

# Imbalance and Excessive use of Pesticides and Fertilizers affecting Human Health and Environment

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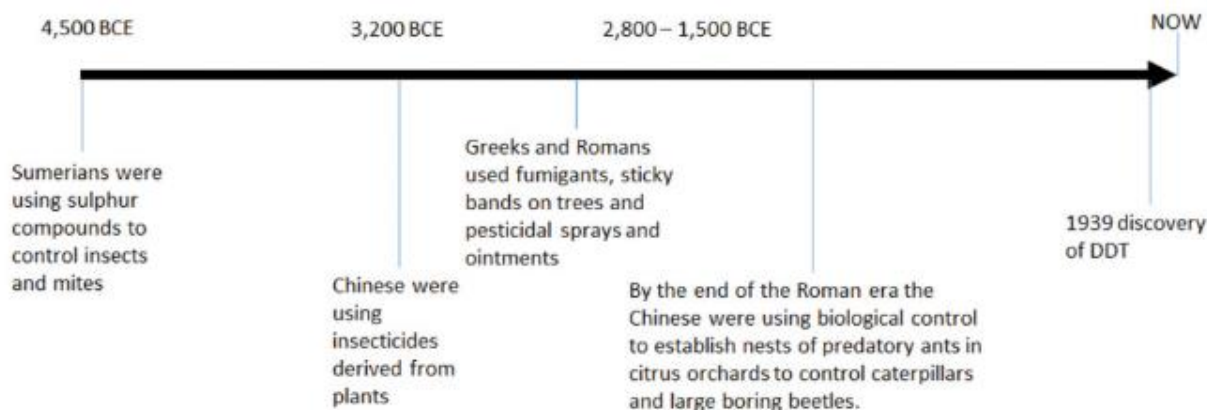
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**Abstract-** Pesticides are the chemical compounds that are used to kill pests including rodents, weeds, insects and fungi. They can be categorized into insecticides, rodenticides, fungicides and herbicides on the basis of type of pests they control. Fertilizers are natural or chemical substances that supply plant nutrients. Judicious and controlled use of pesticides and fertilizers benefit the crops. Overuse of pesticides threaten our ecosystem. They may destruct biodiversity and in turn disrupt global stability. This paper focusses on the harmful effects of pesticides on aquatic biodiversity, terrestrial biodiversity (plants, animals, and pollinators), beneficial microorganisms and humans. It briefly discusses the acute as well as chronic effects of pesticides on humans. Adverse effects of fertilizers on soil, water, environment, food chain and human health is also discussed in this research paper. It also highlights the methods to assess the environmental impact of pesticides.

**Key Words:** Aquatic biodiversity, Terrestrial biodiversity, Pesticides, Fertilizers.

## 1. INTRODUCTION:

Pesticide is a chemical agent used to destroy pests. Pesticide is made up of pest + cide (cida in Latin means -to kill). Pesticides have been used to protect crops since ancient times. Sumerians first used Sulfur compounds to control insects and mites 4500 years ago, followed by Chinese who used mercury and arsenic compounds to control body lice.



**Figure 1. Displaying a timeline, drawn to scale, showing the history of the use of pesticides**

The first modern synthetic insecticide was developed in 1940s, popularly known as DDT (dichloro-diphenyl-trichloroethane). It proved to be a very effective pesticide but it was banned in USA in 1972 due to its adverse effects, non-biodegradable properties and biomagnification.

The Food and Agriculture Organization (FAO) has defined pesticide 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 that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies.*

On the basis of target organisms, pesticides mainly can be classified into herbicides, insecticides, fungicides, rodenticides. Herbicides kill undesirable vegetation. Insecticides target insects, Rodenticides target rodents (rats, squirrels, beavers etc.), and fungicides target fungi. Other types of pesticides can be Avicides (kill birds), bactericides (kill bacteria), Lampricides (kill lampreys), miticides (kill mites), molluscicides (kill molluscs like clams, snails, snugs, squids etc.), nematocides (kill nematodes like ascaris, hookworm, pinworm, whipworm, filarias etc.) slimicides that kill slime producing microorganisms like algae, bacteria, fungi and slime molds, virucides (kill viruses).

Examples of specific synthetic chemical pesticides are Deet, glyphosate, Boric Acid, Propoxur, Acephate, Diazinon, Dursban, DDT, Metaldehyde, Malathion, etc.

