Chapter 1
An introduction to contaminants in agriculture and environment

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Abstract
Recent advances in chemical applications in the agricultural sector have been contributed to
disruptive contamination of crop and environment. Besides the contribution in improving
conventional farming, the development of new methods has also contributed to polluting
agriculture as well as environments. The deposition of several contaminants in agricultural
products, soil, water, air and even into the higher trophic levels of the food chain has disturbed
the well-functioning of the earth ecosystem. The present chapter focused on the primary
information of the book regarding how the contaminants in agriculture are introduced with
possible ways to mitigate their impacts.

Keywords: Agricultural pollution, Contaminants, Development, Sources, Twenty-first century,
Urbanization

Agricultural contaminant definition: “An unwanted sediment or chemical present in the agriculture
and their products which makes it unfit for consumption and survivability of living beings”.

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Introduction

The production of foodstuffs related to meet the animal food requirements by growing and harvesting plants and their products is known as agriculture (Nagendran, 2011). Despite global agricultural and economic revolution during recent past 50 years, human beings have transformed the natural ecosystems according to their selfish necessities. This is due to increased demand of foodstuffs due to overexploitation of natural resources, uncontrolled increase in the global population, and use of chemical substances to promote the crop productivity and plant protection (Bergstrom and Randall, 2016). Besides the contribution in improving conventional farming, the development of new methods has also contributed to polluting agriculture as well as environments (Altieri, 2018).

The deposition of several contaminants in agricultural products, soil, water, air and even into the higher trophic levels of the food chain has disturbed the well-functioning of the earth ecosystem. Pollution has tended to cause anxiety among all living beings from small-sized microorganisms to big sized elephant (Pavlidis and Tsihrintzis, 2018). The recent advancements in the agriculture sector have been contributing to degrading the quality of the environment. Agricultural pollution is a complex combination of rehearses due to its wide range of contributing factors. For this, it has several negative consequences on biotic communities in terms of air, water, and soil pollution (Yang et al., 2018). Moreover, the liquid runoffs from urbanized cities, industries, and agricultural fields contain highly noxious elements like long persisting heavy metals, polyaromatic hydrocarbons (PAH), plastics and polymers, pesticides, chemical and reagents, atmospheric depositions, bio-aerosols, pollen grains, microorganisms, biodegradable residues, which creates serious environmental and health issues in the living beings (Nilsen et al., 2019). Recent reports have shown that the long term deposition of such elements caused serious health impacts on both animals as well as plants.

This exposure to a human being above the threshold may be fatal due to the destruction of body immunity and or organ failure (Liao et al., 2018). Thus, the effective mitigation of such deposition is a challenging approach for the whole world. The effects of harmful toxicants on living cells may be brought either by alteration in the cellular enzyme activities or by chemical and physical modifications in the cell structure (Brunk et al., 2018). These changes might be responsible for the serious health problems like cancer, kidney diseases, weak immunity, bacterial, viral, and fungal diseases, embryonic disorders, hormonal disturbances, organ failure, skin problems and much more (Deng et al., 2018).

This book chapter emphasized an introduction to the contaminants in agriculture and environment and their possible consequences related to interacting biotic communities. The pollution which has been caused or being caused by various activities affecting the quality of agricultural products is well discussed. The necessity of this article was to spread the supplementary information among the global consumers to aware of them how the contaminants in agriculture arise and the possible ways to mitigate their impacts.
21st century and agricultural technology

It is obvious that the agricultural method today is quite different and advanced from the methods used in the year 1950. Today, the researchable association between agriculture and environment has received more attention due to the devastating impacts of contaminants on both biotic and abiotic components. These changes are brought by the recent revolutions in the agriculture sector in India. The modern agricultural practices involving the fertilizer, pesticide, machinery applications, raw foodstuff processing, transportation, preservation, and consumption are quite different from the traditional ways used by our ancestors (Tubiello et al., 2015; Baker et al., 2017). The advancements in the techniques of tillage, plowing, fertilizing, manure spreading, pesticide application, feedlots, and animal corrals utilization, irrigation, and clear-cutting has been revived the net profit and income of farmers (Nagendran, 2011). The integration of the industrial sector with agriculture is the most reason for this. Figure 1.1. It is well known that India has received many technological revolutions during the past 100 years (Figure 1.2). The major revolutions includes, green revolution for agricultural development, white revolution for milk production, blue revolution for fish and fisheries, grey revolutions for fertilizer developments, red revolution for meat production, sky revolution for the information and technological technologies, and finally the evergreen revolution which was meant for revolution of overall agriculture sector and production growth (Goldman and Smith, 1995; Breen, 2017).

