



Impact of Pesticides on Biodiversity

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Pesticides are regarded as one main constituent, out of three of a very often used term 'Green Revolution'. The left two are high quality seed varieties and application of fertilizers. Pesticide is a very broader term which includes a wide range of classes depending upon the type of pest such as insecticides, fungicides, herbicides, acaricides etc. and these pesticide groups are used widely and very often. According to the definition of pesticide, it is a chemical, compound or substance that kill the pest which is damaging the crops and competing with human interest. But on the other hand, something is happening in addition to control the pests. Pesticide residues are often persistent in nature, remain stable in environment and are causing a serious threat to non-target and non-pest organisms as well. In this section, we will focus on the species of organisms that are distressing by pesticide residues and estimate the extent of impact of them on non-target organisms.

Out of entire components of agricultural advancement, pesticides particularly insecticides and fungicides had caused the most devastated effect on species diversity from the time they were being utilized [1]. Many of these compounds are extremely toxic to exposed insects, birds, mammals, amphibians and fish. Biodiversity was affected by indirect effect of pesticide as pesticides are responsible for decline of insects and weeds which may be a source of food for some species. Removal of weed can modify the habitat type by discarding of vegetation and eventually leading to population reduction. Elimination of some arable weeds was caused by the usage of fungicides which allows farmers to stop 'break crops' such as grass and roots [2]. Aerial spraying was a major problem prevailing in Canada related to biodiversity loss and 62% of species decline was associated directly or indirectly with pesticide usage. Maximum biodiversity loss was recorded in areas having intensive agricultural systems. A study investigated that average species loss was 10% in common bird species from 1980 - 2006 but the decline was recorded up to 50% in common farmland bird

species in 2006 leaving no option for recovery and suggesting the harmful effect of pesticides in environment [3].

A term known as Important Bird Areas (IBA) translates the habitats of birds in farmland areas but these areas are not protected officially. Collectively, 1211 species of birds was regarded as threatened species and among these 86% are endangered due to demolition and deprivation of habitat. Primary factors for 187 globally threatened species were addition of heavy metals in terrestrial and aquatic environments, discriminating usage of pesticides and other synthetic compounds [4].

Britain's wild mammal populations had greatly affected by pesticide through their direct and indirect action specially to bats and rodents. Pesticides can accumulate in the tissues of prey and can cause toxic effect to top predators. Particular rodenticides are very toxic and can accumulate in the body of rodents. These can cause secondary to predators like dogs, foxes, non-target mammals and raptors by eating pesticide exposed prey [5]. Herbicides damage the vegetation and can affect the life of common shrew, wood mouse and badger due to the shortage of food and alteration in microclimate [6].

The most important group of insecticide whose application and residues caused a huge loss to biodiversity and environmental contamination is "Organochlorines" the most persistent and stable compounds in the environment. According to a study by [7], it was estimated that the usage of compounds such as DDT and dieldrin from organochlorines group of insecticides resulted a heavy toll to many bird species like fish eating birds and Peregrine Falcon. (*Falco peregrinus*) in some regions of Europe and Americas.

If we further unleash the impact of pesticide residues of birds, another horrifying case came forth and that was contamination of carbofuran (a very well-known insecticide belongs to carbamates

group). It was concluded that applications of granular formulation of carbofuran has an effectual impact on the populations of song-bird exposed to insecticide when they were breeding alongside the edge of contaminated fields [8]. Carbofuran in liquid form was also reported due to its lethal effects on Burrowing Owl (*Speotyto cunicularia*), a bird species which was recalled as endangered [9]. Although, there might be some other factors involved in the reduction of number of individuals of this species. In this way, therefore certain type of pesticide exhibit hazard to biodiversity regionally.

The negative impact of diazinon applied on the grasslands showed maximum mortality in the population of Brant geese (*Branta bernicla*) which used to harbour their nests at that place to lay eggs [10].

Pesticides perform a key role in the addition of pollution causing agents to nature. In aquatic ecosystems, pesticides were observed very dreadful to a majority of aquatic organisms. A study conducted to monitor the impact of four different worldwide known pesticides. Among the two were insecticides (carbaryl and malathion) and the herbicides were (glyphosate and 2,4 - D) applied to algae and twenty-five different species of animals. Abundance of the species was decreased up to 30 percent by malathion, 15 percent by carbaryl and 22 percent with the application of glyphosate. The insecticide group became the causal agent to rule out the diversity of Cladocera's but copepods remained safe [11].

The negative impact of pesticides on fish have been widely documented. According to a study, the insecticidal residues of H - C - H and DDT was found in four different species of fish in freshwater in china. Results of the study showed that H - C - H contents ranged from 0.05 - 14.53 ng g⁻¹, with an average of 3.47 ng g⁻¹ moist mass stuff was found from fish species. The residual content of DDT was observed ranges from 0 - 8.51 ng g⁻¹, with an average of 2.41 ng g⁻¹. Residual scale of H - C - H contents was found comparatively higher in grass carp and chub while that of DDT was examined higher in snakehead species of fish [12].

