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## Food Toxicity in Punjab: A Review of Concerns and Strategies.

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### ABSTRACT

The area of food toxicology currently has a high profile of interest in the food industry, universities, and government agencies, and is certainly of great concern to consumers. Continued unthoughtful application of pesticides for agricultural pest control poses serious threats to human health. Numerous primary epidemiological studies have established the cause-effect relationship between pesticides and a large number of diseases viz. hazards of cancer, neural disorders, birth defects, reproductive and developmental anomalies, mutagenicity etc. Pesticide users and consumers in developing countries are especially vulnerable to pesticide-related health problems due to lack of awareness and inadequate regulatory and preventive mechanisms. The present paper attempts to summarize this fairly large volume of information available on the toxic effects of pesticides on human health emanating from pesticide contamination of food stuff, agricultural and other ecosystems and discusses the related legal and ethical issues with special reference to Punjab, India to make it available to the researchers so that appropriate research priorities in this subject field can be identified for future investigations.

**Keywords:** Food toxicity, pesticides, food toxins

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## INTRODUCTION

Punjab (the five river region) is one of the most fertile regions on earth and is called as the "granary of India" or "Indian bread basket". It occupies only 1.57 per cent of the total geographical spread of India but produces 45 per cent of India's wheat and 15 per cent of total rice production. Indian Punjab produces 2 per cent of world's cotton, 2 per cent of its wheat and 1 per cent of world's rice (Official website of Punjab Government). Punjab has also earned credit being a best example of green revolution in India as the country has changed from a food-deficit country to a food surplus country because of agricultural transformation in Punjab (Official website of Punjab Government). Simultaneously, the green revolution technology and excessive use of chemical fertilizers and pesticides had imposed a big pressure on the ecological system of the state, ultimately resulting into soil resource deterioration and environmental pollution. Therefore, Punjab has turned into a hot-spot of environmental toxicity as highly toxic chemicals have been added into soil, water, air and food chain for the last many decades under the name of development and the inhabitants are affected by mixed toxicity.

The toxins which are present in the environment of Punjab are much in excess of safe limits as follows:

- Fluorides
- Uranium
- Asbestos
- Agricultural toxins (pesticides, insecticides etc.)
- Industrial toxins (lead, mercury etc.)
- Pharmaceutical toxins
- Veterinary drug residues (oxytocin etc.)
- Genetically modified toxicity (Bt cotton).

Among all these toxins, food toxins such as pesticides have become a "problem of high magnitude" in Punjab due to mismanagement and non-judicious use as the state of Punjab is one of the highest user (consumes about 17 per cent of the total pesticides used in India) of chemical pesticides especially after the ushering in of green revolution. It is reported that more than 90 per cent of the pesticides are being used in the cultivation of wheat, rice and vegetables and the Malwa region (cotton belt) accounts for nearly 75 per cent of pesticides used in the state (Mittal *et al.*, 2014). Moreover, the pesticide residues have been largely detected in the food chain and human blood samples in Punjab.

### Health concerns caused by food toxins

Pesticides and heavy metals not only contaminate the eco system but also bio accumulate in the food chain and can be traced in plant and animal tissues causing serious health hazards. Punjabi community is very much fond of eating and consider variety of food items present in their menu as the status symbol. Besides this, the household practices (storage and consumption) are quite inappropriate. Thus, the toxins such as pesticides and heavy metals have been incorporated through diet and pose serious health effects on humans such as:

- Immunological Effects
  - Acquired Immuno-deficiency
  - Auto-immunity
- Hypersensitivity
- Carcinogenic Effects
- Mutagenicity
- Teratogenicity
- Neuropathy
- Nephropathy
- Hepatopathy
- Reproductive Disorders
- Recurrent Infections
- Anemia
- Skin and Hair diseases



**Major epidemics of food toxins in Punjab**

Numerous researches have been conducted from 1978 to 2013 indicate the presence of food toxins in water and food products (esp. wheat, fruits, vegetables etc.) at more than permissible limits which pose health hazards to humans.

