AN OVERVIEW

HIGHLY HAZARDOUS PESTICIDES

IN INDIA

Savitri
THE SAVITRI WANEY CHARITABLE FOUNDATION

Thanal

PAN INDIA

Highly Hazardous Pesticides in India- An Overview

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A project of Savitri,

The Savitri Waney Charitable Foundation is a philanthropic organization working with some of the poorest and marginalized rural communities in India, with a desire to transform their lives. We work with local communities on aspects like the relief of poverty, education, and medical relief. Poverty reduction is at the core of what we do. Through this project, we wish to raise awareness among farmers, consumers and other stakeholders about the adverse effects of Highly Hazardous Pesticides which will not only benefit the farming community to ensure their health and safety but also will ensure a reduction in polluting the environment.

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Thanal Conservation Action facilitates Sustainable Solutions for the Environment. Its objective is to carry on the business of undertaking studies and projects, developing and running communication projects for institutions, companies, Government Organizations, and Individuals, contributing to a better understanding of environmental problems, conservation and protection of environment and wildlife.

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Pesticide Action Network India (PAN India) is a non-profit, public interest, research and advocacy organisation formed in 2013. Its objective is to help communities and governments to reduce dependence on toxic agrochemicals for pest control in agriculture, household as well as public health and to increase the use of sustainable alternatives. PAN India is working to empower farming communities to keep away from toxic pesticides and agrochemicals, and to take up non-chemical methods of farming practices based on agroecology.

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Introduction

Pesticides have become a crucial part of modern agriculture, commonly used to control pests and diseases. There is no denying that centuries of continuous pesticide usage have had a negative impact on the ecosystem and human health. One of the most significant harmful effects of pesticides is their impact on human health. Exposure to pesticides has been linked to numerous health issues ranging from acute illnesses to chronic diseases including cancer, reproductive problems, and neurological disorders. Furthermore, pesticides are found to contaminate natural resources and ecosystems, where they persist in the environment for long periods of time, leading to accumulation in soil and water, with the potential for long-term adverse effects on ecosystems.

In this scenario, a more lethal class of pesticides that are dangerously hazardous than commonly used pesticides is becoming more and more significant. These pesticides are called Highly Hazardous Pesticides or HHPs. They are used widely with other pesticides and are not given adequate consideration given that they are hazardous. Highly Hazardous Pesticides are found to cause numerous adverse effects according to criteria developed by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO). They are noted for severe toxic effects on animals and aquatic systems and many of them are listed in international conventions because of their higher toxicity to humans and prolonged negative impact on the environment. Nevertheless, they continue to be the most widely used kind of pesticide worldwide, and in India, the circumstances stay identical. They are also some of the most widely used pesticides in India, are linked to several health and environmental issues, and are most frequently used in self-poisoning

incidents in the country. This booklet is an attempt to address these issues pertaining to HHPs in India and their current status.

What are Highly Hazardous Pesticides???

Highly Hazardous Pesticides are pesticides that are severely hazardous or toxic than other pesticides. They were recognized by WHO in 1975 by publishing the guideline, Recommended Classification of Pesticides by Hazard. Following the GHS classification on acute toxicity in 2002 and subsequent international agreements on the hazardous nature of chemicals, the Strategic Approach to International Chemicals Management (SAICM) has agreed requirement for a process to reduce pesticide risk and gradually eliminate Highly Hazardous Pesticides (HHPs) in 2006. As a result, the Joint FAO/WHO Meeting on Pesticide Management (JMPM) formulated eight criteria that describe HHPs, and

when the International Code of Conduct on Pesticide Management was updated in 2013, it included a definition for HHPs which is,

Pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems such as the World Health Organization (WHO) or the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) or their listing in relevant binding international agreements or conventions and in addition, pesticides that appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered to be and treated as highly hazardous'

The phasing out of HHPs has been the subject of ongoing global discussion ever since this time period. Many of the HHPs are subject to international regulations from UN organizations and conventions.

HHPs, a hazard!!!

Employing pesticides in agriculture fields has become extremely risky due to the use of Highly Hazardous Pesticides. They are potent chemicals that are steadily destroying both our environment and ourselves. They coexist with other pesticides in our fields. They are used in farms along with other pesticides, and whether we realize it or not, modern agriculture is contributing to their increased usage on a daily basis. It is to note that, they are regarded as chemical formulations not just in fields of agriculture but also in everyday chemicals and products. Concerningly, throughout

the past century, there has been a higher rate of poisoning from domestic pesticides than from agricultural pesticides[1].

