CHAPTER - I

INTRODUCTION
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Life and environment are interdependent. Man has realized that stock of our environment in nature, is limited and if we do not care to use it discriminately one day it will perhaps exhaust and man will be doomed. Environmental pollution is as old as the environment itself and in fact, is man's creation a byproduct of man's advancement mainly in industrialization, urbanisation and agricultural practices.

Pollution is highly correlated with density of population and technical development. The world population is likely to increase from the present $3500 \times 10^6$ to $7000 \times 10^6$ by 2000 A.D. (Shashikant, 1987). To accommodate increasing population and in a bid to banish poverty, many fold steps were undertaken, which comprise unplanned industrialization, deforestation, green revolution involving indiscriminate use of pesticides and chemical fertilizers.

With the advent of the green revolution in mid-sixties, resulting from the introduction of high yielding varieties of cereal crops, new pest problems arose because these varieties were more susceptible to pest attacks and fungal diseases. To get the maximum benefit out of the high yielding varieties, it was necessary to treat them against pests and diseases
with suitable pesticides. The sole motive of the farmer became to earn more and more, so a new system of monoculture, utilization of chemical fertilizers, pesticides, herbicides and insecticides developed and increased. We consume nearly 100,000 tonnes of pesticides annually and 70% of this is banned or severely restricted in western nations (Dalela, 1987). Under the U.S. Federal Environmental Pesticide Control Act, the term pesticide has been defined to include (1) any substance or mixture of substances intended for preventing, destroying, repelling or monitoring any pest (insect, rodent, nematode, fungus, weed, other forms terrestrial or aquatic plants or other forms of animal life eg. viruses, bacteria or other microorganisms) which the administrator declares to be a pest and (2) any substance or mixture of substances intended for use as a plant regulator, defoliant or desiccant (Doull et al., 1980).

Apart from agriculture, pesticides are used for public health and for the control of rodents, insects, ticks, mites, nematodes, slugs and snails which often work as carriers in transmission of so many diseases. In India DDT has prevented about 100 million cases of illness in the first eight years of its use till 1960. In our country the annual loss of income due to malaria, after World War II has been estimated as 1 billion. Malaria eradication efforts reduced this loss by 99.8% by 1965 (Gupta, 1987). Besides malaria, mosquitoes
are also responsible for other human diseases such as yellow fever, dengue and the most important to us now-a-days is the Japanese encephalitis. There is no escape from these deadly diseases other than control of the principal mosquito vector and this is possible by the use of chemical pesticides.

Although pesticides produce many good results in agriculture and public health giving enormous socio-economic benefits, their harmful effects on man and his environment is not ruled out.

Due to intense selective pressure from pesticides, a wide variety of insects, mites, animals and plants have evolved significant levels of tolerance. There is widespread pollution of food by pesticides. Almost all the samples of meat, egg, milk, milk-products, vegetables, cereals, pulses and spices, etc. collected from different parts in India showed the presence of organochlorine pesticides particularly DDT and BHC (Bindra and Kalra, 1971; Gupta, 1979; Sandhu, 1979; Lakshminarayana, 1980; Sullivan, 1980).

Besides this, pesticides ultimately gain entry into human body either due to direct exposure or through food. Some of these are metabolized and eliminated while others get deposited in adipose tissues and exert toxic effects at a later stage (Attri, 1981). In most cases, the insecticide detected
is DDT followed by BHC, other insecticides were of rare occurrences (Dale et al., 1965; Davies, 1973; Ramachandran et al., 1974; Agarwal et al., 1976; Chatterjee, 1979; Agnihotri, 1983; Katala and Chawla, 1983; Gupta et al., 1984; Stacey and tatum, 1985). The United Nations environment programme has disclosed that excessive levels of DDT and other chlorinated hydrocarbons affect functioning of liver, could effect cholestrol levels and might impair the development and functioning of nervous system. The U.S. National Cancer Institute reported that toxaphene one of the most widely used chlorinated insecticide caused liver cancer in mice and should be considered at least a potential hazard in humans. Chlordane and heptachlor have also been branded as potential carcinogen.

