



## Pesticides Overburden In Agriculture And Its Consequences- A Review

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### Abstract

Pesticides are widely used in insect pests management in agricultural and forestry sectors, and they can also be used at home and at work to eradicate household pests to increase agricultural production tremendously. A vast majority of the population in India is engaged in agriculture and is therefore highly exposed to the pesticides used in agriculture. Exposure to pesticides both occupationally and environmentally causes a range of human health problems. Indiscriminate and repeated application of pesticides leads to loss of biodiversity, pest-resistance and other ecological imbalance. In the absence of an effective alternative method of insect control, reliance on chemicals is bound to increase, which exerts selection pressure on the target organism resulting into the development of resistance. The persistence nature of pesticides led to their accumulation in animal tissues and subsequently causes human dietary exposure through consumption of animal products. In the present review, various implications of pesticides use in agriculture is discussed.

**Keywords:** Pesticides, Residues, Environment, Resistance, Agriculture

### Introduction

The production of pesticides started in India in 1952 with the establishment of a plant for the production of BHC near Calcutta, and India is now the second largest manufacturer of pesticides in Asia after China and ranks twelfth globally for the consumption (Mathur, 1999). The pesticides cover a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, plant growth regulators, etc. The introduction of other synthetic insecticides – organophosphate (OP) insecticides in the 1960s, carbamates in 1970s and pyrethroids in 1980s and the introduction of herbicides and fungicides in the 1970s–1980s contributed greatly to pest control and agricultural output. The pesticide market of India in the world is with US\$ 0.6 billion per annum, which is 1.6% of the global market (Hundal and Ananda, 2006). Although the pesticide consumption in India is still very low, there has been a widespread contamination of food commodities with pesticide residues basically due to their indiscriminate and non-judicious usage.

Since pesticides are designed to kill or adversely affect living organisms, by their very nature, they pose risk to humans, non-target plants and animals. They not only contaminate the ecosystem but also bio-accumulate in the food chain and can be traced in plant and animal tissues causing serious health hazards (Johan et al., 2001). Animal husbandry is one of the most important areas of foreign exchange. Feed and fodder offered to animals are often contaminated with pesticide residues (Raikwar and Nag, 2003) and after feeding, these residues pass through the body systems. Pesticide poisoning in human has been extensively studied (Hamilton et al., 2004) and frequently reported in forensic medicine. As per World Health Organization estimates pesticides lead to one million pesticide poisoning cases and 20,000 deaths every year globally. Therefore, there is a need of discussion on causes of environmental contamination, pesticide residues in milk, meat and other dairy products, health hazards associated with dietary exposure of successful in meeting the goals of self-sufficiency in pesticides as well as prevention and control strategies for occurrence of pesticides in animal products in Indian scenario.

### Pesticide consumption in agriculture

In the process of development of agriculture, pesticides have become an important tool as a plant protection agent to boost up food security as these chemicals play a significant role by keeping many dreadful diseases. A vast majority of the population in India (56.7%) is engaged in agriculture and is therefore exposed to the pesticides used in agriculture (Gupta, 2004). Although Indian average consumption of pesticide is far lower than many other developed countries, the problem of pesticide residue is very high in India. Generally, pesticides are used in three sectors viz. agriculture, public health and consumer use. The consumption of pesticide in India is about 600 gms. / hectare, whereas that of developed countries is touching 3000 gm/hectare. Pesticides are found as common contaminants in soil, air, water and on non-target organisms in our urban landscapes. Repeated and excessive use of pesticides in agriculture leads to the development of resistance in many insects/ pests. Residues in food for humans and feed for livestock can be a

consequence of direct application of a chemical to the food source, by the presence of pollutants in the environment or by transfer and bio-magnification of the chemical along a food chain.

The consumption of chemicals in India had gradually decreased during 1994-2006. However, the Punjab and Haryana were the two states using the largest quantity of chemical pesticides during 1999-01. The pattern of pesticide usage in India is different from that for the world in general. The use of herbicides and fungicides is correspondingly less heavy. The main use of pesticides in India is for cotton crops (45%), followed by paddy and wheat. Consumption of pesticides in Haryana in agriculture during 1999–2000 was 5,030 MT. This followed Uttar Pradesh (7,400 MT), Punjab (7,100 MT) and Andhra Pradesh (7,000 MT). However, the g/ha consumption in Haryana was 8,481 as compared to the average consumption of 288 g/ha in the country (Agnihotri, 2000).