Highly Hazardous Pesticides or HHPs have a large impact on human health. They cause acute effects- immediately following the application and long-term effects that are severely concerning. The most dangerous aspect of HHPs is their level of absorption. HHPs not only get absorbed through the skin, nose, and mouth, but most of them can cross the

[1] **Peshin, S. S., & Gupta, Y. K. (2018). Poisoning due to household products: A ten years retrospective analysis of telephone calls to the National Poisons Information Centre, All India Institute of Medical Sciences, New Delhi, India. Journal of forensic and legal medicine, 58, 205–211.https://doi.org/10.1016/j.jflm.2018.07.005**

placenta and get into the blood. These get lodged in organs and drained into the lymphatic system. These active molecules not only accumulate but also react with functional molecules in the body leading to numerous health impacts at the molecular level and damaging to DNA. These molecules can also be transferred to the next generation through genetical makeup, through breast milk, and via blood and thereby cause adverse effects even in unborn children, causing trans-generational effects.

Another important aspect of HHPs is that they not only contaminate the sprayed foods but also leach into the soil, diffuse in the air, and flow to the water resource. HHPs along with many other chemical pesticides have a higher persistence in soil resources and a larger ability to bioaccumulate in animals and other organisms that feed on this pesticide-contaminated food. This is severely toxic not only to the lower-order animals that directly feed on this but also to the higher food chain animals that feed on lower organisms.

Regulations on Highly Hazardous Pesticides are not stringent in many countries and India is no exception. These pesticides do not follow any other stricter warnings or are advised of the impacts they cause. They reach into general audience on a wider scale and have become a part of household names. They are used not only in agricultural zones but also in domestic use, schools, in pet shampoos, and insect repellents in every area. This has caused its wider application not making it limited to agriculture.


विष
विष जहर ઝેર
ವಿಷಂ POISON
വിഷം ਜ਼ਹਿਰ ವಿಷಮು
FOR AGRICULTURAL USE
Expiry period:24 hrs
TM-Trade Mark of
Industries Limited
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HHPs in India

India is the second-largest exporter of pesticides and 4th largest producer of pesticides in the world. India has over 318 pesticides registered for commercial use in 2022. These are extensively used without proper regulation and monitoring.

Among the 318 pesticides (insecticides, fungicides, weedicides, and plant growth regulators) that have registered for use in India in 2022, 120 are found to be meeting one or more criteria meant for HHPs. This is 38 percent of the total pesticide registered for use in the country. These pesticides are not only of higher proportion but they are also not regulated separately. They are nowhere listed as Highly Hazardous Pesticides in regulatory documents as well. These pesticides are among the most produced and consumed in India and are used abundantly in the country

According to the statistics, HHPs account for the most produced pesticides in the nation. The data denotes that more than 80 percent of the total produced is by HHPs in 2022. In the production statistics, information on only 27 HHPs is available. It has been noted that production of these 27 HHPs has increased by 44,189 metric tons within one year – an 18 percent rise. The most produced HHP within the country is mancozeb, a fungicide. This is used to treat foliar diseases and other fungal diseases in a limited number of crops and its production is seconded by chlorpyrifos. These are used in the Indian market under different brand names.

Next to the production details are the details of consumption. HHPs are also among the most used pesticides in the country. Mancozeb constitutes the largest share of HHPs used in India. An important aspect to note regarding their use is that, most of the uses are for non-approved crops in

the agriculture sector. All pesticides registered for use in India have an approved use, which is specific to the crop-pest combination. However, based on previous studies conducted by PAN India, it was noted that many of the uses of these pesticides are not in compliance with the approved uses. This can cause a serious concern for food safety. It was noted that HHPs constitute a major share of the total volume of imported and locally produced pesticides in India. This is a critical issue considering the increased usage of chemical pesticides in India every year. About 50.71% of the locally produced pesticides consumed are HHPs, and of the imported pesticides, 71.15 % are constituted by HHPs, showing the abundance of HHPs used in India.

