# IMPACT OF PESTICIDE AND THEIR RESIDUES ON WILDLIFE

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DOI: https://doi.org/10.5281/zenodo.21705517

**Abstract**

The excessive use of pesticides in the current agricultural practices has greatly improved crop productivity but at the same time caused unforeseen ecological impacts; particularly the negative effects by the usage of pesticides on non-targeted populations of wildlife and organisms leading to depletion of biodiversity. This takes place by the exposure to the pesticide residues through many ways of their entry into the ecosystem, which causes the bioaccumulation and biomagnification of these pesticides in the body of an organism. Birds, in particular, are very sensitive to the poisoning caused due to pesticides and their populations suffer great harm. It is the combined effect of the toxicity of different agrochemicals such as carbamates, organophosphates, and persistent organochlorine compounds (endosulfan); as a result of their vast application practices along with the ecological factors, and the landscape configuration, the harmful effects are seen on the biodiversity. This makes it extremely important to detect the presence of these pesticide residues within the wildlife populations. Therefore, the necessity of developing new technologies and approaches for the detection of pesticide residues in wildlife is critical.

**Keywords:** biodiversity, impacts, pesticide residues, toxicity, wildlife.

## Introduction

Wildlife itself summarises all the flora and fauna found within ecosystems, ranging from the dry deserts to green forests, and oceans, to urban environments. Each wildlife species whether plant or animal, inhabits an ecological niche on the basis of their necessity for food, shelter, territory, and reproduction, whereas the habitat refers to the location which meets all the above requirements necessary for their survival. However, the increase in agricultural activities within the last sixty years has drastically affected their habitats not only due to the conversion of forests into agricultural lands but also by the use of chemicals like pesticides, herbicides, fungicides and other fertilizers.

Wildlife gets exposed to these pesticides due to their direct entry into ecosystems through drift, runoff, leaching, and volatilization, contaminating soil, water, and air and this leads to exposure via direct contact, ingestion in contaminated food or water, or secondary poisoning through trophic interactions (Morrissey *et al.*, 2015). Cases of acute poisoning in animals have become common nowadays and examples include the death of fishes due to contamination caused by run-off water and birds dying from eating treated seeds. Chronic exposure to toxic substances, especially persistent chemical compounds like organochlorine compounds, can adversely affect the reproductive capabilities leading to the reduction in populations and biodiversity. Herbicides that limit the biodiversity of the plants, leading to limited insect populations that serves as an important source of food for birds and other small animals; hence interfering with food chains by reducing the numbers of insects and plants that constitute an important source of food for both birds and animals. Herbicides also affect the vegetation composition and make the habitat unsuitable for the survival of various species, while fungicides allow monoculture cultivation.

## Impact of Pesticides on wildlife

Overuse of pesticides has been linked to biodiversity loss and ecosystem instability (Tudi *et al.*, 2021). Wildlife is particularly vulnerable, with variety of species of animals, birds, amphibians, and aquatic organisms that are facing direct and indirect exposure to toxic residues. Chronic exposure can impair reproduction, behaviour, and immune function, while acute toxicity may lead to mortality. For example, neonicotinoids are shown to disrupt pollinator navigation and foraging, which has contributed to population declines,

especially of honeybees (Apis mellifera) and bumblebees (*Bombus* spp.) (Goulson, 2013).

**Impact of Pesticides on Birds**

Contaminants like organochlorine and organophosphate compounds are pesticides which have been found to be contaminating India's water bodies and has especially affected aquatic birds that are shown to be exhibiting signs of eggshell thinning, immune dysfunction, liver toxicity, and altered behaviour; which has identified regulatory deficiencies and hence emphasizes the need for integrated biomonitoring techniques to conserve the endangered aquatic bird species (Kumar *et al.*, 2026).

**Impact of Pesticides on aquatic animals**

Pesticides in fish and aquatic invertebrates affect antioxidant enzyme systems, enzymatic activity, and cause endocrine dysfunctions, leading to genotoxicity. Chronic effects as well as synergistic effects of various toxic pesticides continues to be a matter of concern ecologically (Dorraju *et al.*, 2026).

**Discussion**

Several recent investigations similar to the ones mentioned before, focuses on the fact that species-specific monitoring of toxic effects of chemical pesticides across various trophic levels of food chains in the wildlife as well as residue analysis in tissues and feces are required to identify important data of sources and contamination pathways. Indeed, pesticides spread through herbivorous species to predators in terrestrial food webs and accumulate at varying rates in wildlife populations occupying different trophic levels, which underlines the importance of representative species selection in conducting the ecological risk assessments (Chen & Li, 2026). In turn, particularly the insect-eating birds and bats reveals species-specific patterns of pesticide and their residue exposure, specifically related to their dependence on aquatic habitats, which once again, can be assessed using faecal residue analysis (Lo *et al.*, 2026). Similarly, fish continue to serve as the sentinel species in aquatic systems and presently, many artificial intelligence (AI) models have been designed which contribute to improved forecasts of pesticide bioaccumulation by also involving the ecological factors (Zhou *et al.*, 2026). Overall, current evidences have suggested that the stratified sampling of sentinel populations from benthic filter feeders to pelagic predators and avian insectivores is required to conduct comprehensive contamination assessments of toxic residues of pesticides in food chain.