According to a research, the predator-avoidance behaviour of guppy fish (*Poecilia reticulata*) in response to the effect of pentachlorophenol in the presence of a predator largemouth bass (*Micropterus salmoides*). The findings of this study suggested that the groups of guppies treated with higher level of chemical exhibit sluggish response and could not maintain an optimal flux of speed to get escaped after the attack of predator [13]. There are approximately 6000 species of amphibians documented in literature to date world widely. One-third of this amount is endangered due to various reasons like overexploitation, introduction of predator species and habitat destruction. The prominent factor in this context is the water pollution caused by runoff and leaching of pesticide residues [14].

A study was conducted to investigate the effect of a herbicide diclofop-methyl and the fungicide difenoconazole on albino rats describing the alarming situation of toxic effects of these chemicals. The study revealed that these compounds had altered the enzymatic and metabolic activities of tested rats. It was suggested that after the application of above mentioned compounds, there are a lot of potential toxic effect to humans as well as environment [15].

EU cereal yield loss was widely documented and inspected that it was effected due to one half reduction of plant species and up to one-third reduction in the diversity of carabid beetles and bird species of farmland [16]. In Agricultural habitats in UK, up to one-half reduction in plants, one-third loss in insects and about one-fifth decline in bird species have been recorded [17]. A wide range of literature was reviewed by [18] describing the studies of organic contaminants concentrations in mammals from 2008 to date and focusing the current position of environment and our role in this regard. It was also revealed that extent of chemical compounds such as organochlorines, PBDE and HBCD etc. in environment after the implication of regulations and recommendations dealing their usage. Residues of DDT, chlordane and HCB was found in blubber of Franciscana dolphins in Brazil from (1994 - 2004) and found a little decrease gradually [19]. A study was arranged from 1992 - 2006 determining the concentration of pesticides (DDTs, HCH and Dieldrin) residues in blubber of bycaught female common dolphins. Significant results were obtained determined that residue levels were declined after time [20].

Hazardous effects of pesticides to non-target organisms have been documented by several specialists [21] highlighted the risk of biodiversity to the toxicants of pesticides. In this study, it was described that the physiological activity of pesticides has a similarity between both pest and non-target species. For example, Carbofuran, Chlorpyrifos and Terbufos are very efficient and well-known pesticides to control the corn rootworm immatures present in the soil but these insecticides impose extremely lethal effects to populations of earthworms. It was also discussed that aerial application of some pesticides was responsible for total extinction of arthropods in different crops such as cotton. Systemic insecticides caused secondary poisoning in predator species which fed on pesticide exposed insects.

Biological control and beneficial insects such as *Chrysoperla carnea* and other are threatened by agrochemicals in farmland ecosystems. Research was designed to investigate the effect of temperature fluctuation with different insecticides like spinosyns, organophosphates, pyrethroids and new chemistry insecticides towards *C. carnea*. It was concluded that in multiple cropping systems, temperature fluctuation is the main factor adopted prior the pest management strategies to conserve *C. carnea* populations. It was also estimated that insecticides having negative temperature coefficient may be useful to preserve *C. carnea* populations [22].

Pesticides exert very devastating effects to honey bees. Impact of imidacloprid, diafenthiuron and Etofenprox was observed in response to metabolic changes in larvae and adults of wild honey bees (*Apis dorsata*). Haemocytes of bees were badly affected resulted in the loss of immunity against diseases and other abnormalities such as agglutination, enucleation and cell shape distortion. It was concluded that pesticide exposure was the key factor in the destruction of immune system in honey bees [23]. Lethal and sublethal effects of some insecticides were tested against a predatory bug *Orius insidiosus*. According to results of studies, it was derived that insecticides such as abamectin, cartap, imidacloprid, and Flubendiamide was seemed to be save and those pyriproxyfen and rynaxypyr were characterized as non-injurious and phenmetrazine was categorized as somewhat damaging [24]. The impact of neonicotinoids was observed affecting the immunocompetence of honey bees (*Apis mellifera* L.). Results obtained show that thiacloprid and imidacloprid found in the reduction of number of haemocytes, encapsulation response, and antimicrobial activity. Clothianidin was responsible for carrying out these abnormalities at somehow large concentrations [25]. Bioassays with sublethal effects of clothianidin, imidacloprid and thiamethoxam against the foraging behaviour of honey bees. Results showed that neonicotinoids were associated with multisensory disruptors and had a damaging role counter to feeding activity of pollinators [26].

A wide range of literature was reviewed by [27] stressing on the limited use of agrochemicals. In this study, it was admitted that after green revolution, agrochemical became an integral part of modern crop production technologies to fulfil the dietary demands of rapidly increasing populations but in current scenario, their toxic and deadly effects to living organisms demand restricted use of these agrochemicals. Though, more quickly degradable chemicals are invented which exchange the persistent ones, but their residues are still capable of putting an organism's health at risk by contaminating food, environment and water. Increment in food production in present and future point of view, must oblige with production of good class of food and with less lethal contaminants.

The residues of organochlorines insecticide are still found in some ecosystems years after they had been used. In some areas of the world especially in developing countries, these compounds have not been yet banned and their discriminating use is ongoing. Apart from research efforts, it is a responsibility of world environment and wildlife protection organizations to highlight and stop the use of such compounds over the world. Otherwise, we will get hand washed from the beautiful and utmost important assets of nature [28]. Organic farming is much important to specie richness and abundance of living organisms. Review of extensively documented literature highlighted the importance of organic farming pointing out various tactics of management of pests like declined usage of pesticides and fertilizers, conservation of non-cropped habitats and sustainable agricultural systems [6].

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