

EXPOSURE TO PESTICIDES AND THEIR HEALTH HAZARD IN HUMAN: A REVIEW**Akta Sharma^{1*} and P.D. Charan²**^{1,2}Department of Environment Science, Maharaja Ganga Singh University, 334004, Bikaner, Rajasthan, India
E-mail: ¹drekta09@gmail.com**ABSTRACT**

Around the world, the use of pesticides in crop production has significantly increased. Chemicals are frequently used in the agriculture industry to control weeds, pests, and diseases associated with pests in order to boost productivity and quality. Pesticides are important for the advancement of agriculture. Yet the use of pesticides can cause both acute and long-term toxicities in humans, and the negative impacts of pesticides on the environment and human health continue to be a major issue. Thus, it is necessary to talk about the health hazards associated with pesticide use. Particularly concerning are the health issues associated with pesticide use and exposure in developing countries. It is apparent that indiscriminate and excessive use of pesticides pollutes not only the environment and agriculture but also contaminate the food chain affecting health of farmers and humans. The present study is focused to investigate the relationship between pesticides and their impact on human health. Based on the preliminary surveys, there are eight major pesticides being used in Bikaner region. The impacts of selected pesticides on human health was assessed for present investigation. This research aims to present scientific data regarding the detrimental health impacts on communities and applicators equally. To lessen the negative impacts of pesticides on the environment and human health, policymakers should enact a number of beneficial policies, such as integrated pest management (IPM) legislation that forbid the use of pesticides with high risks and the creation of national implementation plans (NIPs).

Keywords: Pesticides, Crops, Human health.**INTRODUCTION**

The main source of food for human and their consumption is agriculture. It provides different types of crop production. The economy of India has always been dependent on agriculture. Where farming is the primary occupation of people is agriculture. About 60-70% of the people are involved with agriculture and cultivation in India. It is considered to be the backbone of the national economy. According to the agricultural situation in India, census 2015 after the united states, India is the second largest fertile land area in the world, which is 159.7 million hectares. Similarly, India is the largest gross irrigated crop area in the world, which is 82.6 million hectares. India ranks in the top three countries in the world for the production of a wide range of many crops, including wheat, rice, pulses, cotton, groundnut, mustard, fruits and vegetables. An important part of modern agriculture is the use of pesticides, a class of organic and inorganic substances that help prevent diseases, weeds, and the eradication of pests (insects, rodents, fungi, nematodes, other farm animals or terrestrial plants, life, bacteria, viruses, or other microorganisms), other plant pathogens, and illnesses. This increases crop productivity and

fosters food security (Pang et al., 2016). Pesticides can be considered as a compulsory synthetic chemical substance, because they protect the crops, increase crops quantity, quality and yields. The excess and unjustified pesticide usage may result in severe health issues in living being including human.

With the start of the green revolution in 1965, agricultural productivity in India saw a significant improvement. The introduction of innovative irrigation methods, chemical fertilizers, synthetic pesticides, herbicides, and high-yielding varieties laid the foundation for the Green Revolution. It is believed that since the start of the Green Revolution, pesticides have killed some 800,000 people in developing nations. Each year, pesticide exposure through food poisoning claims the lives of about 20,000 people in under developed countries (Bhardwaj and Sharma, 2013). Pesticides are the most common synthetic chemical input into the environment, and during the past 50 years, this input has increased more than any other single factor contributing to global environmental change, including greenhouse gas emissions (Bernhardt et al. 2017). It is estimated that 56% of herbicides, 19% of insecticides, 25% of fungicides, and other pesticides are applied worldwide. Approximately

51% of insecticides, 33% of fungicides, 16% of herbicides, and the use of additional insecticides are used in India (FAO, 2018). Presently, there are still public concerns about the consequences of using pesticides in health (especially in old people and children). In contrast, because of the exponential growth of the population in the last decades, global production of pesticides is growing at the same trend (Fishel et al., 2013). Researchers are working to create genetically modified crops in modern agriculture that can insecticides or show resistance to pests and broad-spectrum herbicides. This new pest management could reduce uses of pesticide application and their hazardous impacts on human health and environment (Bernardes et al., 2015).

