IMPACT OF POLLUTION ON FRESH- AND MARINE WATER RESOURCES - A REVIEW

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ABSTRACT

The Asia-Pacific Marine resources are economically important to most countries. It is the centre for global mariculture. But, now, it has become a major cause of concern as this area is continuously being exposed to heavy pollution and increase in fish catch using destructive fishing techniques. Although marine pollution due to discharge from river heavily contaminated with municipal sewage and untreated industrial effluents, dumping of land based solid waste into sea, accidental oil spills and increased use of pesticides and fertilizer are becoming evident, level of pollution in coastal waters is still manageable. Many countries of Asia-Pacific region have joined various international and national agreements to resolve the problem. Satellite imageries and information available with Survey of India indicates that most of the 2700 lakes in Bangalore Metropolitan Region have dried up. Over the years, Urbanization has claimed some of the lakes. Karnataka is among the priority area under a pioneering project to conserve lakes in the country. National River Conservation Directorate, Ministry of Environment and Forest (MoEF) and National Lake Conservation Plan (NLCP) aim at an integrated approach to restore and protect lakes. Signs and consequences of human activity is found everywhere on the earth. The impact of aquatic pollution on lakes and marine environment is discussed in present paper.

KEY WORDS: Freshwater, marine, coastal pollution, effluents, fishes.

INTRODUCTION

Water resources have been the most exploited natural systems since man strode the earth. With the rapid development of Industrialization and an increase in human population, the pollution of water bodies has become a universal phenomenon in the present day world. Water quality of the coastal areas, estuaries and major river around the world is getting rapidly degraded due to massive discharge of industrial wastes of diverse origin, domestic sewage, mine drainage, oil spills, extensive use of agro-chemicals and use of destructive fishing techniques etc. Development of coastal towns and industries, aquaculture, dredging of sea floor etc., has resulted in degradation of land and mangrove forests. Human interferences have also exerted adverse impact on river and lake ecosystem. This anthropogenic activity leads to depletion of oxygen in water, elevated BOD load, changes in transparency, pH, phosphate, nitrate, COD and mineral concentration causing rapid eutrophication thus degrading water quality. This unabated exploitation of ecosystem is exerting tremendous strain on aquatic communities including plankton, fishes and other invertebrates.

Importance of Coastal Regions

Coastal areas are physical buffers protecting communities near the coast from storm surges and flooding. Oceanic fisheries and oil and gas are taken from the continental shelf close to the coast for the requirement of human population. US $8 to $10 billion is generated each year in US by the coastal activities such as canoeing, bird watching, swimming, sport fishing and tourism. People use beaches for recreation and relaxing.

Estuaries are nurseries for many fish and shellfish and they are home for wildlife. Seventy five % of commercially harvested fish and shell fish depend on estuary and nearby coastal water for some part of their life cycle. Puget Sound supports 220 species of fish, 100 species of shore and seabirds and 26 species of marine animals. Galveston Bay supports more than 162 species of fish. Chesapeake Bay supports more than 3,000 migratory and resident species of

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wildlife. Fishes come to Laguna Madre, the natural fish hatcheries of our oceans, to spawn, and then return back to the Gulf. Lakes and other freshwater bodies recharge underground water table, cooling of the ambient air and reducing heat in the surrounding areas of the city. Islands formed in the lakes attract variety of birds and act as a nesting place and recreational spots for localities as well as educative research bodies for children and students.

Incidence of Ecological Significance Threatening Biodiversity and results of these activities

Nutrient pollution causes excess growth of plants and algae which clogs our water ways and blocks light to deeper waters while the organisms are alive; when they die they use up dissolved oxygen causing oxygen poor water resulting in “dead zones”.

Oil spills like the Exxon Valdez spill off the coast of Alaska etc., are the cause of major water pollution for wildlife, fishermen and coastal business. Drilling and extraction of oil and gas contaminate coastal water and ground water. Components of crude oil called polycyclic aromatic hydrocarbons (PAHs) persist in marine environment for years and are toxic to marine life by affecting their development, increasing susceptibility to diseases and jeopardizing their normal reproductive cycles.

