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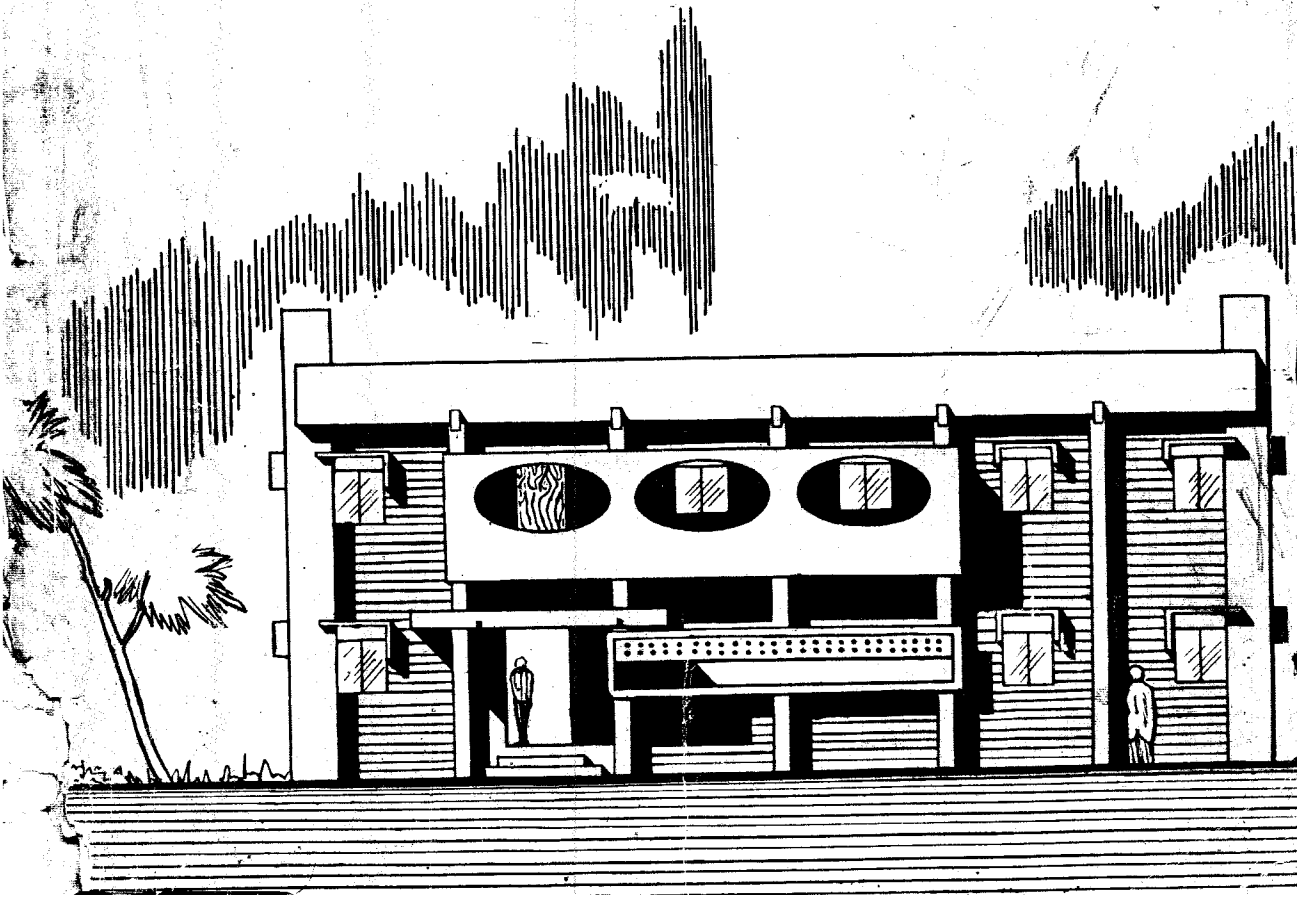

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POLLUTION OF THE AQUATIC ENVIRONMENT

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Introduction

From the earliest period of human history man lived by the side of rivers and the waters of the earth had been the dumping ground of his unwanted wastes. Till recently this was not a serious problem except in certain localised areas. But now the rivers and lakes of the highly industrialised nations have become polluted and the water which was clear and clean for thousands of years have become repulsive and malodorous due to man-made effluents. Even the seas are threatened by the great centres of population and industries located on their shores and by the increasing importance of sea transportation.

Today the total population of the world is about 3700 million. Each individual of this growing population is, on the average, using more and more material things and thus increasing the supply of wastes and adding to the problem of pollution. The rapidly increasing pollution of our natural aquatic environment is thus related to three worldwide problems which must be assessed and mastered if we are to succeed in the abatement of pollution. These are: the increasing population of the world, combined with crowding in some areas; the increasing demand by the average individual for material things; and the limited nature of both renewable and non-renewable natural resources. The magnitude of pollution in the aquatic environment in various regions depends on the density of the population and on the level of industrialization, with the capability to produce their requirements for food and other consumer goods, This can be achieved without repeating the mistakes made in the past by the industrialised nations. It is hoped that this seminar would draw the attention of the public to this problem.

