

Table I. An Example of Food Chain Concentration of a Persistent Pesticide, DDT*

	PPM** DDT RESIDUES
Water	0.00005
Plankton	0.04
Silverside minnow	0.23
Sheaphead minnow	0.94
Pickereel (predatory fish)	1.33
Needlefish (predatory fish)	3.07
Heron (feeds on small animals)	3.57
Tern (feeds on small animals)	3.91
Herring Gull (scavenger)	6.00
Fish Hawk (Osprey) egg	13.8
Merganser (fish-eating duck)	22.8
Cormorant (feeds on larger fish)	26.4

* Data from Woodwell, Wurster, and Isaacson, 1967.

** Parts per million (ppm) of total residues, DDT + DDD + DDE (all of which are toxic, on a wet weight, whole organism basis).

organs in the body, the liver is the most extraordinary. It presides over so many vital activities that even the slightest damage to it may bring about serious consequences. The liver provides bile for the digestion of fats, receives blood from the digestive tract, stores sugar and replaces it as glucose in measured quantities to keep the blood sugar at a normal level. It also builds body protein, maintains cholesterol at its proper level in the blood plasma and is a storehouse of many vitamins. But a liver damaged by pesticides is incapable of functioning properly.

Carson (1962), states that through an infinite number of experiments on animals and by observation on human subjects as well, it is very clear that chlorinated hydrocarbons directly affect the nervous system.

Accumulation of chlorinated hydrocarbons have been discovered in the sex organs of a variety of birds and mammals.

Wurster (1969), evaluates the problems of chlorinated hydrocarbons as follows:

The chlorinated hydrocarbon insecticides, now among the world's most widely distributed synthetic chemicals, are contaminating a substantial part of the biosphere. They are dispersed throughout the environment in currents of air and water. Their movement and widespread distribution throughout the world is explained by their solubility characteristics and chemical stability, and especially their tendencies to absorb on organic matter, to be transported in air droplets, and to become concentrated in food transfers from plants to herbivores to carnivores. Their broad toxicity indicates a potential for biological effect on many kinds of organisms.

The chlorinated hydrocarbons are seriously degrading biotic communities in many parts of the world. They have been shown to destroy larval stages of valuable aquatic food organisms and to depress photosynthesis of marine phytoplankton (which could have grave effects on the gaseous balance in the atmosphere). While direct effects on the hormone balance in man have not yet been demonstrated, concentration levels in human tissues are now high enough that such effects, and also cancer and deleterious mutations, could occur in the future (since they have been demonstrated to occur in laboratory animals), especially if nothing is done to control and to monitor the further use of these potentially hazardous chemicals.

MAGNITUDE OF THE PROBLEM

Pesticides may enter the human body directly or indirectly. They enter directly when a person is exposed to the chemical. He may breathe in the fumes, swallow it or absorb the chemical through the skin. They may enter the body indirectly when a person eats fish, meat or vegetables that have been directly or indirectly exposed to insecticides. Pesticides may also enter the body through drinking water. Increasing applications of pesticides in large-scale agriculture and in forest areas can contribute to the presence of these toxic materials in the water supply (Standard Methods, 1971).

The extent to which the use of chlorinated hydrocarbons and other chemicals have polluted and possibly contaminated the environment cannot be documented due to the lack of quantitative data. However, Alcalá (1974), states the following: "In the Philippines, some studies have shown that levels of pesticides such as DDT and

related compounds, *Lindane*, *Heptachlor*, *Chlordane*, *Methoxychlor*, *Dieldrin*, and *Endrin* in the tissues of freshwater fish from Laguna de Bay have increased 7.5 to 500 times between 1972 and 1973. It is worth-noting that residues of these pesticides in duck eggs were higher than in fish. x x x As of 1973, the quantity of these pollutants in the flesh of fish was below the generally accepted tolerance level of 20 ppm but will reach the critical levels if nothing is done to stop the increase."

Something must be done now to stop the saturation of the Philippine environment with harmful chemicals. With the increasing need for food, man will rely more heavily on pesticides. Using pesticides have provided a temporary solution to the problem. However, these substances have produced one of the world's most serious pollution problems (Odum, 1971).

Consider the farmer who uses *endrin* or another chlorinated hydrocarbon in his ricefield or fishpond. Of the many farmers using these chemicals, probably very few have ever used a great enough quantity to immediately kill fish in the nearby waters. However, continual use of these harmful substances will have an effect on the entire surrounding biological community because of the accumulative nature of the poisons. The end result will be devastating because it is not visible until it has affected many organisms including man.