S. No.	Reference	Objective	Study Design	Findings
1.	Joia <i>et al.</i> , 1978	To assess the residues of DDT and BHC in wheat flour in Punjab	No. of wheat flour samples= 140 Sources: Flour mills and Retail shops of Jalandhar, Patiala, Sangrur, Ludhiana, Amritsar, Faridkot and Chandigarh	i) Detected 124 samples had residues of DDT. ii) Found BHC residues in 116 samples.
2.	Kalra and Chawla, 1980	Occurrence of DDT and BHC residues in human milk in India	No. of human milk samples= 75	The mean level of DDT was 0.511mg/l (eq. to 0.09 mg/kg/ d which was 18 times higher than the daily intake of 0.005mg/ kg/ d as per recommended by WHO.
3.	Chattopadhyay, 1980	To study the toxic effects of insecticide and pesticide pollution of food stuffs on man.	Carried out a survey and sample of sprayed cabbage, cauliflower and brinjal were analyzed.	i) Reported over 40 pesticides used in various districts. ii) Residues of methyl parathion (17.54-17.94 ppb), quinalphos (5.30 ppb) and malathion (7.62ppb) were found in higher range.
4.	Chahal <i>et al.</i> , 1998	Monitoring of farm gate vegetables for insecticide residues in Punjab.	No. of vegetable samples= 197 collected from farmer's field	70 per cent of vegetables were contaminated with different pesticides and 27 per cent samples were found to have higher pesticide residues when compared with the MRLs.
5.	Battu <i>et al.</i> , 2005	To assess the pesticide residues in soil, water and food stuffs at Talwandi Sabo, Bathinda.	No. of soil, water and vegetable (Okra) samples= 15	Ethion was detected to be as high as 1.42µg/g which was above the MRL of 1µg/g fixed for vegetables under PFA Act, 1954.
6.	Kumar, 2005	To study the prevalence of Cancer in villages of Talwandi Sabo Block, District Bathinda, Punjab.	Assessment of 39,732 families comprising 1,83,243 people in 129 villages and analysis of pesticide residues on vegetable samples in two blocks i. e. Talwandi Sabo and chamkaur sahib	i) Age adjusted cancer cases in Talwandi Sabo were higher i. e. 103 per lakh whereas in Chamkaur Sahib, the incidence was 71 per lakh. ii) The levels of HCH/BCH, ethion (1µg/g) and chloropyrifos (0.027 µg/g) were above permissible limits in fruits and vegetables grown in Talwandi Sabo. iii) Further, the residues of heptachlor, aldrin and endosulfan were also present in blood samples of cancer patients from both the blocks.
7.	Mathure <i>et al.</i> , 2005	To analyse the pesticide residues in blood samples from villages of Punjab.	No. of samples= 20 blood samples each from four and one villages of Bathinda and Ropar districts, respectively.	i) Six to twelve types of pesticide residues were found. ii) All the 20 samples had shown 15 to 605 times higher residues of organochlorine pesticide as compared to the blood samples of people in the United States. iii) The average levels of monocrotophos in the blood