Water Pollution in India

The water pollution in India is mainly an inland water problem. India has a coastline of more than 5000 km with a number of rivers and estuaries that periodically enrich the coastal waters with essential nutrients and minerals. The principal rivers of India, including their main tributaries have a total length

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of over 27,000 km and the canals and irrigation channels of 113,000 km length form a network throughout the country. From the rapid industrialisation and urbanisation since independence there have been reports of the rivers, back-waters and estuaries getting polluted. The Hooghly estuary downstream from Calcutta receives the wastes from about a hundred industries. Other polluted coastal areas are near Bombay and the outlets of the rivers Krishna, Godavari, Cooum and Chaliyar. Pillai and Jacob (1972) have described the aquatic pollution in India.

Nature and sources of water pollutants

A great variety of pollutants are produced by man and many of these reach the aquatic environment either directly or indirectly. Some of these are decomposed by biological processes but others which are resistant to decay persist in the aquatic environment for long periods. Some of the pollutants are leached out from the land or carried by rivers while others are deliberately introduced into the rivers or into the ocean. Some are dumped into sea from ships and some are transported by the atmosphere and ultimately washed out by rain on land and sea and lakes. The various pollutants that reach the aquatic environments are the domestic sewage, agricultural pesticides, oils and oil dispersants, mercury and lead, waste heat and several solid wastes, apart from the various industrial effluents.

1. Persistent Substances in the food web

DDT and other chlorinated pesticides such as dieldrin, endrin etc., have been extensively used since the mid forties. The use of pesticides for crop protection and for control of malaria and filaria has assumed large proportion. It is estimated that 625,000 tons of benzene hexachloride, DDT, endrin and other chlorinated hydrocarbons and organo-phosphates are used for crop protection. The world production of DDT is 85,000 tons The following table gives the total quantity of pesticides used in Kerala State in 1972.

Pesticides

Powders	*Quantity*
BHC 10% dust	241 . 687 Tons
BHC 50% WDP	10 . 307 ,,
DDT 50%	6 . 007 ,,
Copper Sulphate	13 . 752 ,,
Lindane Dust	7 . 568 ,,
Dithene	20 . 000 ,,

Liquids	*Quantity*
Dimacron	209.0 Lit
Malatheon	446.0 ,,
Endrin	2737.0 ,,
Paramar	981.0 ,,
Ekatox	1634.0 ,,
Folidol	1152.0 ,,
Stam F 34	4099.0 ,,
Thiodan	4427.0 ,,
Kelthane	5620.0 ,,

Cultivable area
(in thousand ha)

Net area sown:	2173
Total cropped area:	2933

DDT and its decomposition by-products have been widely distributed throughout the world and have had profound biological effects. DDT is fat soluble and accumulates in the lipid pool of organisms.* So it tends to become more and more concentrated as it is passed on to higher levels in the food chain. Zooplankton which graze on phytoplankton accumulate DDT in their tissue. Carnivorous fish and fish eating birds have still higher accumulation. Many water birds which eat fish have had their populations reduced because of the interferencc of DDT with their calcium metabolism. The egg-shells tend to become thin resulting in breakage during incubation. The persistence and biological effects of DDT have resulted in considerable rethinking on its use in spite of its short-term benefits. So a strictly controlled use of organochlorine compounds such as DDT and dieldrin for limited purposes giving no possibility for aquatic pollution is the only solution for this problem.

The organophosphorous compounds though are less persistent and are more easily degradable than organo-chlorine compounds, some intermediate decomposition products have been found to be quite toxic to other organisms including fishes. When these compounds are applied by aerial spray, coastal pollution by drifting can occur and careful control of such application is required.

The polychlorinated biphenyls (PCB) used extensively in industry as plasticizers and in paints are quite toxic. Pollution by PCB in aquatic environments especially in coastal and open sea areas has been reported in the last few years and this seems to present a serious hazard to human health. The retention time of these compounds is believed to be very long, Several countries have already prohibiied the use of PCB in open-system applications.

Mercury compounds are used in agriculture as well as in many of the electric and electronic industries. Mercury, because of its persistency and ability to convert to the highly toxic methyl mercury compounds, has created a serious pollution problem in certain lakes and seas. In Japan 111 cases of mercury poisoning occured (with 41 deaths) some time back as a result of eating fish and shell fish taken from Minamata Bay which was contaminated by effluents from an industrial plant Several lakes in Sweden and a few coastal regions in the Baltic have become so contaminated with mercury that sale of fish caught in them has been prohibited. (In Sweden consumption of fish containing mercury over 0.5 mg. per kg of wet weight is discouraged).

2. Oil

Oil tankers carry crude petroleum from the oil field to the refinery or refined products from the refinery to or between depots. The refined products are clean and rapidly evaporate when spilt at sea. Black crude and heavy fuel oils and some lubricating oils persist when spilt, causing lasting pollution problems. Because crude and residual fuel oils are incompatible with refined material, crude carriers are not used for products but make the return journey empty of cargo. A completely empty tanker ride very high in the water with much of the screw and rudder exposed.