Increasing as well as indiscriminate use of pesticides has caused unpreceended ecological impact. A large number of pesticides applied in the field are not taken up and degraded completely by the target organism. Instead, they find their way into the rivers, lakes, streams, ponds and the sea, ultimately it starts accumulating in the atmosphere, lithosphere, biosphere and hydrosphere and causing thereby deterioration especially of the aquatic environment to a great extent.

Fish form one of the most important groups of vertebrates for man, influencing his life in various ways. "Millions of
human beings suffer due to hunger and malnutrition and fish form rich source of food and provide means to tide over the nutritional deficiencies of man. Fish diet provides proteins, fat and vitamins A and D. It contains 13 to 19 per cent of animal protein 5 to 6 per cent of iron, 0.1 to 2.6 per cent calcium and 0.5 to 2.5 per cent phosphorus as reported by Natarajan and Sreenivasan (1962). Fifty per cent of the Indian population, particularly in the coastal areas, consume fish. Besides as food, the fish is used in the manufacturing of drugs, tonics, liquid glue and insinglass, etc. With rapid growth of population, increasing food requirements can be achieved by improving fish industries. Several species of fishes are larvivorous in habit and feed upon insect larvae. Thus they play an important role in controlling and eradicating certain disease causing insects eg., *Chela*, *Puntius*, *Berilius*, *Danio*, *Colisa*, *Rasbora*, *Esomus*, *Ambassis*, *Aplocheilus*, etc. The potential yield of fisheries has been estimated at 10 million tons (8.5 marine and 1.5 Inland). India ranks 8th among the fishing nations of the world and part of its catch is being exported to the sophisticated markets of Japan, America, Europe and Australia. The export of marine products during 1977-78 which was valued at Rs. 1,810 million rose to Rs. 2,346.2 million in 1978-79 and to Rs. 2,488.2 million in 1980-81. During 1984-1985, 86,187 tonnes of marine products valued over Rs. 384.29 crore were exported. Export of marine product during 1985-86 was 83,65 tonnes valued at Rs. 398.00 crore (India 1986).
Most pollution monitoring programmes are oriented solely towards chemical and physical methods. However, these methods do not meet the requirements for an operational surveillance system related to toxic compounds (Poels, 1975). Since living organisms will respond to every possible substance or mixture of substances at some level, what their chemical or physical characteristics may be, the biological techniques are playing an important role in predicting and controlling water pollution (Cairns et al., 1977). Seth et al. (1967), Elzorgani et al. (1979), Bjerk and Brevik (1980) suggested that fish, like some other aquatic organisms could be used as indicator organisms for monitoring pesticide pollution and its impact on the aquatic environment. It has been reported by Jung (1973) and Dauson et al. (1975) that fishes are more sensitive to acute intoxication by pollutants than man. No water body should be considered in a satisfactory condition unless fish will live and thrive in it (Turing, 1947). All these facts emphasize the importance of the fish.

However, there is regular fish kills by discharge of waste waters, rapid industrialization, use of pesticides in agricultural and human health and other ways of water pollution. Pollution of any kind in the ecosystem initiates a long chain of interaction in organisms and a few of them get acclimatized to tolerable limit but majority above the threshold levels cannot tolerate and pass out (Pandey, 1985).
Pesticides enter into the aquatic environment as surface run-off (Odum, 1970; U.S.E.P.A. 1975; Battacharya, 1985; Pandey and Shukla, 1985; Satyanarayan and Krishnamoorthi, 1985), air drift during aerial application (Attri, 1981) or through direction application to inland and coastal marshes for mosquito eradication (Coppage and Duke, 1971; Guerrant et al., 1970; Pinkovski, 1972; Konar, 1975) and their possible use in fishery management practices (Mukhopadhyay and Dohadrai, 1980). According to Ware and Hoan (1970), Frank (1971) and Bindra (1972), source of pesticides in freshwater ecosystems have been classified as intentional and accidental. The intentional practices include chemicals which are used for the control of objectionable flora and fauna as well as industrial wastes, disposal of unused materials, decontamination procedures etc. and the accidental includes, drift from target areas, run-off water, irrigation, etc.

