

# Chapter 7

## Pesticides: Impact on Environmental and Sustainable Management

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### ABSTRACT

*Pesticides are chemical compounds that are toxic and are used to control different types of pests and uncontrolled growth of weeds for plant protection in crop production and food storage. A large number of pesticides are being used all over the world. Pesticides play a great role in food security. Crop production has been increased by controlling insect attack, removing weeds by herbicides, controlling crop loss by rodenticides. To get a high yield of products, a higher amount of fertilizers is also needed. The growth of plants is associated with the growth of weeds by which nutrients for the plants are consumed by herbs. So higher amounts of herbicides are also needed to remove herbs as traditional weed removal by humans has become expensive. The residue of pesticides in the foodstuff is reducing food safety as well as a threat to the environment. Pesticides are ubiquitous in the environment and are found in air, soil, and water. Judicial and sustainable use of pesticides is required for food security and ensuring a healthy environment.*

### INTRODUCTION

Chemical compounds of different types such as pesticides, antibiotics, plant growth regulators, hormones, etc. are used in crop production, aquaculture, and human medicine. Pesticides are natural or synthetic chemical compounds mainly used in agriculture to protect plants from pests or weeds. They are designed to control pests and diseases of plants, eradicate weeds, to kill pests and microorganisms that also spoil agricultural products. Pesticides have a long history of utilization against vector disease and parasites as well. They are also used to control malaria, dengue fever, and schistosomiasis in many countries.

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## Pesticides

Insecticides, fungicides, herbicides, rodenticides, and growth regulators of plants are some examples of pesticides. The main intention of their application is plant protection also known as crop protection which protects plants from insects and pest attacks and control weeds. The Food and Agriculture Organization (FAO) has defined pesticides 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 (FAO, 2013).

## HISTORY OF PESTICIDES

People have been dependent on pesticides to protect crops from pest attacks since ancient times (Unsworth, 2010). Sulfur was the first recorded effective insecticide to control insects and mites and was used by Sumerians about 4500 years ago. Chinese people used mercury and arsenical compounds for controlling body lice about 3200 years ago. Bordeaux, a mixture of copper sulphate and hydrated lime was used as an effective fungicide and became widely used between 1860 and 1942. Pyrethrum, which was recognized as Pyrethrum daisies had been used as an insecticide for over 2000 years originated from the dried flowers of *Chrysanthemum cinerariaefolium*. Nitrophenols, chlorophenols, creosote, naphthalene, and petroleum oils were also popular for fungal and insect pest control. The use of synthetic pesticides such as aldrin, benzene hexachloride (BHC), captan, chlordane, dichlorodiphenyltrichloroethane (DDT), 2,4-dichlorophenoxy, dieldrin, endrin, and parathion started in the 1940s (Unsworth, 2010). These products were effective and inexpensive; among them, DDT had better broad-spectrum activity and was the most popular. Eventually, DDT was widely used and effective against vector diseases, like malaria, yellow fever, and typhus, and Dr. Paul Muller won the Nobel Prize in Medicine in 1949 for discovering its insecticidal properties (Delaplane, 1996). However, it was reported later that DDT harms non-target plants and animals, and leaves as residues. The publication of *Silent Spring* by Rachel Carson in 1962 describes how DDT can enter the food chain, accumulate in the fatty tissue of all animals, including humans, and cause cancer and genetic damage (Carson, 2002). She concluded that DDT and other chlorinated pesticides had irreversibly harmed birds, animals and negatively affected the world's food supply. Later, scientists paid attention to developing more environmentally friendly and effective pesticides. However, considering the adverse effects of halogenated pesticides scientists and policymakers around the world became concerned about these harmful compounds and decided to make a convention meeting in Sweden on May 23, 2001, known as the "Stockholm Convention" (UNEP, 2019). Twelve hazardous persistent polychlorinated compounds *i.e.* aldrin, chlordane, dieldrin, DDT, endrin, heptachlor, mirex, toxaphene, hexachlorobenzene, polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were identified as persistent organic pollutants (POPs) and are commonly known as the 'Dirty Dozen' in the Stockholm Convention. The convention aims to protect human health and the environment by phasing out these hazardous pollutants from the environment. These chemicals are of particular concern due to their intrinsic characteristics, namely- wide spectrum persistency, bioaccumulation, biomagnification, transportability, and toxicity. Later, more pesticides were included in the list of POPs (UNEP, 2019). POPs are a poison that can spread without maintaining its boundary. There are several physical and chemical properties of POPs that are responsible for adverse

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