				samples were found to be four times higher (0.095µg/g) than the MRLs recommended by WHO and FAO.
8.	Sharma <i>et al.</i> , 2005	To study the awareness level of the farmers regarding use of pesticides.	Survey of Jalandhar and Moga districts of Punjab.	<ul style="list-style-type: none"> <li>i) More than 50 per cent of farmers did not follow the instructions written on the pesticide containers.</li> <li>ii) Majority of the farmer (75.5 per cent) reused the empty containers for storage of grains and other household activities.</li> </ul>
9.	Sharma <i>et al.</i> , 2013	Pesticide Residues in Food Items: A study of Organized and unorganized retail outlets in Ludhiana District.	Samples of cereals and raw vegetables were collected from 30 household along with the information about sourcing of the food item i. e. organized and unorganized retail outlets.	<ul style="list-style-type: none"> <li>i) No pesticide residues were found in rice and wheat flour samples sourced from both the stores.</li> <li>ii) The residue of chlorpyrophos (0.200 ppm) in cauliflower sample was above the MRL recommended by Codex.</li> <li>iii) Majority of the pesticides found in the vegetable samples (especially tomato and okra) in both the stores were not in the official recommended list of Codex Alimentarius Commission.</li> </ul>
10.	Singh <i>et al.</i> , 1990	To study the air, water and soil borne pollution in Amritsar.	Soil and crop samples were collected from the farms (upto 5 kms. Of the reference point) irrigated by two drains viz. 1. Ganda Nallah (Hakimwala Drain) and 2. Tung Dhab Drain.	<ul style="list-style-type: none"> <li>i) The contents of copper and zinc were found as 270µg/g and 412.8µg/g, respectively which were very high for cultivated lands.</li> <li>ii) The levels of copper, zinc and lead were above permissible limits in some vegetable crops,.</li> </ul>
11.	Dhillon <i>et al.</i> , 1997	Land conservation and Reclamation	In 1000 ha areas, selenium content of soils was studied in Hoshiarpur and Jalandhar Districts of Punjab.	<ul style="list-style-type: none"> <li>i) Selenium content was found to be increased as four times. This could be due to the continuous practice of wheat-rice cropping pattern.</li> <li>ii) The sources of selenium were appeared to be ground water and floodwater loaded with selenium from Shiwalik hills.</li> </ul>
12.	Khurana <i>et al.</i> , 2003	In: Ground Water Pollution.	Carried out a study to see the heavy metal content esp. DTPA (Diethylene Triamine Penta-acetic acid) in soils irrigated by sewage water in comparison with the tube well irrigated soils in four districts viz. Ludhiana, Jalandhar, Amritsar and Sangrur of Punjab.	The highest DTPA content was found in the soils of industrialized city of Ludhiana and least in the soils of city of Sangrur.
13.	Ram <i>et al.</i> , 2005	Effects of Contaminants in Waste Water on Soil and Vegetables.	Survey was conducted in two cities viz. Chandigarh and Mohali to assess the pesticide residues on root vegetables.	<ul style="list-style-type: none"> <li>i) The concentrations of cadmium, lead, zinc and chromium were found to be higher than the permissible limits in root vegetable samples drawn from the waste water irrigated fields.</li> <li>ii) All the root vegetables like turnip, onion, potato, turmeric and radish had pathogens on their surfaces.</li> </ul>

## Strategies Formulated to Minimize Toxicity

### Legal and Policy Responses: (Tiwana *et al.*, 2005)

- The introduction of Bt cotton has proved to be a boon for the state as the pesticide consumption has decreased since 2003-04.
- The bio pesticides have been promoted by the state government by creating its awareness among the farmers.
- The new policy focuses on technologically, environmentally and economically sustainable growth.
- New innovations in the field of biotechnology in terms of promotion of plants which consumes less water, drought resistant, pest resistant, highly nutritious, having higher yields and environment-friendly have been carried out.
- Balanced use of biomass, organic and inorganic fertilizers and controlled use of agro-chemicals through integrated nutrients and pest management (INM and IPM) has been encouraged.

### Administrative Responses

- Both agricultural and allied sectors are focused as the state government has included several new schemes which emphasize on:
- Conservation of natural resources such as zero tillage, bio-fertilizers, bio-pesticides, integrated pest management and diversification of agriculture.
- In July, 2005, Punjab State Farmers Commission was constituted to review the status of agriculture and allied sectors in the state. Cultivation of pesticide free vegetables through implementing the technology of low cost net houses has been successfully demonstrated by the commission.
- Agriculture council was formulated which focuses on the diversification of crops.
- In January 2006, Council for Citrus and Agri. Juicing, Council for Value added horticulture, Organic farming council of Punjab and Viticulture Council of Punjab were set up to promote value-addition and organic farming.

**Agricultural Diversification, Infrastructure, Research and Development Fund** has also been established by the Government of Punjab to give boost to improved harvest technologies, value addition through processing, supply chain management and improved yields through genetic modifications and biotechnology.

**Establishment of Centre of Agriculture Excellence:** Punjab Agricultural University, Ludhiana and Bharti Enterprises, Rothschild have jointly set up the Field Fresh agriculture centre of excellence at Ladhawal to promote the adoption of best practices such as poly house, net houses, glass and green houses, micro irrigation in agriculture and to enhance agricultural productivity in an environmentally sustainable manner.