Aquatic ecosystems are particularly susceptible, since the food chains are more complex than in terrestrial systems and therefore opportunity for biological concentration of pesticides is more. Organochlorine, organophosphate and carbamate compounds are three major groups of persistent toxicants of aquatic environment in modern usage. Among these, organochlorine pesticides assume special significance as they are stable in the environment for several years, depending on the chemical, its dosage and characteristic of the environment.
(Cohen and Pinkerton, 1966; Arora et al., 1971a; Holstead, 1972; Crosby, 1973; Pimental and Goodman, 1974; Agarwal, 1985; and Shukla, Pandey, 1985; Samuel et al., 1988). Their movement and widespread distribution is due to their soluble characteristics, chemical stability and especially their tendencies to adsorb on organic matter. Living organisms have a tremendous capacity to concentrate organochlorine pesticides, especially in food chains where successive concentration occurs, as small organisms are consumed by larger ones. Therefore, low concentrations in the environment cannot be assumed to be harmless.

Pesticides when in water poses a constant threat to the non-target organisms, especially to the fishes, because pesticides are known to alter their behaviour pattern, growth and nutritional value, reproductive potential, cellular morphology and physiology, etc. The fishes get sicken or killed, when pollution develops slowly in the stream. However, in that situation they may deliberately leave the polluted areas, but sudden pollution results in the death of the fish. Fish mortality due to contamination of water has been reported quite often in different parts of the world (Chacko and Ganapati, 1949; Darsie and Corriden, 1959; Mulla, 1961; George et al., 1966; Rao et al., 1967, 1975; Pantula, 1969; Arora et al., 1970; Krishnagopal, 1976; Singh et al., 1981; Fox and Matthiessen, 1982; Jhingran, 1982; Chanda et al., 1983).
Besides this, there is a great concern about fish, developing resistant to pesticides. Ferguson (1967) has found that mosquito fish *Gambusia affinis* and sunfish *Lepomis sp.* have become resistant to endrin and can accumulate sufficient pesticides in their bodies to poison predators feeding on them. It is reported that large mouth bass have disappeared in areas where such resistant fish occur, indicating that the effects may be ecologically significant, thus presumably presenting a potential hazard to any one unfortunate enough to eat one (Ferguson, 1967).

The increased pollution of aquatic environment is highly toxic, not only to fish but also to the organisms which contribute to the food stock for the fishes (Anderson, 1960; Butler *et al.*, 1970; Chambers and Yarbrough, 1974). Fishes are the end products of the whole complex of environment, plants and invertebrates, unless their habitat continues to supply them with the food, the shelter and the breeding sites they need, they cannot thrive, even though the water may not be poisonous to them (Turner, 1947). In North America, Canada, Iraq, Egypt, India, etc., the rivers and river systems are polluted to different degrees by pesticides.

Organophosphorus and carbamate compounds are now extensively used in place of organochlorine compounds on account of their lesser residuals toxicity, but still prevention of
fish mortality remains an important object.

The present work include a study of the toxicity assess-
ment of carbaryl, malathion, BHC and endosulfan on three
fresh water teleost Heteropneustes fossilis (Bloch), Mystus
tengara (Ham) and Anabas testudineus (Bloch). Histopatholo-
gical effects induced by these pesticides in the testis and
ovary has also been investigated. In addition the accumula-
tion of pesticide residues in the testis and ovary of
H. fossilis has been studied by thin layer chromatography.