THE FREQUENCY OF CURRENTLY USED PESTICIDES ON AGRICULTURAL CROPS GROWN IN BIKANER DIVISION

The application of pesticides is very necessary for effective yield of both Kharif and Rabi crops in India. Rajasthan, an arid region of India, is distinguished by its limited water supplies and challenging weather features. Despite these difficulties, agriculture is still an important industry in the area and considerably affects local's quality of life. Rajasthan is the largest producer of edible oils and the second largest producer of oilseeds in India (Sharma and Dutta, 2019). India is the fourth position in mustard production which is contributing about 11% of world's total production (Pahariya, 2022). Bikaner contributes about 10.30% area of groundnut and 3.30% area of mustard in the Rajasthan state in India (Saran *et al.*, 2018). Bikaner has the highest production of oilseeds among all district in the Rajasthan, which is 47.2 tons (Kumar *et al.*, 2022). In Rajasthan, the mustard crop is mostly cultivated in Alwar, Bharatpur, Bikaner, Jaipur, Dholpur, Swaimadhopur, Sriganganagar, Jhunjhunu and Sikar district. While the groundnut crop is mostly cultivated in Bikaner, Jaipur, Jodhpur, Churu, Sikar and Dausa (Pahariya, 2022). Major food crops cultivated in Bikaner district include: guar (*Cyamopsis tetragonoloba*), mustard (*Brassica nigra*), gram (*Cicer arietinum*), cumin (*Cuminum cyminum*), coriander (*Coriandrum sativum*), moong (*Vigna radiata*), bajra (*Pennisetum glaucum*), wheat (*Triticum aestivum*), groundnut (*Arachis hypogaea*) and cotton (*Gossypium herbaceum*). Groundnuts and mustard are two of the main crops grown in Rajasthan's Bikaner district, which is located in the

north. To control numerous pests and boost crop productivity, pesticides are frequently used in Bikaner, as they are in other agricultural areas. Pendimethalin, Mancozeb, Azoxystrobin, Difenoconazole, Hexaconazole, Carbendazim, Propiconazole, Thiophanate methyl, Thiamethoxam, Imidacloprid, Lambda cyhalothrin, Monocrotophos, Dimethoate, Chlorpyrifos and Emamectin benzoate are major pesticides used in Bikaner region but Pendimethalin, Hexaconazole, Carbendazim, Mancozeb, Chlorpyrifos, Monocrotophos, Dimethoate and Emamectin Benzoate etc. are major pesticides used for groundnut and mustard crops in the Bikaner division.

IMPORTANCE OF PESTICIDES IN AGRICULTURE IN PRESENT SCENARIO

Due to the scarcity of vaccinations that may effectively combat hazardous diseases carried by insects, controlling insects is a major factor in the management of vector-borne diseases that affect both humans and animals. Thus, among many other vector-borne illnesses including dengue, filariasis, and malaria, pesticides are crucial in their management (Anonymous, 1976). Agriculture was developed to produce crops and livestock for human consumption. The human population increase the amount of food produced is very important. Unfortunately, the change in agricultural practices because of the use of pesticides. In various environmental samples, pesticides have been detected in ground water, surface water, ambient air, and soil samples. Pesticides protect forests and other wildlife habitats from invasive species of plants and non-native insects and other pests. Improved agricultural yields help the farmers to produce more food without expanding their agricultural land which consequently protects biodiversity. Insecticides also improve home sanitary conditions by keeping the population of bugs in control (Delaplane, 2000). Pesticides also prevent disease outbreaks through the control of rodent and insect vectors hence they contribute to improved human health. Deaths of about seven million people all around the world have been prevented through insecticide mediated killing of disease vectors.

The most significant example is of malaria control that was responsible for an average of 5000 deaths per day (Ross, 2005). These are two levels of benefits for pesticides use, primary and secondary.

Primary benefits are direct gains from the use of pesticides and secondary benefits are effects that more long term (Cooper and Dobson, 2007). Secondary benefits are more difficult to establish cause and effect, but nevertheless they can be powerful justifications for pesticides use. Pesticides also preserve the beauty of recreational spots by controlling weeds and also prevent structural damage associated with termite infestations. Herbicides and insecticides are used to preserve the turf on grounds, pitches and golf course (Aktar et al., 2009). When it comes to public health, pesticides are used on a regular basis to eradicate pests such as rats, mice, ticks, and mosquitoes from homes, workplaces, shopping centers, and public spaces. The enormous burden of diseases caused by these vectors has therefore been significantly reduced or completely eradicated (Lawler, 2017). In terms of a decrease in the number of pests, pesticides produce encouraging outcomes. These substances have been used for ages to combat pests. Remarkably, during the second part of the nineteenth century, the use of these compounds increased significantly on a global scale (Manyilizu, 2019). The global pesticide consumption in 2019 came to about 4.19 million metric tons, of which China was the world's largest pesticide consumers with 1.76 million tons, the United states is 408 thousand tons, Brazil is 377 thousand tons and Argentina is 204000 tons (kt) (Fernandez, 2021). In many regions of the world, the use of copper salts, compounds containing arsenic, and nicotine extracts was widespread at the turn of the 20th century (Tudi et al., 2021).