### **Impacts of pesticides**

#### **Impacts on non target organisms**

Pesticides are found as common contaminants in soil, air, water and on non-target organisms in our urban landscapes. These chemicals can harm plants and animals ranging from beneficial soil microorganisms and insects, non-target plants, fish, birds, and other wildlife. Pesticides can kill birds in several ways, including direct effects of acute poisoning by ingestion of granules, baits, treated seeds, and direct exposure to sprays. Indirect death of birds may result from consumption of treated crops, contaminated water, or feeding on contaminated prey. Wildlife poisoning depends on a pesticide's toxicity and other properties (eg. water-soluble pesticides may pollute surface waters), the quantity applied, frequency, timing and method of spraying (eg. fine spray is prone to drift), weather, vegetation structure, and soil type. Insecticides, rodenticides, fungicides (for seed treatment) and the more toxic herbicides threaten exposed wildlife.

#### **Impacts on environment**

Pesticides present the only group of chemicals that are purposely applied to the environment with aim to suppress plant and animal pests and to protect agricultural and industrial products. Pesticides can contaminate soil, water, turf, and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish and beneficial insects. However, the majority of pesticides are not specifically targeting the pest only and during their application they also affect non-target plants and animals. Repeated application leads to loss of biodiversity. Many pesticides are not easily degradable, they persist in soil, leach to groundwater and surface water and contaminate wide environment. Depending on their chemical properties they can enter the organism, bio-accumulate in food chains and consequently influence the environment.

#### **Impacts on human health**

Exposure to pesticides both occupationally and environmentally causes a range of human health problems. It has been observed that the pesticides exposures are increasingly linked to immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer. There is now overwhelming evidence that some of these chemicals do pose a potential risk to humans and other life forms and unwanted side effects to the environment. No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects, though a disproportionate burden is shouldered by the people of developing countries and by high risk groups in each country (WHO, 1990).

It is estimated that nearly 10,000 deaths annually to use of chemical pesticide worldwide, with about three-fourths of these occurring in developing countries (Horrigan et al., 2002). Pesticides being used in agriculture are released into the environment and come into human contact directly or indirectly affecting human life. The consumption of such vegetables and fruits that are grown in pesticide contaminated soil and water used for long-term, accumulation increase the concentration of toxins inside the body organs and causes chronic diseases such as neurotoxicity, cancer, necrosis, asthma, reproductive disorder, cardiac disease, diabetes, etc. (Kalyabina et al., 2021). Humans are exposed to pesticides found in environmental media (soil, water, air and food) by different routes of exposure such as inhalation, ingestion and dermal contact. Exposure to pesticides results in acute and chronic health problems (Calaf, 2021). The world-wide deaths and chronic diseases due to pesticide poisoning were numbered about 1 million per year (Environment Forum, 1999). Some of these are suicides, but most involve some form of accidental exposure to pesticides, particularly among farmers and spray operators in developing countries, who are careless in handling pesticides or wear insufficient protective clothing and equipment. In India, the first report of pesticide poisoning was documented from Kerala in 1958, where more than 100 people died after consuming wheat flour contaminated with parathion. One instance occurred in Bhopal, where more than 5,000 deaths resulted from exposure to accidental emissions of methyl isocyanate from a pesticide factory.

There are two types of the pesticide effects on human health- chronic and acute. Chronic health problems linked to pesticides include adverse neurological effects such as a fourfold increased risk of early-onset Parkinson's disease, shortened attention span, memory disorders, and reduced coordination; reproductive problems including miscarriages; reduced infant development; birth defects; depression; and cancer. Acute health problems which are sometimes misdiagnosed or not recognized as being associated with pesticide toxicity, include blurred vision, headaches, salivation, diarrhea, nausea, vomiting, wheezing, eye problems, skin conditions, seizure, coma, and even death. Mild to moderate pesticide poisoning mimics intrinsic asthma, bronchitis, and gastroenteritis. Pesticides are especially harmful to

children because of their developing physiology. And, relative to their size, they are exposed to higher amounts of pesticides.