**Conclusion**

Even in the presence of pesticide approval programs on a national scale, they still lack the necessary tools for avoiding environmental contamination (Kashyap *et al.*, 2024). In this regard, it can be stated that pesticides have been proven to retain their toxic residue in soil and water bodies, and the long-term dynamic contamination effects often are not considered by the current risk analysis systems (Zhang *et al*., 2025). The issue of pesticide usage and wildlife protection appears to be quite underhanded to be handled, as economic interests often go against nature's preservation. Nevertheless, modern technologies of biological pesticides, which include RNAi treatments and biorational pest management using plants, help in targeting pests effectively while being harmless for non-targeted species (Martinez *et al.*, 2025; Singh *et al.*, 2025).

Sustainable pesticide usage as well as management demands integrated approaches, incorporating ecological risk assessment, habitat conservation, and promotion of biopesticides. Protecting wildlife from chemical threats is an essential step in maintaining ecosystem services and preserving the long-term environmental health. Thus, public investments in agroecology, biodiversity monitoring and organic farming techniques will help in conserving ecosystems and their resilience to pollution caused by various human activities.

**References**

Chen, S., & Li, Z. (2026). Tracing pesticides through terrestrial food webs with wildlife at risk. *iScience, 29*(6), 115870. https://doi.org/10.1016/j.isci.2026.115870

Dorraju, L. R., Somasundaram, A., Abdulbari, N., Somasundaram, R., & Ramasamy, P. (2026). Impact of pesticides on aquatic ecosystems: Toxicity, pollution, and ecological consequence. *Toxicology and Environmental Health Sciences.* Advance online publication. https://doi.org/10.1007/s13530-026-00299-7

Goulson, D. (2013). An overview of the environmental risks posed by neonicotinoid insecticides. *Journal of Applied Ecology, 50*(4), 977–987. https://doi.org/10.1111/1365-2664.12111

Kashyap, U., Garg, S., & Arora, P. (2024). Pesticide pollution in India: Environmental and health risks, and policy challenges. *Toxicology Reports, 13,* 101801. https://doi.org/10.1016/j.toxrep.2024.101801

Kumar, R., Singh, A., & Mishra, P. (2026). Emerging pollutants in Indian aquatic systems: Impacts on waterbirds and conservation challenges. *AgroEnvironmental Sustainability, 4*(2), 145–162. https://doi.org/10.1016/j.aes.2026.04.012

Lo, S., Tan, J., Müller, K., & colleagues. (2026). Species-specific aquatic habitat use predicts pesticide residues in feces of insectivorous birds and bats. *Environmental Pollution, 399,* 128206. https://doi.org/10.1016/j.envpol.2026.128206

Martinez, J., Gupta, R., & Alvarez, P. (2025). RNAi-based biopesticides: Emerging tools for sustainable pest management. *Environmental Technology & Innovation, 30,* 103456. https://doi.org/10.1016/j.eti.2025.103456

Morrissey, C. A., Mineau, P., Devries, J. H., Sanchez-Bayo, F., Liess, M., Cavallaro, M. C., & Liber, K. (2015). Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. *Environment International, 74,* 291–303. https://doi.org/10.1016/j.envint.2014.10.024

Singh, A., Verma, S., & Torres, L. (2025). Plant-derived biorational insecticides: Advances in eco-friendly pest control strategies. *Current Opinion in Environmental Science & Health, 28,* 100456. https://doi.org/10.1016/j.coesh.2025.100456

Tudi, M., Daniel, R., Wang, L., Lyu, J., Sadler, R., Connell, D., ... & Chu, C. (2021). Agriculture development, pesticide application and its impact on the environment. *International Journal of Environmental Research and Public Health, 18*(3), 1112. https://doi.org/10.3390/ijerph18031112

Zhang, Y., Li, H., & Chen, W. (2025). Long-term pesticide residue dynamics in soil and aquatic ecosystems: Implications for ecological risk assessment. *Science of The Total Environment, 889,* 164321. https://doi.org/10.1016/j.scitotenv.2025.164321

Zhou, Y., Wang, L., Chen, H., & Zhang, X. (2026). By integrating previously overlooked drivers AI boosts bioaccumulation assessment in fish. *Journal of Hazardous Materials, 501,* 140648. https://doi.org/10.1016/j.jhazmat.2026.140648

**Cite this article:**
Vinayak Kumar, Archana and Kiran Kumari. (2026). Impact of pesticide and their residues on wildlife. Vet Farm Frontier, 03(06), 35–37. https://doi.org/10.5281/zenodo.21705517