Mining is a major cause of water pollution, which exposes heavy metals and sulfur compounds which are locked in the earth. The rainwater leaches these compounds out of the earth resulting in “acid mine drainage” and heavy metal pollution. The Iron mountain mine in California USA has been closed since 1963, but it continues to drain sulphuric acid and heavy metals (cadmium and zinc) into the Sacramento River. The rivers bright orange colour is completely devoid of life, having pH of -3, which is 10,000 times more acidic than battery acid.

Chemical and industrial pollution is another source of water pollution all over the world. In US 34 billion litres/year of the most hazardous liquid waste heavy metals and radioactive materials is injected directly to deep ground water via thousands of “injection wells”. These pollutants have already entered underground water supply in Florida, Texas, and Ohio. In late 1990’s India’s Central Pollution Control Board found that groundwater has become unfit for drinking in 22 major industrial zones surveyed. Nuclear energy is also one among the causes of water pollution.

Plastics and other plastic like substances such as nylon from fishing nets, entangle fish, sea turtles and marine mammals causing pain, injury and death. Plastic, which is broken down into micro particles, is ingested by tiny marine organisms and is moving up the marine food chains. The plastic does not decompose - it remains in the ecosystem to kill again and again.

Household cleaning products and pharmaceuticals for example laundry detergents, shampoo, toothpaste etc., and medicines like antibiotics, steroids etc., whenever used goes down the drain in altered or unaltered form into the local water waste that accepts the treatment plant’s supposedly clean effluent. Effects of these chemicals are being studied and the scientists have found fragrance molecules inside fish tissues. Ingredients from birth control pills are thought to be causing gender-bending hormonal effects in frogs and fishes and the chemical nonylphenol, a remnant of detergents, is found to disrupt fish reproduction and growth.

Other pollutants

In developing countries, an estimated 90% of wastewater, untreated sewage etc., is discharged directly into rivers and streams without treatment. This causes ground water and stream contamination. Beaches are also affected due to water pollution from sewage.

Sudden fall in dissolved oxygen in lakes due to drainage or seepage of household (highly concentrated detergents) and industrial effluents choke the fishes to death (Fig 1) as per the reports of Pollution Control Board, Lake Development Authority, Fisheries Cooperative Society and other concerned authorities. Dead fishes both small and big - including silver carp, grass carp, rohu, catla were found in thousands in lakes like Ulsoor, Vengaiah and Sarakki Jalaganahalli lake in Bangalore, Karnataka and Kankaria lake in Ahmedabad. The reason being low oxygen, high level of chlorophyll ‘a’ and pH level 9.2 due to discharge of untreated sewage, acids and other industrial effluents.

Surprisingly enough, air pollution contributes substantially to water pollution. Pollutants like mercury, sulphur dioxide, nitric oxides and ammonia deposit out of the air and then cause problems like mercury contamination in fish, acidification of lakes and eutrophication. Man made carbon dioxide absorbed by the ocean caused an increase in ocean acidification, which will subsequently cause the carbonate structure of coral,
Fig. 1. Impact of anthropogenic activities on freshwater lakes & sea

Fig. 2. Coastal Pollution

algae and marine plankton to dissolve.

Increased water temperature caused by discharges of cooling water by factories resulted in death of many aquatic organisms. Global warming is also imparting additional heat to the oceans.

The ever-increasing noise from ship engines and sonars has a negative effect on the sounds of marine mammals, sea turtles and fishes, which they use to communicate, navigate and hunt.

In India dead bodies are a cause of water pollution, since the half burnt body is immersed into the sacred Ganga river.

Poorly designed landfills, hazardous waste sites wild animal droppings, cruise ships etc., are also some of the causes of water pollution.