#### **Impacts on livestock animals**

There is increasing anxiety about the importance of small residues of pesticides, often suspected of being carcinogens or disrupting endocrine activities, in drinking water and food. In spite of stringent regulations by international and national regulatory agencies, reports of pesticide residues in human foods, both imported and home-produced, are numerous. Pesticide residues in livestock generally accumulate by two ways either through direct application on animals or on agricultural crops and fodder (Poppenga, 1999). The livestock reared on pesticides contaminated soils, crops, and fodders may accumulate considerable residues in edible tissues. Furthermore, pesticide residues also accumulate on cropland soil. Animals can accumulate these substances from contaminated feed and water. Also, due to the lipophilic nature of these pesticides, milk and other fat-rich substances are the key items for their accumulation (John et al., 2001). Therefore, an indirect source of pesticides accumulation can be represented by animal-derived products.

It was however reported that unlike the other organochlorinated insecticides, endosulfan apparently does not pass into the milk of cattle when ingested in feed—even at a high concentration for a prolonged period of time. Animal husbandry constitutes backbone of fish collected in River Yamuna in Delhi, which received discharges from a DDT factory, contained DDT traces. Similarly, fish from rural ponds that million buffaloes, 185 million cattle, 120 million received agricultural runoff contained DDT and HCH goats, 62.5 million sheep, 14.3 million pigs and 430 at mean concentration of 7 and 6.3 mcg/g, respectively million chickens (FAO, 2006). Among several meat products, greatest contamination was observed in chicken muscle followed by goat and beef collected in Lucknow, India. The increasing incidences of pesticide residues in the meat and milk are of a great concern for ensuring food safety and human health.

#### **Water contamination**

Pesticides can reach surface water through runoff from treated plants and soil. Contamination of water by pesticides is widespread. During a survey in India, 58% of drinking water samples drawn from various hand pumps and wells around were found contaminated. Maximum residue levels (or tolerances) have been established for pesticides in foodstuffs and drinking water in most countries to avoid any adverse impact on public health, and to insist on good agricultural practice (Panigrahi et al., 2014). A number of researchers have reported pesticides and heavy metals in drinking and groundwater in different parts of India (Bansal and Gupta, 2000). Water samples of wells in Bhopal showed residues of total HCH and DDT. Organochlorine and organophosphorus pesticide residues were detected in groundwater samples from irrigation wells, domestic wells and canals used for irrigation and drinking purposes in Aligarh (Ray, 1992).

#### **Pesticide resistance**

This use of pesticides has led to appearance of pesticide resistance in 27 insect pests; 14 of public health importance, 7 of agricultural crops and 6 of stored grains and commodities. Insecticide resistance to representatives of commonly used insecticide groups (pyrethroids-cypermethrin; organophosphates-chlorpyrifos; cyclodienes-endosulfan) was determined in five major insect pests of cotton from the main cotton growing regions of India with emphasis on Andhra Pradesh and Maharashtra (Kranthi et al., 2002).

In India, about 60% of livestock is reared by small and marginal farmers and use of OP compounds like diazinon and malathion is very common for the control of agricultural pests including livestock and poultry (Ghosh et al., 2006). Besides their applications against agriculturally important pests, OP compounds are also used for mass eradication of mosquito larvae in the breeding places (ICMR, 2002). All dairy and meat animals are suffering from tick infestation and cause significant economic loss. Indiscriminate use of pesticides for the control of these ecto-parasites has resulted into development of large scale of different acaricides in *R.(B.) microplus* collected from different agro-climatic regions of India (Sharma et al., 2012; Ghosh and Nagar, 2014; Rinesh Kumar et al., 2020).

#### **Conclusion**

Pesticides are often considered a quick, easy and inexpensive solution for controlling insect pests in agriculture system. Pesticide contaminated the soil and air, and surface and ground water across the nation. Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms, to insects, plants, fish, and birds.

Intensive pesticide application results in several negative effects in the environment that cannot be ignored. The solution lies in promoting practices like Integrated Pest Management (IPM), organic farming, biopesticides and crop diversification. IPM employs control of pests with use of crop rotation, biopesticides and pesticides of plant origin like Neem formulations. Neem and plant-based formulations like Repline, Neemark and Indene can be adopted routinely. With popularization of some of the above practices, it is expected that the use of pesticides in the agriculture sector in the country will reduce and soil, ecosystem and human health will be restored. Farmers are unlikely to change the way they manage their animals and parasite problems unless they see convincing evidence that a new approach will confer an economic advantage.

#### **Acknowledgement**

Authors are thankful to Division of Research and Innovation, Uttarakhand University, Dehradun, for valuable support.

#### **Conflict of interest**

The authors declare that they have no conflict of interest.

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