An obvious consequence of the continued use of chlorinated hydrocarbons in Philippine waters could be the disappearance of *bangus* and *sugpo* fry upon which the inland fisheries development program depends. The mouths of rivers into which fishponds and ricefields drain are often near the fry grounds that support the fishponds with seedlings. When these chemicals are flushed from fishponds and ricefields downstream, the delicate fry will be one of the first organisms to come in contact with them.

Using chlorinated hydrocarbons to solve the immediate problem of pest control in fact creates greater problems when these chemicals eventually come in contact with organisms that are not targeted for control.

This problem is compounded by the fact that many insects may rapidly develop strains that are resistant to a particular chemical.

Different deadly chemicals or stronger doses of the same chemical will be required for successive applications.

CONCLUSIONS

There has been a long history of chemical pollution throughout the world. The general chemical contamination of vast areas of land and water can have a significant impact on the quality of life in the future.

Chemical pollution is a problem all people will have to face. There is no "one-shot" solution, nor will there ever be one (Odum, 1971). However, it is important that the Philippines start to look for and try some of the possible solutions to the problem.

It is imperative that our people do not pollute inland and coastal waters. Being a fish-eating country and a nation of islands, we are more dependent on fishery products than most countries. A few years of heavy pesticide use may cause decades of problems.

RECOMMENDATIONS

1. *Endrin should be banned from all markets in the Philippines. This ban should be strictly enforced.*

Endrin is the most toxic of all chlorinated hydrocarbons. It is 15 times as poisonous as DDT to mammals, 30 times as poisonous to fish, and about 300 times as poisonous to some birds. In the Pesticide Manual prepared by the Cooperative Extension Service of the Northeast Land Grant Universities, U.S.A., *endrin is not recommended for any purpose.*

2. *Farmers should be encouraged to use pesticides that are less persistent in the soil and less toxic to human beings.*

Two of the greatest enemies of our farmers in agricultural production are insects and weeds. Because of these enemies, most farmers have resorted to the use of pesticides to protect their valuable and needed crop.

Some agriculturists estimate that as much as 50% of a rice crop may be lost if herbicides were not used to control weeds that com-

pete with rice for nutrients in the soil. Some even estimate a 70% loss in a rice crop if pesticides were not used to control insects.

Due to the increasing demand for food, it is not feasible for farmers in the Philippines to discontinue the use of all kinds of pesticides. However, certain extremely toxic pesticides should be avoided. In many cases, once sprayed on rice fields, these harmful chemicals may be accumulating in the soil, creeks, rivers and other bodies of water. If less persistent chemicals were used, the chances of a large build-up of toxic residues would be lessened.

3. *The Bureau of Plant Industry and the Bureau of Agricultural Extension should coordinate with the Bureau of Health in conducting seminars about the hazards of pesticides to farmers.*

Many pesticides are extremely harmful to persons handling and using them. Many of these farmers are not aware of the hazards involved or the precautionary measures to be taken when using pesticides. There have already been a number of deaths reported that were caused from the improper handling and use of pesticides.

4. *All farmers should be encouraged to use resistant varieties of rice like IR-26, IR-28, and IR-32.*

When resistant varieties of rice are used, pesticide use is minimized. At present, with the use of pesticides in agricultural production, the potential production of fishery products in inland waters can not be realized. Rice-fish culture is possible if IR-26, IR-28 and IR-32 were used.

5. *The BFAR should mount an intensive educational campaign among fishpond operators on the use of certain chemicals in the control of pond pests and diseases.*

Many fishpond operators are using *endrin* to kill pests and predatory fish in their fishponds. Some are even using *endrin* to harvest fish and shrimps.

6. *All government agencies, schools and research institutions should share efforts in organizing seminars, classes and campaigns to create a general awareness about pesticides.*

At present most people are not aware of the uses and effects of pesticides particularly, chlorinated hydrocarbons. These seminars should not be scare-campaigns but rather informative classes instructing

the general public on the types of pesticides used in the Philippines and their effects.

7. *Research organizations should intensify their efforts to develop new resistant strains of rice and biological control of insects.*

As stated earlier, pesticides, regardless of the type, provide only a temporary solution to the problem. The only good pesticide is one that is never used. If biological controls or newer and better resistant strains of rice were developed, there would then be little, if any, need for pesticides in agricultural production.

8. *Research organizations should be encouraged to research more on the biodegradation of pesticides.*

Information is now available about the biodegradation of pesticides in temperate regions. However, little is known about this area in the tropics. Some researchers report that many pesticides break-down much faster in tropical climates than in temperate climates. If more were known about biodegradation of pesticides, certain less persistent pesticides could be recommended until safer controls are found.

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