India has a coastline of about 7000 km in which main rivers flowing from the mainland discharge about 1645 km³ of freshwater annually to the sea (75% is added to Bay of Bengal) (Rajendran and Subramaniam, 1998). There are enormous quantities of pollutants added to the sea for example pesticides, untreated industrial and sewage effluents in river Yamuna, (Chandra et al., 1998), river Bhavari a tribute of river Cauveri (Srinivasan et al., 1998) and numerous other estuaries are also similarly polluted (Fig. 3). Water quality reflects the collective influence of various physico-chemical and biological criteria of water. Biodiversity of plankton,
seaweeds and other important food resources for aquatic animals are found to be affected by water pollution.

Asian rivers account for nearly 50% of the total sediment load transported by the world's rivers (UNEP, 1992) 70% of the waste effluent discharged into the Pacific Ocean has no prior treatment 80% of the pollutants in the Yellow Sea and South Sea of Korean peninsula comes from the inland activities via the four largest Korean rivers (Government of Korea, 1994).

Pollutant input into marine environment through freshwater ways can be distinguished in three main ways

- Direct discharge of effluents and solid wastes into sea and oceans.
- Land runoff into coastal zone mainly with rivers.
- Atmospheric fallout of pollutant transferred by the air mass onto the seas' surface.

The relative contribution of each of these channels into the combined pollution input into the sea will be different for different substances in different situations. For a number of pollutants (metals, oils and some other hydrocarbons) which are distributed in the marine environment are not connected with human activity caused pollution due to the natural processes as volcanic activities splits and breaks of earth's crust, river flooding and many others. Recognizing these complications explains why many earlier conclusions about the level, flow and balance of many substances in the hydrosphere are currently under revision. The data available show that landbased and atmospheric sources account for about 2/3rd of the total input of contaminants into the marine environment, constituting 44% and 33% respectively. The main pollution stress undoubtedly falls on the shelf zones especially on the coastal areas.

Anthropogenic impact in the sea and freshwater pollution

Two reasons allow us to consider pollution as the most widespread and dangerous factors of anthropogenic impact on the hydrosphere,

1. Pollution accompanies most kinds of human activities including offshore and marine oil transportation.
2. In contrast with land ecosystems, in the water environment, pollutants quickly spread over large distances from the sources of pollution.

In the freshwater and inland ecosystems the effect of pollution are obvious and literally appear in front of our eyes. In contrast the World Ocean has a large inertia of response to all forms of external impact. It requires a long hidden period to manifest the evidence of non-obvious consequences of this impact. The danger of the situation is complicated by the fact that when it happens, it will be too late to do anything.

Indiscriminate uses of forest and land resources are threat to environment and life on land and water. Mangrove forest and swampy coastal regions are declining due to development of coastal towns and industries. In Manakudy estuary of Kanyakumari district of Tamilnadu the aquatic environment was subjected to aquatic pollution due to coconut husk rotting operation.

Society for Environmental Education and Development (SEED) Nagercoil, in 1991 organized a pilot project called operation mangroves, which was supported by Swedish International Development Agency (SIDA) to conserve these forests and estuaries (Santha Kumar G., 1998).

Pollution has many consequences

Marine animals, such as shellfish, concentrate pollutants in them. Animals that eat polluted shellfish have greater health risk for example
mercury in fish can cause health risk to human population. It may kill off a thriving tourist business in a coastal region (Fig. 2).

Dangerous species may become common causing health problems and interfering in tourism and fisheries for example a few years ago, a new organism, Pfiesteria piscicida, was found in some estuary along the eastern side which killed fish and also same to cause sores and memory loss in people who handled the dead fish.

Large quantities of nutrients and organic wastes lead to plankton blooms. When the plants die due to pollution, they decay and reduce the oxygen in deeper waters, e.g. the Gulf of Mexico Hypoxia (dead) zone caused by Mississippi river runoff.