HHPs constitute among the highest of the exported and imported pesticides in India. In quantitative terms, the topmost HHP exported is Cypermethrin. A total of 6,48,317 metric tons of chemical pesticides were exported from India in 2020-21, worth a sum of Rs.36,497.87 crores. Brazil is the largest market for pesticide exports from India (1,29,942 Metric tons, Rs.9,259.66 crores) followed by USA, Bangladesh, and Vietnam. Pesticides are also highly imported to the Indian market. Of the imported pesticides, 71.15 % are constituted by HHPs. This is a serious concern, given that most of the imported pesticides are HHPs and possibly banned in other countries, which is surprisingly true. Investigative studies conducted by *Unearthed and Public Eye* reported that companies in the UK and some European countries are exporting massive amounts of pesticides banned in their countries to Low- or Middle-income countries, including India[2].

Several of these HHPs registered in India are not properly studied or tested for safety, as they were in use prior to the Insecticide Act 1968

[2] https://unearthed.greenpeace.org/2022/02/22/bees-syngenta-paraquat-uk-exports/

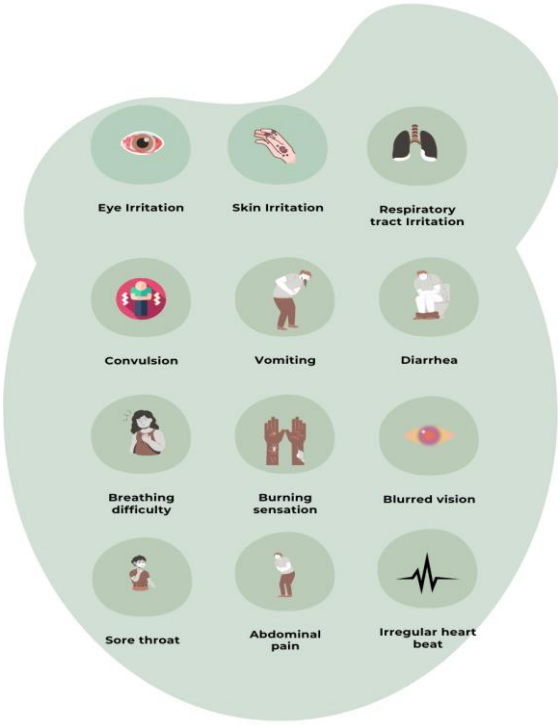
came into effect. These pesticides are called Deemed to be Registered Pesticides. In India, 26 HHPs are designated as DRPs[3]. Disparity in the recommended use of pesticides in different states to nationally approved use was also noted, which shows non-compliance and indicates the lack of proper regulatory efforts regarding pesticide usage and the need for a strict framework for regulation. It was also noted that 81 of the HHPs registered in India are banned elsewhere or listed in conventions. Few of these HHPs, which are banned for a particular formulation are still used and made available in India, adding to the concern. HHPs are used for self-poisoning and a major share of them is the culprit in many unintentional poisonings, which is alarming considering the availability of these in the Indian market.

[3] Dileep Kumar A. D & Athira P. S. 2022. Deemed to be registered Pesticides in India. Pesticide Action Network India. Pesticide Action Network India. https://pan-india.org/wp-content/uploads/2022/09/Deemed-to-be-Registered pesticides_report_PAN-India-Web.pdf

Health effects of HHPs

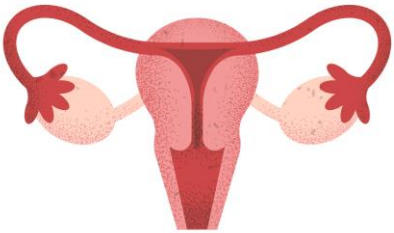
HHPs and Acute health effects:

Acute toxicity is the ability of a substance to cause harmful effects, which develop rapidly following its exposure. Immediate health effects following exposure to HHPs include stinging eyes, rashes, blisters, blindness, nausea, dizziness, and diarrhea. Since pesticide-related illnesses appear similar or identical to other illnesses, pesticide poisonings are often misdiagnosed.



Depending upon the acute toxicity, Pesticides are classified by the WHO into classes Ia, (extremely hazardous); Ib (highly hazardous), class II (moderately hazardous), class III (slightly hazardous), and class U (Unlikely to cause acute effects) based on dermal and oral toxicity studies in test animals. According to JMPM criteria for defining HHPs pesticides belonging to classes 1a and 1b are HHPs. Among the HHPs noted in India three HHPs belong to class 1a and 11 HHPs belong to class 1b.