**Setting of Biotechnology Cluster:** A biotechnology cluster is set up by the Government of India which comprises of:

- i) National Agri-Food Biotechnology Institute (NABI)** will be dedicated towards research and development and world class training of human resource in Food Science and Technology and Nutritional Science.
- ii) Bio-Processing Unit** is set up to scale up and process optimization of new technologies developed by NABI or acquired through licensing from other sources within India and abroad.
- iii) Biotechnological Park in Punjab** will be comprised of business and service centres to promote biotechnology industry in Punjab.
- iv) Punjab Biotechnology Incubator** is a joint project of DBT, Government of India and State government which will provide testing and certification facility to agricultural produce.
- v) National Institute of Nanotechnology** is planned by DST and Government of India to be set up in the knowledge city at Mohali.

In 2005, **Punjab State Medicinal Plants Board** was established at Chandigarh in order to draw new policies and strategies for conservation, cost-effective cultivation, research and development, processing and marketing of raw materials to protect, sustain and develop this sector. Further, the board has recommended 32 medicinal plants for their cultivation in the state and is now creating awareness regarding their cultivation.

### Preventive Actions to Combat the Problem

- Twenty-eight chemical pesticides and insecticides have been banned in the state to protect the soil from chemical pollution.
- Various programs such as promotion of organic farming, vermi-composting, biofertilizers, biopesticides and IPM have been carried out in order to reduce the use of chemical pesticides.
- National Horticulture Mission (NHM) with its twin objective of crop diversification and income-generation to farmers has been implemented.
- Village adoption scheme by cotton industry consortium has been started to improve the method of cotton cultivation
- Promotion of value addition to agricultural produce through various agro-processing industries such as Nestle India Ltd. at Moga, Nijjer Agro Foods at Jandiala, Dumex at Jagraon, Pepsi Agro Foods at Zahura, Hoshiarpur and Glaxo-Smithkline at Nabha.
- Besides these efforts, Punjab Agricultural University, Ludhiana is also playing a pivotal role in mitigating this alarming situation by making its contributions in the field of extension education, through creating awareness and imparting trainings about latest technologies at district level through Krishi Vigyan Kendras (KVKs) and kisan melas.

### Other Initiatives

- In January, 2004, a **Kisan call centre** for Punjab has been set up at Chandigarh by Government of India and has provided a toll free telephone facility (**number 1551**) to farmers in order to get free information regarding agriculture and allied areas including meteorology in regional language.
- A regular Punjabi program entitled "**Mera Pind Mere Khet**" is telecasted by Doordarshan Kendra, Jalandhar for spreading awareness on various aspects of agricultural activities amongst the farmers.
- Various NGOs have been promoting activities such as organic farming, traditional varieties and use of organic manures etc. amongst the farmers by organizing meetings, seminars, camps, conducting field visits and by distributing printed materials in regional language.

### CONCLUSION

In the nutshell, it is evident from the past and present scenario that Punjab is now battling with residual effects of extensively used chemical pesticides and heavy metals in various components of the environment and food products. Therefore, the state is heading towards destruction in terms of ill health status of the inhabitants and food safety has become an area of major concern. Thus, there is urgent need for increased general awareness about the adverse effects of pesticides on various dimensions of human health. Besides the groups experiencing occupational exposure, the wider populace needs to be informed. When pesticide use is inevitable, appropriate safety measures must be adopted. Special care must be taken to safeguard children against accidental acute and chronic exposure to pesticides. Very little research effort in India, has been undertaken in this direction, which needs to receive more priority and attention from the researchers in near future for adequately safeguarding human health. Though, praiseworthy efforts have been made by the central and state governments and state agricultural university, but long distance is yet to be covered!

### Recommendations

- The state agricultural policy needs to be reformulated.
- More emphasis should be laid on post harvesting and value addition techniques.
- Diversification must be promoted through shifting the existing wheat-rice cropping pattern to other alternatives by switching over to maize, pulses, legumes, oilseeds and citrus cultivation.
- Organic farming by focusing on vermicomposting, mulching etc. should be emphasized and markets for organic foods must be developed.
- Traditional varieties must be encouraged in the fields and seeds should be made easily accessible to the farmers.