HUMAN HEALTH HAZARD RELATED TO PESTICIDE EXPOSURE

Yet, there are several environmental and health issues that have been brought up due to the excessive and uncontrolled usage of pesticides. Their indiscriminate use can result in the buildup of hazardous residues in food, water, soil, and other resources, thereby endangering human health and the environment. Pesticide residues can bioaccumulate in living things and infiltrate the food chain, resulting in acute and long-term health impacts such neurological problems, dermatological disorders, hormone abnormalities, and even cancer. Moreover, pesticide residues in soil and water can disturb ecosystems, resulting in the extinction of non-target species, a loss of biodiversity, and poisoning of water supplies.

Bind and Kumar (2019) have been revealed that the exposure to various pesticides is linked with a different types of health problems such as various forms of Cancer, Parkinson's and Alzheimer's like neurodegenerative diseases and also reported its effects on new born baby as anomalies. Khan et al., 2020 studied six pesticides in different samples of fruits, vegetables, soil and water. They observed that the concentration of Imidacloprid was detected in spinach, bitter guard, mustard plant, beetroot, guava and soil sample. The concentration of Imidacloprid in sample found was 6.667 mg/kg, 3.374 mg/kg, 1.9643 mg/kg, 1.2902 mg/kg, 2.392 mg/kg and 8.3090 mg/kg. It is dangerous for human health because it can occur neurotoxic disorder, reproductive disorder and mutagenic disorder.

Table 1: Potential Health Impacts of commonly used Pesticides in Bikaner district (Sharma, 2015)

S.N.	Category of disorders	Pesticides	System affected	Common symptoms
1.	Neurological disorders	Pendimethalin, mancozeb, hexaconazole, carbendazim, monocrotophos, dimethoate, chlorpyriphos, emamectin benzoate	Brain, spinal cord, nervous system	Headache, confusion, change in behavior, dizziness, convulsions, depression, coma, cancer
2.	Dermatological disorders	Pendimethalin, mancozeb, hexaconazole, emamectin benzoate	Skin, eye	Redness, dilation of pupils, swelling, rashes, itching, irritation, allergy

3.	Gastrointestinal disorders	Pendimethalin, mancozeb, hexaconazole, dimethoate, chlorpyrifos	Stomach, intestine	Vomiting, diarrhea, nausea, cancer
4.	Reproductive disorders	Mancozeb, carbendazim, monocrotophos, chlorpyrifos	Ovaries, testes, fetus	Infertility, miscarriage
5.	Respiratory disorders	Pendimethalin, mancozeb, carbendazim, chlorpyrifos	Nose, lungs, trachea	Tightness in chest, irritation in respiratory tract

Since pesticides are long-lasting and easily bioaccumulated in the adipose tissues of both humans and animals, they are known as "silent killers". Despite the enormous benefits derived from pesticides, these chemicals may be lethal, if used improperly. Many pesticides are toxic to living organisms and interfere with specific biochemical systems. The presence of pesticides in food and vegetables has created a certain apprehension and fear in the public. Thus, the problems that a chemical may be toxic to non-target organisms must be taken into account not only in developing the pesticides, but also in its use.

Pesticide residues in food are a potential hazard, which has received much attention during the past two decades. In developed countries extensive regulatory agencies have been created to deal with pesticide residues in food. In many developing countries MRL's of pesticide residues in food have not been established, however the guidelines developed by Food and Agriculture Organization and the World Health Organization (FAO/WHO) are generally followed. Some pesticides are relatively stable and, in some cases, may bioaccumulate, which causes damage to food chain. Generally, organochlorine pesticides persist in environment for longer time. Most of new pesticides are not sufficiently stable to result in bioaccumulation. Recent increases in childhood cancers in throughout North America, such as leukemia, may be a result of genotoxic and non-genotoxic pesticides due to somatic cell mutations. Insecticides targeted to disrupt insects can have harmful effects on the nervous systems of mammals, due to basic similarities in system