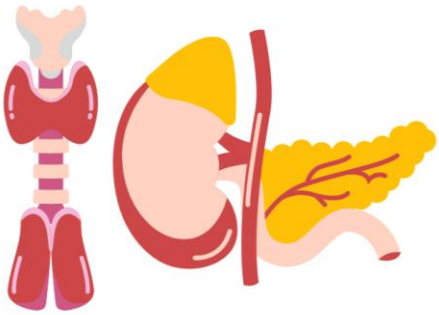
HHPs and Reproductive health:



One of the major detrimental effects of pesticides is the reproductive damage they cause in living organisms. Pesticide exposure has been linked with multiple reproductive disorders in humans, which range from birth defects, early onset of puberty, and sexual maturation to infertility and miscarriages in females to testicular dysfunctions, prostate cancer, and infertility in males.

Pesticides upon entry can cause direct damage to the structure of cells, interfere with biochemical processes necessary for normal cell function or cause biotransformation resulting in toxic metabolites. These can result in decreased fertility in men and women, demasculinization (antiandrogenic effects), elevated rate of miscarriage, altered sex ratio, and change in the pattern of maturity are observed. In India 20 HHPs are known to be reproductive toxicants.

HHPs and Endocrine Disruption: Pesticides can act as chemicals, which mimic, inhibit, or lower the activity of hormones by interacting with more than one component of the endocrine system in the body. These endocrine disruptors (Pesticides) can affect Estrogen receptors (ER) that have a direct metabolic effect on aspects of glucose transport, visibly resulting in Diabetes.



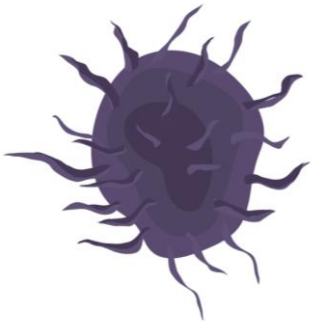
They can also interfere with the natural biochemical synthesis of Thyroid hormones, growth hormones, etc. Much of the damage caused by EDs occurs during gametogenesis and the early development of the fetus and symptoms appear during early adulthood.

Exposure to pesticides can begin as early as in the womb through placental transfer or in infants through breastfeeding, where fat mobilization from the mother is high. Infants and children are more susceptible to EDs because of their low immunity, high exposure to pesticide-contaminated resources per body volume, and dynamic body metabolism.

Bioaccumulation of pesticides is higher in women because of higher fat deposition, higher dermal absorption, and a higher level of hormone-sensitive tissue. This situation is worsened and heightened in women in developing countries, where women make up 85% of pesticide applicators in the field. Abnormalities of the female reproductive system that might be associated with EDC include; precocious puberty,

polycystic ovary syndrome, premature ovarian failure, increased growth of the endometrium, uterine fibroids, menstrual irregularities, infertility, higher risk of breast cancer, and vaginal cancer. In India, 33 HHPs are suspected of causing endocrine disruption.

HHPs and cancer:



Cancer occurrence in organisms can be benign (stagnant) or malignant (invasive) in nature and can be acute, chronic, severe, or deadly based on the type, location, stage, and health status of a person. Farmers and occupational workers in the fields with direct exposure to pesticides tend to have a higher risk of cancer than others. People working with high levels of pesticides may have an increased risk of some types of cancer. Pesticides can trigger cancer in a variety of ways, including disrupting hormones, damaging DNA, inflaming tissues, and turning genes on or off. Many pesticides are "known or probable" carcinogens. In India, 25 HHPs are probably/possibly carcinogenic. Many studies have also shown a link between pesticides and breast cancer.

HHPs and Neurotoxicity:

Neurotoxicity refers to the adverse effect on the peripheral and central nervous system, by any physical, chemical, or biological agents termed as neurotoxicants. Most of the pesticides currently used deploy this mechanism to kill insects. However, the same mechanism is also affecting humans and other animals causing neurotoxic effects and disorders.

Several classes of pesticides such as organochlorines, organophosphates, carbamates, pyrethroid, and neonicotinoids directly target nervous tissue and functioning. The effects of pesticides on the nervous system may be involved in their acute toxicity, as in the case of most insecticides, or may contribute to chronic neurodegenerative disorders, most notably Parkinson's disease.

