gwalior, Madhya Pradesh, too, waste water is used for irrigation. While some environmentalists may be willing to justify the use of waste water for irrigation, others point out that the high content of pathogens in waste water would affect the purity of tomatoes and other vegetables even while providing them nutrients for their growth. A large number of our cities have no sewer lines so sewage accumulates in ugly, smelly cesspools that attract mosquitoes, then leach into the groundwater. Some cities have sewer lines but they are choked by garbage and the accumulated waste water then percolates into the groundwater.

In India the main source of river pollution is city sewage. However, industrial pollutants are on the rise. In the current year it is estimated that some 30,000 million liters of pollutants are entering our river systems every day, 10,000 million liters from industrial units alone. With industrial development on the rise, industrial pollution accounts for 33 per cent of the total pollution as against 20 per cent a decade ago.

Environmental legislation relating to water pollution in India

Primary Acts/rules relating to water pollution

The water (Prevention and Control of Pollution) Act, 1974 was one of the first environment legislations in India. The purpose of this act is "to provide for the prevention and control of water pollution and the maintenance or restoring wholesomeness of water for the establishment, with a view to carrying out the purpose of aforesaid of Boards for the prevention and control of water pollution, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith." This is the Act that established the Central Pollution Control Board and State Pollution Control Boards for to promote cleanliness of streams and wells in different areas of the States by prevention, control and abatement of water pollution.The acts and rules which seek to prevent water pollution in India are:

- The Water (Prevention and Control of Pollution) Act, 1974, amended 1988
- The Water (Prevention and Control of Pollution) Cess Act, 1977, amended 1992 and 2003. The Water (Prevention and Control of Pollution) Rules, 1975.
- The Water (Prevention and Control of Pollution) Cess Rules, 1978
- Standards to prevent & control water pollution for Small-scale Industries located in the Union Territories.

Supporting policies/legislations

These policies/legislations do not specifically talk about water pollution but they do refer to the pollution happening to the ground water, river water and lake water. Before

embarking on audit on water pollution, it is essential that auditors go through the provisions of these policies/legislations.

- **Environment Protection Act, 1986**—In the wake of Bhopal tragedy, the Government of India enacted the Environment (Protection) Act, 1986 (EPA) under article 253 of the constitution. The purpose of the Act is to act as an "umbrella" legislation designed to provide a frame work for Central government co-ordination of the activities of various central and state authorities established under previous laws, such as Water Act & Air Act. The potential scope of the Act is broad, with "environment" defined to include water, air and land and the inter-relationships which exist among water, air and land, and human beings and other living creatures, plants, micro-organisms and property. Environment protection rules were also enacted as a corollary to this Act.
- **National Conservation Strategy and Policy Statement on Environment and Development, 1992**--This proposed some of the specific means through which the goals of an environmentally wise society could be attained.
- **Policy Statement for the Abatement of pollution, 1992**-- The objective of document was to integrate environmental considerations into decision-making at all levels. To achieve this, the document laid down steps to be taken to prevent pollution at source, encourage, develop and apply the best available practicable technical solutions.
- **National Environment Policy, 2004 and 2006**-- The principal objectives of the policy in 2004 were the conservation of critical environmental resources, intra-generational and inter-generational equity, integration of environmental concerns in economic and social development, efficiency in environmental resource use, environmental governance and enhancement of resources for environmental conservation. The NEP 2006 is intended to be a guide to action: in regulatory reform, programmes and projects for environmental conservation; and review and enactment of legislation, by agencies of the Central, State, and Local Governments. The policy also seeks to stimulate partnerships of different stakeholders, i.e. public agencies, local communities, academic and scientific institutions, the investment community, and international development partners, in harnessing their respective resources and strengths for environmental management. The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource. The policy also seeks to stimulate partnerships of different stakeholders, i.e. public agencies, local communities, academic and scientific institutions, the investment community, and international development partners, in harnessing their respective resources and strengths for environmental management.
- **Vision Statement on Environment and Health**—the purpose of this document was to evolve a strategy of health-risk reduction arising from environment pollution

would help the implementing agencies to revise the environmental and industry specific actions.

Legislative framework or Water Pollution in India

Water pollution

Acts

- The Water (Prevention and Control of Pollution) Act, 1974, amended 1988.
- The Water (Prevention and Control of Pollution) Cess Act, 1977, amended 1992 and 2003.

Rules

- The Water (Prevention and Control of Pollution) Rules, 1975.
- The Water (Prevention and Control of Pollution) Cess Rules, 1978.
- Central Board for the Prevention and Control of Water Pollution (Procedure for Transaction of Business) Rules, 1975 amended 1976.

Notifications

- Date on which the Water (Prevention and Control of Pollution) Cess (Amendment) Act, 1974 (6 of 1974) came into force and Date on which the Water (Prevention and Control of Pollution) Cess (Amendment) Act, 2003 (19 of 2003) came into force.
- Rate of Cess notified under the Water (Prevention and Control of Pollution) Cess (Amendment) Act, 1977(36 of 1977).
- Effective abatement of pollution and conservation of the river Ganga, Notification. S.O.583(E) Water Quality Assessment Authority, Order.
- Water Quality Monitoring Order 2005, Notification.