structure. Both chronic and acute alterations have been observed in those who are exposed. Pesticides have been suspected to have an impact in the promotion and proliferation of cancer while causing hormone imbalance. DDT and its breakdown product DDE, with levels still present in the environment, despite its ban, are known to disturb estrogenic activity and possibly lead to breast cancer. Exposure to pesticides, for example DDT, in fetal stages has been proven to alter male penis size in animals to that much smaller than average as well as develop undescended testicles. Exposure to pesticides may occur in postnatal early stages of development, in utero, and even if either parent was exposed before conception took place. Reproductive disruption has the potential to occur by chemical reactivity and through structural changes to a system (Ramchandra, 2011). Guo et al., (2024) reported that the assessment of chronic and acute exposure, as well as health risks associated with pesticide residues in mustard, was conducted for different age groups within the Chinese population, including adults (6–14 years), children (15–49 years), and the elderly (50–74 years). The results of this assessment indicated that pesticide residues in mustard cultivated in China are not expected to be of short- or long-term risks to the Chinese customers.

Calaf (2021) reported that the cancer problem is caused by the various pesticides, but breast cancer is the most common in all cancer types and is associated with organophosphorus (malathion and parathion) that affect cellular growth and proliferation. Similarly, autoinhibitory M2 muscarinic receptors on parasympathetic neurons

that innervate airway smooth muscle are implicated in the case of asthma by organophosphorus. Similarly, Nascimento et al., (2022) reported that the possible genetic damage initiated by occupational pesticide exposure is much greater than that caused by smoking and alcohol consumption. This points to the commonly unacceptable fact that pesticide exposure is much more dangerous than quitting smoking. Dhankhar and Kumar (2023) have carried out research on pesticides pollution. The study was examining that pesticides have caused some type of environmental and water pollution. They also assessed that pesticides have such type of excessive toxicity, destroying undesirable fungi, herbs, rodents and insects. As well as pesticides harm human beings' fitness if they have used improperly.

MITIGATION MEASURES AND RECOMMENDATIONS

Based on the findings, recommendations for mitigating the risks associated with pesticide residues in Bikaner district are proposed. These include the adoption of integrated pest management practices (Implementing a combination of biological, cultural and chemical methods to control pests), promoting organic farming (Adopting farming practices that avoid synthetic pesticides and promote soil health) and enhancing awareness

among farmers about the justified use of pesticides. Furthermore, the development of effective monitoring systems and regulations for pesticide residues is necessary to ensure the safety and well-being of the population and the environment.

CONCLUSION

Such pesticides have harmful effects that can lead to serious health problems in humans and other living things. The main findings of this investigation showed that, in order to lessen the negative effects of these well-known chemicals, strategies for reducing potential risks to human health and the environment must be developed with urgency. Better management of pesticide usage in the region is also urgently needed. The environmental consequences of eight key pesticides that are frequently used in the Bikaner division were the main focus of the current investigation. The study also aimed to raise awareness of the issue of pesticide residues in the research region. Data from the past 20 years about the relationship between pesticide exposure and human health showed that a number of pesticides induce degenerative diseases and neurological disorders. Pesticides have a major impact on growth and have the potential to cause cancer in humans as well as inherited abnormalities.

REFERENCES

1. Aktar, W., Sengupta, D. and Chowdhury, A. 2009. Impact of pesticides use in agriculture: their benefits and hazards. *Interdiscipl Toxicol.*, 2: 1–12.
2. Anonymous, 1976. Pest Control: an assessment of present and alternative technology, Pest control and public health, US National Academy of Sciences, Vol.-V, Washington, D.C. 11-17.
3. Bernardes, M.F.F., Pazin, M., Pereira, L.C. and Dorta, D.J. 2015. Impact of Pesticides on Environmental and Human Health London, UK. In *Toxicology Studies—Cells, Drugs and Environment*, 195–233.
4. Bernhardt, E. S., E. J. Rosi, and M. O. Gessner. 2017. Synthetic chemicals as agents of global change. *Frontiers in Ecology and the Environment* 15(2): 84–90. <https://doi.org/10.1002/fee.1450>.
5. Bhardwaj, T. and Sharma, J.P. 2013. Impact of pesticides application in agricultural industry: An Indian scenario, *International Journal of Agriculture and Food Science Technology.*, 14(8): 817-822.
6. Bind, V. and Kumar, A. 2019. Pesticides toxicity may causes adverse effects to our health-a review. *MOJ Toxicol.*, 5(1): 17-18.
7. Calaf, G. M. 2021. Role of organophosphorous pesticides and acetylcholine in breast carcinogenesis. *Semin. Can. Biol.* 76: 206–217. doi: 10.1016/j.semcancer. 2021.03.016.
8. Cooper, J. and Dobson, H. 2007. The benefits of pesticides to mankind and the environment. *Crop Protection.*, 26: 1337-1348.
9. Delaplane, K.S. 2000. Pesticide usage in the United States: history, benefits, risks, and trends. Cooperative Extension Service. The University of Georgia, College of Agricultural and Environmental Sciences.
10. Dhankhar, N and Kumar, J. 2023. Impact of increasing pesticides and fertilizers on human health: A review. Materialstoday: Proceedings.