In India, 21 HHPs have choline esterase inhibition properties and other neurotoxic effects, which cause neurotoxicity. The neurobehavioral impact of pesticides includes behavioral changes in children and adults; learning disabilities, attention deficit hyperactive disorder (ADHD) and autistic spectrum disorders are other undesired outcomes. Other neurological impacts are reduced memory and IQ, poor eye-hand coordination, lack of neuromuscular coordination, brain tumors, etc.

HHPs and Immunotoxicity:

In humans, pesticide-inductive diseases are of three categories; direct immunotoxicity (caused by the effects of pesticides on the immune system, leading to immunosuppression and subsequently reduced resistance to infectious diseases), hypersensitivity (exaggerated or inappropriate immunologic responses occurring in response to an antigen or allergen) and autoimmunity (the process by which the immune system makes a mistake and attacks the body's tissues or organs). Pesticides are reported to cause numerous clinical responses of hypersensitivity, even when the underlying mechanism remains poorly understood. A significant association between asthma and the use of carbamates has been found in many studies.

HHPs and Genotoxicity & Teratogenicity:

Genotoxicity refers to the change in the genetic constitution of the cell by any agent. Pesticides induce genetic change, which can alter cell functioning drastically. They can cause an increased frequency of DNA damage which affects the next generation. HHPs are studied to alter genomic structures and cause genotoxicity. Teratogenicity is the ability of a chemical or drug (pesticides) to cause fetal abnormalities or deformities. They can cause physical or functional defects in the development of the embryo or fetus when the pregnant

parent is exposed to these agents. Highly Hazardous Pesticides are prime suspects of pesticide-induced teratogenic effects in infants.

HHP poisonings in India

Agriculture is the mainstay in many states of India. Globally, Industrialization and the Green revolution have caused an increased use of agrochemicals including pesticides in agriculture in the past century. This has also led to the increased access to Highly Hazardous Pesticides by illiterate and naive farmers. The marketing tactics of agrochemical companies and the development pressure from modem agriculture caused Pesticides to become an important element in agriculture.

They are taken as poisoning agents in times of hardship as well. The accidental deaths and suicides in India as per the 2021 report of the

National Crimes Record Bureau (NCRB) note 7950 deaths due to accidental intake of pesticides. Madhya Pradesh has the largest number of suicides by pesticide poisoning (1466) according to this report[4].

Unintentional Acute Pesticide poisoning (UAPP) occurs when pesticides are accidentally inhaled, ingested, or consumed. Boedeker et al. (2020) have provided a global estimate of 44 % of farmers and farmworkers suffering from unintentional acute pesticide poisoning every year, with that figure rising to 66% in India. This report further estimated that about 60 % of global unintentional deaths from pesticides occur in India. These higher figures of poisoning and death could be attributed to the high toxicity of the pesticides used[5]

Environmental effects of HHPs

Highly Hazardous Pesticides are having a disproportionately large impact on the functioning of our ecosystem. Biodiversity changes in terms of habitat loss and reduced species richness have been prominently monitored in the past years from different parts of the world. They can affect soil fertility, diversity, and microbiomes in soil. Microorganisms have a higher role to play in the field of fertility and its dynamics. HHPs

[4] Sambhaji Pate, R., Vijay Rojekar, M., & Chandrakant Hire, R. (2017). Trends of Poisoning Cases in Tertiary Care Teaching Hospitals in Western Indian Population. International Journal of Medical Toxicology and Forensic Medicine, 7(3(Summer), 177-184.

[5] Boedeker, W., Watts, M., Clausing, P., & Marquez, E. (2020). The global distribution of acute unintentional pesticide poisoning: estimations based on a systematic review. BMC public health, 20(1), 1875

can cause adverse effects to soil-dwelling organisms as well as to their fungal and algal components. Pesticide accumulation in the food chain can affect organisms directly, or by biomagnification.

Dietary intake and feed intake by cattle and other herbivores, which feed on these pesticide-laden herbs, are of major concern. As most of the pesticides are lipophilic, they accumulate in their fat tissues, including milk and meat, which can affect the physiology of the animal, and is transferred to higher food trophic levels. Apart from these, the constant use of pesticides has caused multiple pests to develop pesticide resistance. The analysis noted that 9 HHPs in India are highly bio-accumulative. Twelve HHPs are very persistent in soil/water/sediment, 15 HHPs are very toxic to aquatic organisms, and 52 HHPs are highly toxic to bees.