- Well equipped residue testing laboratories should be established to detect and control the toxic residues in the environment and food.
- Environment cells should be set up in order to assess the long term impacts of agricultural and industrial activities.
- Statistical department should be strengthened by updating food and environment data.
- Epidemiological studies related to agricultural and industrial activities and house-hold practices need to be taken up.
- Last but not the least, extension activities should be more effectively implemented in southern districts of Punjab (Bathinda, Mansa, Faridkot etc.) in order to create awareness for environment and food safety.

#### REFERENCES

- [1] Battu RS, Singh D Sahoo S 2005 Status of Pesticide Residues at Talwandi Sabo, Bathinda. Punjab Agricultural University, Ludhiana, Personal Communication
- [2] Chahal KK, Singh B, Battu RS Kang BK 1999 Monitoring of Farmgate Vegetables for Insecticidal Residues in Punjab. *Ind. J. Ecol.* 26 (1): 50-55
- [3] Chattopadhyay PK, 1998. Insecticide and Pesticide Pollution of Food Stuffs and their Toxic Effect on Man. Project sponsored by Punjab State Council for Science and Technology, Chandigarh.
- [4] Dhillon SK and Dhillon KS 1997 Land Conservation and Reclamation. 5:313-323
- [5] Joia BS, Chawla RP Kalra RL 1978 Residue of DDT and HCH in Wheat Flour in Punjab. *Ind. J. Ecol.* 5(2): 120-127
- [6] Kalra RL and Chawla RP 1980 Occurance of DDT and BHC Residues in Human Milk in India. *Experientia* 37:404-405
- [7] Khurana MPS, Nayyar VK, Bansal RL Singh MV 2003 In: Ground Water Pollution (Singh V. P. and Yadav R.N. eds.). Allied Publishers Pvt. Ltd, New Delhi: 487-495
- [8] Kumar R 2005 An Epidemiological Study of Cancer Cases reported from Villages of Talwandi Sabo Block, District Bathinda, Punjab. PGIMER, Chandigarh and PPCB, Patiala
- [9] Mathure HB, Agarwal HC, Johnson S, Saikia N 2005 Analysis of Pesticide Residues in Blood Samples from Villages of Punjab. Centre for Science and Environment, Tughlakabad, New Delhi. [http://www.downtoearth.org.in/Images/20050615/Punjab\\_blood\\_report.pdf](http://www.downtoearth.org.in/Images/20050615/Punjab_blood_report.pdf)
- [10] Mittal S, Kaur G, Vishwakarma GS 2014 Effects of Environmental Pesticides on the Health of Rural Community in the Malwa Region of Punjab, India: A Review". *Human Ecological Risk Assessment: An International Journal* 20 (2): 366-387
- [11] Official website of Punjab Government ([www.punjabgovt.nic.in/punjabataglance](http://www.punjabgovt.nic.in/punjabataglance)).
- [12] Ram B, Garg SP, Matharu SS, 2005 Effects of Contaminants in Waste Water on Soil and vegetables. Punjab Pollution Control Board
- [13] Sharma A, Khurana GS, Dhaliwal GS 2005 Awareness of the Farmers of Punjab State regarding Environment Implication caused due to Excessive use of Pesticides. *Ind. J. Ecol.* 32(1): 76-78
- [14] Sharma S, Sangha JK and Singh B 2013. Pesticide Residues in Food Items:A Study of Organized and Unorganized Retail Outlets in Ludhiana Districts. *Ind. J. Ecol.* 40 (1): 96-99
- [15] Singh H, Singh R Singh B 1999 Studies in Air, Water and Soil Borne Pollution in Amritsar. Project sponsored by Punjab State Council for Science and Technology, Chandigarh
- [16] Tiwana NS, Jerath N, Saxena SK, Nangia, P Parwana HK 2005 State of Environment: Punjab, 2005. Punjab State Council for Science and Technology, Chandigarh: 315.