11. FAO. (2018). Pesticide Use Data-FAOSTAT. Retrieved from <http://www.fao.org/faostat/en/#data/RP>
12. Fernández, L. (2021). Global pesticide uses by country | Statista. Available online at: <https://www.statista.com/statistics/1263069/global-pesticide-use-by-country/>.
13. Fishel, F.M. and Ferrell, J.A., 2013. Managing Pesticide Drift. Agronomy Department. PI232, University of Florida, Gainesville, FL, USA. Available: <https://edis.ifas.ufl.edu/pi232>.
14. Guo, Q., Yue, X., Feng, X., Wang, X., Hu, X., Ma, F., Zhang, L., Li, P. and Yu, L. 2024. A study of the pesticide residues in rapeseeds in China: Levels, distribution and health risk assessment, *Environmental Research*, 246(1): 118110.
15. Jallow, M.F.A., Awadh, D.G., Albaho, M.S., Devi, V.Y. and Thomas, B.M. 2017. Pesticide risk behaviors and factors influencing pesticide use among farmers in Kuwait. *Sci. Total Environ.*, 574: 490–498.
16. Khan, N., Yaqub, G., Hafeez, T. and Tariq, M. 2020. Assessment of health risks due to pesticide residues in fruits, vegetables, soil and water. *Journal of Chemistry*.
17. Lawler, S.P. 2017. Environmental safety review of methoprene and bacterially-derived pesticides commonly used for sustained mosquito control. *Ecotoxicol. Environ. Saf.*, 139: 335–343.
18. Manyilizu, W. B. 2019. Pesticides anthropogenic activities, history and the health of our environment: lessons from Africa. Pesticides- use and misuse and their impact in the environment M. Larramendy, & S. Soloneski (Eds.).
19. Pahariya P 202, Mustard production and distribution in Rajasthan. *International Journal of Trend in Scientific Research and Development*. 6 2456-6470.
20. Pang, S., Yang, T. and He, L. (2016). Review of surface enhanced Raman spectroscopic (SERS) detection of synthetic chemical pesticides. *TrAC Trends in Analytical Chemistry*, 85:73-82.
21. Ramachandra, T.V. 2011. Soil and Groundwater Pollution from Agricultural Activities, Canada. 205. (Canada: TERI Press., 2011).
22. Ross, G. 2005. Risks and benefits of DDT. *Lancet* 366(9499): 1771–1772.
23. Runkle, J., Flocks, J., Economos, J. and Dunlop, A.L. 2017. A systematic review of Mancozeb as a reproductive and developmental hazard. *Environ. Int.*, 99: 29–42.
24. Saran D, Singh G, Kumari P and Jangid R 2018, Study the status of organic farming in Bikaner district of Rajasthan. *Journal of Pharmacognosy and phytochemistry*. 7 879-883.
25. Sharma N and Dutta S 2019, Analysis of pesticide residues on crops with related health impact on farmers in agriculture field of Sikrai Tehsil, Dausa District, Rajasthan, India. *Int. J. Curr. Microbiol. App. Sci.* 8 161-169.
26. Sharma, R. (2015). Pesticide contamination in some lakes of Rajasthan. *IOSR Journal of Pharmacy and Biological Sciences*. 10(6), 64-66.
27. Tudi, M., Daniel Ruan, H., Wang, L., Lyu, J., Sadler, R., Connell, D., Chu, C., Phung, D.T. 2021. Agriculture development, pesticide application and its impact on the environment. *Int. J. Environ. Res. Public Health.*, 18: 1112.
28. Yadav, I.C. and Devi, N.L. 2017. Pesticides classification and its impact on human and environment. *Environ. Sci. & Engg.*, 6: 140-158.