* My own blood was found to contain 46 parts per billion (ppb) of DDT while another person from Bombay had 93 ppb. The values in the blood of people from uncontaminated areas will be less than 5 ppb.

So she takes on between 1/3 to ½ of her capacity in sea water ballast, distributed between her various cargo tanks. These tanks still carry a film of oil, clinging to the sides and to the various frames and braces across them. At some stage of the return journey a crude tanker washes her ballast tanks in order to refill them with clean water which can be discharged direct into the sea as she loads with oil. It is these tank washings that cause most oil pollution. Strict regulations against dumping of ballast water and the so called Load On Top system (LOT) now being used by many tankers (the use of one of the cargo tanks as a slop tank) have considerably reduced this source of pollution. Unburnt fuel oil from exhaust also contribute to oil pollution which has not yet been controlled.

The biological aspects of oil pollution have been studied by several scientists on many marine organisms. Shell fish polluted by fuel oil retain its components in their bodies for a very long time as they are unable to metabolise them. So if these components enter the food chain they become potential risks at higher tropic levels. For fishes oil pollution can cause several adverse things. Many predatory fishes find their preys with the aid of their oil factory senses, while others get away from their hunters using the same sense. Migrating fishes find their particular routes by a very sensitive analysis of the smell of the area. Oil and its aromatic compounds may completely hide the natural smell in the water. For a fish this is as disastrous as a man becoming blind. Further more, there are risks that fishes may be mislead by erroneous clues. The mass stranding of pilot whales on the east coast some time back might have been due to the loss of their sense of direction due to oil polluiion from the ships plying in the area. The available information shows that the whales were detracted from their course somewhere near Ceylon. Here, the area is crossed by international shipping (including oil tankers). The oiling and subsequent death of many water birds was one of the earliest and most obvious effects of oil spills. Oil will have a detrimental effect on the survival ability of some species in the sea. This may affect many other species which through the food chain are dependent on the damaged one. Oils also ccncentrate DDT and other organochlorines and retain in the sediments at much higher concentrations that they occur in the water.

The oil dispensing agents bring in still more disastrous results. They may affect the hatching of pelagic fishes. The hatched larvae my become deformed and die within one day. The chemareceptors of the larvae become blocked and so they may not be able to move to regions favourable for their survival. But as we do not have any cleansing operations at the moment on our coasts this danger does not exist.

3. Domestic Sewage, Agricultural Wastes and other Organic and Inorganic Wastes

Domestic sewage and some agricultural wastes fertilize the water and increase the rate of productivity of the aquatic ecosystem. When they are overfertilized, the waters become entrophic and the excessive growth of plants and algae becomes a nuisance. The entrophication of lakes is a serious problem in all the industrialized countries and also in some developing countries. Excessive amounts of nutrients change the algai community from one of diversity of species to that of a few. The changes in the plant population thus indirectly cause changes throughout the entire ecosystem.

When untreated domestic wastes are discharged into an aquatic environment they are attached by bacteria and decomposed to their inorganic constituents, assimilating dissolved oxygen from the water in the process. When this occurs in confined bodies of water, the oxygen required for decomposing the waste may exceed the oxygen content of the water. The water then becomes devoid of oxygen and most of the organisms will die. The determination of B. O. D. enables the quantification of pollution load from organic matter.

A variety of organic compounds occurs in the waste material from industries such as pulp and paper production. In Kerala, the coir industry will be producing a large quantity of organic wastes. So too the sea food industry, Both are vitally important industries for this State. Recycling and reuse of the materials is one potential solution to the problem.

A large number of inorganic chemicals are added to the aquatic environment as waste products. These range from innocuous to highly toxic. The most important in terms of their impact upon the natural biological system of the aquatic environment are mercury, coppor, lead, cadmium, chrominum, zinc, nickel and arsenic. They are all potentially dangerous in the aquatic environment because they are accumulative poison.

Radioative naterials, waste heat from thermal generators and some industrial plants, solid wastes from domestic uses are some of the other pollutants in the aquatic environment.

Effects of Pollution on Ecosystem and Fisheries

Effects of pollution on the aquatic ecosystem are difficult to evaluate. It will tend to eliminate some species leaving the more resistant and tolerant forms to survive The size of catches and landing of commercially important fishes may be reduced due to mass mortalities. Aquaculturists suffer considerable economic loss.

Conclusion

It may thus be seen that water pollution is a threat to water quality, as well as to the aquatic ecosystem and to fisheries. Water itself is a valuable resource and increasing amounts are being used in homes and industries. What once used to be a no-cost commodity has become a limiting factor for many undertakings. Water in some rivers of developed countries are being reused. It is technically possible to purify water to any level required. Higher water quality standards require more expensive treatment. Depending upon the use criteria and standards are set up. After that a monitering system is needed to make sure that the standards are met. But at present there is much void in the machinery and conventions necessary for the control of water pollution. But once awareness of the community and the government concern are generated the prospects of prevention of aquatic pollution are bright. The success of developing aquatic ecosystem for greater protein harvest will ultimately depend on the amelioration of pollution effects.

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