![Figure 1.1. Integrated framework of routes of contaminants in agriculture and environment.](image-url)
Contaminants in agriculture and environment

Whether the contaminants in agriculture arisen from the farming and industrial practices or by natural pollutant deposition, they all are considered as agricultural contaminants as they all have negative impacts on the survivability of the living beings (Figure 1.3). Such renowned methods have contributed to contamination of both grounds as well as surface waters with several pathogens like bacteria, viruses, fungi and other microbes (Nagendran, 2011). The agricultural and industrial runoffs contribute to accumulating different salts into agricultural lands, water bodies, surface, and ground waters. The application chemical fertilizers and pesticides have persisting and long term effects on the ecological contributors. Besides this, the high concentrations of trace heavy metal and radioactive elements released into the environment can cause the serious health issues in animals and plants (Rawlins et al., 1998; Harrison, 2015). Accumulation of different nutrient in water bodies from such runoffs are also The various agricultural practices like tree cutting, shifting cultivation, forest clearing and overgrazing tend to accelerate the soil erosion rates in the respective regimes which often cause the siltation of the river bottoms and increased turbidity levels (Doula and Sarris, 2016). The altered water quality further affects the flora and fauna of both internal as well as external river system i.e. riparian zone (Petts, 2018). The intake of contaminated crops by household cattle, birds and rodents create severe disease which is sometimes fatal. The contaminated fodder when taken by cattle affect the quality of produced milk, and even the residues of heavy metals, pesticides, and other carcinogens have been reported by several researchers (Rawlins et al., 1998). Besides this, among the other environmental impacts, soil erosion is also a major problem caused by agricultural and industrial runoffs.

However, forested areas show less soil erosion as compared to unprotected areas like fallow lands, which are directly affected by numerous natural as well as anthropogenic activities such as rainfall patterns, river streams, landslides, wind patterns, agricultural practices, overgrazing, deforestation and river bed mining are the major once and therefore contribute to high soil loss (Jain et al., 2001). Overgrazing is the process by which the fertile soil surfaces attached with
grasses are removed by means of the grazing and walking activities of livestock like sheep, goats, cattle, camels, horses, and others. Like other elements, overgrazing is also an important factor which contributes to the enhanced frequencies of agricultural contamination by means of incorporation of harmful pests, pathogens, and loosing soil strength and quality. The removal rate of soil nutrients is accelerated when the runoff process happened in such soils. Or the contaminants from other sites are transported to the agricultural soils via such liquid discharges.

**Contaminant transmission pathways in the agriculture food chain**

The transport mode of an agricultural contaminant in the food chains is strongly regulated by natural and anthropogenic factors. The pollutant retention in a particular trophic level depends on the metabolism and residual dispersion to higher ones (Fowler, 2018). The control of physical and chemical factors is also a determinant of contaminant mass transfer into living cells. Over-application of pesticides and fertilizers have contributed to accumulate their higher

*Figure 1.3. Sources of contaminants in agriculture and their health consequences.*
amounts in the soils and further their transportation the upper parts of the plants. On the other hand, higher trophic levels of the agricultural system are also affected by agricultural pollution (Liu et al., 2015; Kumar et al., 2018). The process of bio magnification of pesticides and heavy metals in a complex mechanism, where plant enzyme-proteins actively binds with such pollutants and transport them to the edible and non-edible parts of the plant. Later, the herbivores take the energy from those contaminated plants or plant products and help in transferring them to top consumers including human itself.

For example, in India, the case of house sparrow bird deaths was due to extensive pesticide accumulation in rice crop which declined its significant population in both rural and urban areas (Rawat and Agarwal, 2015). The accumulation of harmful pesticides in rice crop tends to increase the toxicity of early rice grains, which are taken by birds. On the other hand, the pesticide application on crop leaves kills the pests which are further fed to infants by mother sparrow. Consequentially, pesticides like Aldrin, DDT, Carbendazim, etc. act as toxic substances in the bird which further cause deaths. As not all insects are harmful to crops, many beneficial pests like a fly predator, lady beetle, moth egg parasite, honey bee, etc. are killed by such pesticide and fertilizer applications. This cause the disturbance in the natural food chain as many of them act as important keystone species to balance the agricultural ecosystems (Wojciechowska et al., 2016).

Livestock grazes large quantities of grasses, herbs, and shrubs present in the mountain areas. The walking and grazing activities create terracettes (steeper slopes) on the uppermost soil surfaces, where small contours, nearby 1.6 meters in depth. The formation of these slopes undergoes to make the soil detached from the mail surface layer and results in slow soil erosion (Pandey, 1996).

If the process continues for a long time, it becomes a threat to the food chain and well as a risk to the concerning ecosystem caused by a decrease in the net gross productivity. The walking activity of livestock from one agricultural field to another spreads the pathogens easily. The probability of getting the non-disease crop increase when the number of livestock enters having such pests, or pathogen spores.

**Conclusion**

In conclusion, after surveying the past and current status of contaminants in agriculture and environment, we found that human revolution has significantly contributed to increasing the health problems by incorporating the harmful substances. Besides this, the development of advanced technologies for gaining more benefits has perceived more attention of farmers for using modern chemical fertilizers and pesticides.

Recent studies revealed that the agricultural and industrial runoffs contribute to accumulating different salts into agricultural lands, water bodies, surface, and ground waters. The high concentrations of trace heavy metal and radioactive elements released into the environment can cause serious health issues in animals and plants. Therefore, the responsive goals for mitigating these contaminants should be taken into account.
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References


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