The occurrences of “red tides” caused by blooms of particular plankton species have become environmental problem of major concerns in the coastal areas of that region. In addition to depletion of oxygen levels, which causes mass death of aquatic organisms, the red tides also caused paralytic shellfish poisoning (PSP) with serious risk to the health of fish consuming the affected shellfish.

95% of St. Francisco Bay’s original wetlands, more than 30% Connecticut’s coastal wetlands and 55% of Galveston Bay’s seagrass meadows have been destroyed. Oysters harvests in Chesapeake Bay plummeted from 25 million pounds to 1 million pound in just 30 years. The number of wild salmon returning to Maine’s rivers has dropped 80% in last 10 years.

National Academy reported that trawling and dredging affected the sea floor habitats. A single dredge can destroy living plants and animals to a depth of 10 cm and the track remains visible for 2.5 years.

Heavy metals like zinc, copper, cadmium, nickel, iron etc, domestic sewage, mine drainage, dumping of radioactive materials into the sea etc., caused a general decline in all the blood parameters viz., Hb, RBC, WBC, hematocrit (PCV), MCHC etc., in freshwater fishes e.g., Channa punctatus, Gambusia afinsis, cyprinids etc., when exposed to laboratory conditions (Sastry and Pratima, 1998, Rajshri et al., 1998).

Untreated industrial effluents and sewages discharges into lakes and rivers cause depletion in oxygen level, high level of chlorophyll ‘a’, and high alkalinity (pH 9.2) which inturn caused high mortality of fishes.

Underestimation of the striking complexity of anthropogenic impact on the water ecosystems and the use of a single-factorial approach to analyze their state, focusing on some single aspect of human activity, generally lead to a distorted picture on the consequences on such activity. Anthropogenic impact on the water environment should be defined as a cumulative manifestation of all kinds of human activity which causes obvious and hidden disturbances in the natural structure and functions of water biotic communities, anomalies in their habitats, changes in the hydrology of the water bodies, diminishing their fisheries and recreational value, and other negative effects of ecological, economic/socioeconomic nature.

Many kinds of economic activities are difficult to differentiate based on their effects in the marine and the freshwater systems. Many pure inland activities can lead to ecological changes in the marine environment. For example, dam construction, removal of river water for irrigation, use of chemicals in agriculture, deforestation, atmospheric emissions from factories and automobiles, sewage discharges into lakes and rivers and many other impacts that take place 1000 of km away from the sea shore. Sooner or later, these activities affect the ecology of estuaries, Bays, coastal waters, entire seas and ocean.

**Reviving water resources**

A large number of government and non-government bodies for example FAO, UNEP, ESCAP, WWF, GESAMP etc., have undertaken large number of projects which aim to initiate environmental corrective action. These bodies are providing financial supports to various agencies and development authorities for mapping and restoring lakes, groundwater table treatment of industrial and sewage effluents, assessment of pollutant affecting water resources, restoration and maintenance of polluted freshwater ways, coastal regions and other related aquatic environment.

**CONCLUSION**

Anthropogenic impact on the water environment may be defined as...

Cumulative manifestation of all kinds of human activity, that causes changes in marine environment. Pollution is adversely affecting and degrading the environment and consequently the quality and yield of fish in many of the reservoirs, lakes, rivers and other freshwater bodies are affected. Wastes from thermal power plants, industrial, domestic,
agricultural effluents are affecting the productivity of many of our freshwater bodies. These in turn cause immense physiological damage to fish stocks that render them susceptible to diseases, loss in breeding vigor, hamper growth and reproduction, resulting in breeding failure. The toxins (heavy metals, synthetic detergents and pesticides etc.,) recorded in water and sediments of these freshwater bodies at times accumulate in fish flesh that in high doses may cause health hazard to humans as well (Vass, 2005).

Thus, impact that takes place 1000 km away from the seashore affects the ecology of estuaries, Bays, Coastal water and entire sea and ocean.

REFERENCES


