Chapter 3
Organochlorine Pesticides:
A Threat to Aquatic Ecosystems

Garima Harit
IIS University, India

ABSTRACT

Indiscriminate use of different pesticides in agriculture has increased over the years, especially in the developing countries. This influences the aquatic environment to a great extent. This also poses a great danger to freshwater organisms, including fish, which constitute a major share in the aquatic environment and contribute to the economy of the nation. Water pollution is posing intricate problems that need immediate redress. Organo-chlorine pesticides (OCPs) are a major contributor to aquatic pollution and are amongst the most serious global contaminants. In addition, organochlorine pesticides have a tendency to accumulate in aquatic biota; they also undergo food chain amplification. Lipophilic pollutants are chemically very stable and resistant to microbial, photochemical, chemical, and thermal degradation. The chemical stability of these compounds, their high lipid solubility, and their toxicity to human beings and animals has led government and researchers to feel concerned about their presence in the environment.

INTRODUCTION

Aquatic Ecosystem

An ecosystem in a water body where communities of various organisms depend on each other as well as on their environment is referred as aquatic ecosystem. Organisms which depend on water for their life activities such as feeding, breeding, shelter, etc. in order to survive are called as aquatic organisms. It is of three types namely freshwater, marine and estuarine. Freshwater covers only 8% of the earth and involves lakes, ponds and pools (lentic) and rivers and streams (lotic) habitats. Marine water bodies cover largest surface area and constitute oceans, seas, reefs, sea beds, intertidal zones, etc. Estuarine areas are those which experience the flux of both freshwater and marine water depending on tide and water currents. Animals living in these water bodies have adapted themselves according to their habitats.

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Estuaries are semi enclosed bodies of brackish water which is less salty than marine waters. Freshwater animals cannot survive in the saline environment of marine water bodies. Freshwater used for irrigation purposes in agricultural land often absorbs levels of salt that might harm freshwater organisms.

Aquatic ecosystem links human populations, land and wildlife through water. Man has shown keen interest in aquatic resources such as sea food, fisheries, fishing sport, swimming, observing natural beauty, etc. The relationship of man with his environment is essentially symbiotic and equilibrium should be maintained between the two. Rapid growth of human population, over-exploitation of natural resources and developments in agriculture and industry has contributed extensively to the presence of various pesticides in the aquatic environment. Time is perhaps not far when pure and clean water, particularly in densely populated and industrialized areas, may be inadequate for maintaining normal living conditions.

Pesticides

Pesticides are the chemicals that were designed for the human beneficial aspect to control the pests. According to FAO pesticide has been defined as, "Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies." Pesticides can protect forests and farms from crop losses and can lead to more production of yield. The application of pesticides in forests is done to reduce the spread of insects and control many insect borne human diseases like malaria, plague, etc. They are generally cost effective and their mode of application is also relatively easy. In fact in certain situations they are the only options left to deal with the pests. Indiscriminate use of different pesticides in agriculture has increased over the years, especially in the developing countries (Prashanth and Neelagund, 2008) this influences the aquatic environment to a great extent leading to a great danger to amphibians, fish, reptiles, aquatic birds and other wildlife which constitute a major share in the aquatic environment and contribute to the economy of the nation.

Protection of wildlife and water quality becomes convenient with the use of pesticides; but these have to be wisely selected and safely applied so as to avoid the surface water pollution and any sort of damage to aquatic life. Excessive use of pesticides can lead to the damage of ecosystems. They may harm untargeted animals, decrease biodiversity and might lead to extinction of species. By disturbing food chains/webs, the balance in ecosystem is disrupted, thereby affecting many aquatic and terrestrial species. Life of microorganisms, plants and fish in aquatic ecosystem is reported to be adversely affected by pesticides (Grande *et al.,* 1994; De Lorenzo *et al*., 2001; Frankart *et al*., 2003; Liess *et al*., 2005 and Castillo *et al*., 2006). In the India, excessive use of pesticides started since the 1960s with the initiation of the "Green Revolution" and in order to fetch high agricultural, yield maximum agrochemicals were used.

Pesticides have influenced the following at the community and ecosystem levels:

1. Induction of dominance by small species.
2. An increase of species richness and diversity.
3. Elongation of the food chain and reduction of energy transfer efficiency from primary producers to top predators. Pesticides may affect the population dynamics by controlling individual survival and reproduction, and by altering the sex ratio (Hanazato, 2001).