The WHO Recommended Classification of Pesticides by Hazard:

Class		LD <sub>50</sub> for the rat (mg/kg body weight)	
		Oral	Dermal
Ia	Extremely hazardous	<5	<50
Ib	Highly hazardous	5-50	50-200
II	Moderately hazardous	50-2000	200-2000
III	Slightly hazardous	Over 2000	Over 2000
U	Unlikely to present acute hazard	5000 or higher	

## 2. ADVERSE IMPACTS OF FERTILIZERS AND PESTICIDES:

Fertilizers and pesticides have many adverse effects on aquatic biodiversity, terrestrial biodiversity and human beings.

**2.1 On aquatic biodiversity:** Aquatic biodiversity includes flora and fauna that live in water bodies like river, sea, oceans etc. When pesticides and fertilizers are sprayed on land, water molecules act as vehicle to transport the chemical pollutants from land to water cycle via rain, ground water flows etc.

Aquatic flora and fauna are affected by these chemical pollutants. Long term exposure of pesticides and fertilizers lead to mutations or abnormalities in developing fish larvae. Moreover, short term exposure led to death of fishes. Reproductive Failure, thinning of egg shells and reduced functioning of immune system are also result of toxicity of pesticides.

- i) DDT, PCBs (Polychlorinated biphenyls), dioxanes get accumulated in the food chain and suppress their immune system.
- ii) Atrazine targets their reproductive organs and delays sexual maturation.

Excess use of fertilizers can cause toxic algal bloom which in turn harms aquatic life.

**2.2 On terrestrial biodiversity:** Terrestrial biodiversity includes plants and animals that reside on land. Excess use of fertilizers lead to soil acidification and basification and ground water contamination.

**2.2.1 On Plants:** Herbicides are not selective in their action. They destroy target as well as non-target plant species, by inhibiting photosynthesis, respiration, cell growth, fatty acid and amino acid biosynthesis etc.

Herbicides affect four stages of growth in plant.

- a) Early stages of seed formation
- b) Late stages of seed formation
- c) Reproductive organ of plant
- d) Vegetative part of the plant

**2.2.2 On Animals:** Pesticides and fertilizers create a negative impact on humans as well as non-human biota such as animals. Long term exposure of pesticides and fertilizers may cause reproductive toxicity, developmental changes, Neurotoxicity and cancer.

**2.2.3 On Pollinators:** The toxicants in herbicides non selectively destroy plant biodiversity, in turn reducing pollinator insects' population. Pesticide droplets can directly fall on bees and kill them or they could suppress their immune system.

- a) Neonicotinoids cause colony collapse disorder in bees.
- b) Cypermethrin affects nervous system of bees.
- c) Organophosphates, carbamates are neurotoxic, they lead to paralysis and eventually death of insects.
- d) Fungicide of captan kills honey bee larvae.
- e) Herbicides disrupt metabolic and reproductive functioning of insects.

**2.2.4 On Humans:** Hazards of pesticides and fertilizers depend on the amount of exposure and toxicity.

Hazards = Toxicity x Exposure

Pesticides can cause various types of harmful effects.

- a) Acute effects: Headache, dizziness, blurring of vision, tremors, numbness, sweating, nausea etc.
- b) Chronic effects: Confusion, drowsiness, headache, impaired memory, disorientation, lack of concentration etc.
- c) Allergic effects: Skin irritation, rash, itching, watery eyes, snizzing, asthma etc.

## 3. ENVIRONMENTAL EXPOSURE TO PESTICIDES:

In order to decrease the exposure of environment to pesticides Vereijken et al. (1995) proposed EEP (Environmental exposure to pesticides) score. It is calculated as

$$EEP_{air} = m \times p$$

$$EEP_{soil} = m \times DT_{50}$$

$$EEP_{water} = m \times DT_{50} / K_{om}$$

Where m = mass of pesticide active ingredient applied

P = vapor pressure of the substance

DT<sub>50</sub> = soil degradation half-life

K<sub>om</sub> = Organic matter sorption constant

## 4. CONCLUSION:

Over usage of pesticides and fertilizers have adverse effect on human as well as non-human biota as they cause health hazards and disrupt the ecological balance. Therefore, PPE (Personal protective equipment) should be worn in order to reduce the exposure of pesticides.

Pesticides with low toxicity should be preferred. Use of eco-friendly fertilizers should be promoted. Organic food products contain lesser amount of pesticides residue as compared to conventionally grown food products and they have high nutrient content (high amount of ascorbic acid and good protein quality). Therefore, organic food products should be preferred. Alternative cropping method should be practised. Pesticides risk can be reduced to a great extent by using them only when required. Chemical pesticides should be used in consumption with natural methods of elimination of pests. Integrated approach including environmental chemistry, ecology, and toxicology shall be emphasized to comprehend overall effects of pesticides on humans and environment.

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