Full test of all the acts, rules and notifications relating to air pollution can be found at **http://envfor.nic.in/legis/water.htm**

Programmes of MoEF on reduction of water pollution

Apart from acts/laws for the control and prevention of water, MoEF also funds programmes for reduction pollution. These are:

- **National River Conservation Programme:** The river cleaning programme was started in 1985 with the launching of Ganga Action Plan (GAP). The main objective of the GAP phase I was to improve the water quality of Ganga to acceptable standards by preventing pollution reaching the river. However, on the recommendations of the Monitoring Committee of GAP Phase I, the objective of the plan was recast to restoring the river water quality to the designated best use class of Ganga, which was bathing class. In 1995, GAP was further extended to other major rivers of the country under NRCP. NRCP comprises of (a) GAP II and (b) Other major rivers conservation plans. The objective of NRCP is to improve the

water quality of the major rivers, which are the major fresh water sources. NRCP covered pollution abatement works in **164 towns** along the polluted stretches of **35 rivers** spread over **20 States**. The total approved cost of NRCP was Rs 4733.03 crore (excluding establishment, R&D and consultants cost of Rs 130.73 crore). The pollution abatement works had to be carried out in the state based on DPR submitted by the state government to MoEF. The DPR would contain details of the pollution abatement activities envisaged to be implemented in the state along with the scheduled completion date. The DPR would be approved by the MoEF with revisions in cost or scope of work, if any. The different activities for pollution abatement would have to be implemented by the implementing agency in the state, in accordance with the DPR.

- **National Lake Conservation Programme:** The National Lake Conservation Plan (NLCP) was initiated in June, 2001 with approval of 3 lakes namely, Powai (Mahrashtra), Ooty & Kodaikanal (Tamil Nadu). The scheme as approved as 100% Centrally Sponsored Scheme (CSS). The funding pattern under NLCP was, however, changed to 70:30 cost sharing between Central and State governments w.e.f. Feb 2002. The objective of the scheme was to restore and conserve the polluted and degraded lakes of the country. To begin with, NLCP proposed to cover urban lakes of tourist importance especially those not covered under the wetland program of the Ministry. The scope of work under NLCP has, however, been expanded during the X Plan to include rural water bodies also.

Standards for Water quality

CPCB in collaboration with concerned SPCBs/PCCs established a nationwide network of water quality monitoring comprising 1019 stations in 27 States and 6 Union Territories. The monitoring is done on monthly or quarterly basis in surface waters and on half yearly basis in case of ground water. The monitoring network covers 200 Rivers, 60 Lakes, 5 Tanks, 3 Ponds, 3 Creeks, 13 Canals, 17 Drains and 321 Wells. Among the 1019 stations, 592 are on rivers, 65 on lakes, 17 on drains, 13 on canals, 5 on tanks, 3 on creeks, 3 on ponds and 321 are groundwater stations.

Presently the inland water quality-monitoring network is operated under a three-tier programme i.e. Global Environment Monitoring System (GEMS), Monitoring of Indian National Aquatic Resources System (MINARS) and Yamuna Action Plan (YAP). Water samples are being analysed for 28 parameters consisting of 9 core parameters, 19 other physico-chemical and bacteriological parameters apart from the field observations. Besides this, 9 trace metals and 22 pesticides are also analysed in selected samples. Biomonitoring is also carried out on specific locations. In view of limited resources, limited numbers of organic pollution related parameters are monitored i.e. micro pollutants (Toxic Metals & POPs) are analysed once in a year to assess the water quality. The water quality data are reported in Water Quality Status Year Book.

Water Quality Standards—

Designated Best Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism 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
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
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
Propagation of Wild life and Fisheries	D	Free Ammonia (as N) 1.2 mg/l or less
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
	Below-E	Not Meeting A, B, C, D & E Criteria

- **Standards to prevent & control water pollution for Small-scale Industries located in the Union Territories**-- This lays down standards for compliance by small-scale industries located in the Union Territories, in respect of which Minimal National Standards have not been yet evolved.

- **Effluents:** CPCB has also set standards for the discharge of effluents by industries like Battery Manufacturing Industry, Oil Refinery, Bullion Refining, Oil Drilling & Gas Extraction Industry, Environment Standards for Coal Mines, Organic Chemicals Manufacturing Industry , Paint Industry, Coal Washeries, Pesticide Industry, Coke Ovens , Petro-chemicals, Diary Industry , Dye & Dye Intermediate Industry , Edible Oil & Vanaspati Industry, Pulp & Paper Industry (Small), Refractory Industry, Electroplating Industry, Slaughter House, Meat & Sea Food Industry, Small Scale Industry, Soda Ash Industry, Starch Industry, Sugar Industry, Synthetic Rubber, Tannery, Thermal Power, Thermal Power Plant (Gas/Naptha Based) Plant, Thermal Power Plant : Temperature Limit for Discharge of Condenser Cooling Water, Water