International code of conduct on pesticide management in 2013 has stipulated that 'Prohibition of the import, distribution, sale and purchase of Highly Hazardous Pesticides may be considered if, based on risk assessment, risk mitigation measures or good marketing practices are insufficient to ensure that the product can be handled without unacceptable risk to humans and the environment'. This must be considered in Indian context, where the safe handling using scientific measures of these HHPs are impossible to achieve. They are having a harmful impact on human health where they cause acute and chronic illness. They also contribute to reduce biodiversity, where they have a direct effect on beneficial insects and organisms, decomposer microorganisms, root pathogens and rhizosporic pathogens in soil biota. They also affect ecosystem processes. Ecotoxicity effects caused by HHPs on wildlife is also evident.

Various brands of HHPs are available, cheaply in the Indian market. They are manhandled and are applied by workers without draping in proper PPE equipment making contact exposure, a calculable grievous outcome. Most of these chemical pesticides are available at an affordable price without much inscription about their poisonous nature. Therefore, their regulations at a higher level must be ensured, such that, these HHPs remain out of the hands of illiterate farmers and farm workers. Tackling this issue also presents us with the question of whether to continue with the use of such chemicals that can cause irreversible adverse effects. Apart from stricter regulations, non-chemical alternatives are required to tackle the innumerable adverse effects caused by HHPs. Advancing agroecological farming practices is the key to craft the change. Such farming practices need to be encouraged at the national level and need to be practiced on a large scale with adequate policy and institutional a well as extension support systems.

Information on HHPs in India

- Out of 318 pesticides registered in 2022, 120 are found to comply with the criteria of HHPs, as per the PAN HHP list of 2021.

- This study finds that organophosphates form the major share of 120 HHPs in India, while insecticides constitute the major type of HHPs. Chlorpyrifos (1,036.69 MT) is the most used insecticide HHP and Mancozeb (2194.51 MT), a fungicide, is the most used HHP in India.

- HHPs constitute nearly half of the total volume of pesticide used in India. But this data pertains only to 70 HHPs, and not for all 120 HHPs. Of the imported pesticides, 71.15 % by volume is constituted by HHPs.

- Production data set of 27 HHPs are available from a total of 41 pesticides, for which data is available. This data analysis revealed that 96.53 % of the total pesticide production is of HHPs. There is a 17 % increase in production of HHPs in 2022 compared to its production in 2021. Mancozeb was found to be the largest produced HHP (1,17,831 MT) in India.

- Export and import dataset of only 7 HHPs were available, from which cypermethrin, an HHP shows the largest import and export volume.

- Twenty-six of the 120 HHPs in India are Deemed to be Registered Pesticides. That means these HHPs have escaped the proper registration scrutiny.

HHPs registered for use in India that are banned in other countries and listed in conventions

Eighty-one of these HHPs are banned and/or restricted in other countries. Among the 81, 68 HHPs are found to be banned in more than 10 countries. Five HHPs registered in India are banned in more than 50 countries, which are; DDT

(banned in 147 countries), Monocrotophos (banned in 129 countries), Carbofuran banned in (87 countries), Paraquat Dichloride (banned in 58 countries) and Dicofol (banned in 52 countries). Twenty-seven of these HHPs are have been found to be in congruence with FAO JMPM criteria meant for HHPs.

Seven HHPs currently registered in India are listed in 3 International conventions (DDT, Carbofuran, Carbosulfan, Monocrotophos and Paraquat dichloride in Stockholm Convention, DDT and Dicofol in Rotterdam convention and Methyl bromide in Montreal Protocol)

List of HHPs among the pesticides registered in India

1. 2,4-Dichlorophenoxy Acetic Acid
2. Abamectin
3. Acephate
4. Aluminium Phosphide
5. Amisulbrom
6. Bendiocarb
7. Benfuracarb
8. Beta Cyfluthritrialn
9. Bifenthrin
10. Brodifacoum
11. Bromadiolone
12. Butachlor
13. Captan
14. Carbendazim
15. Carbofuran
16. Carbosulfan
17. Chlorantraniliprole
18. Chlorfenapyr
19. Chlorfluazuron
20. Chlorothalonil
21. Chlorpropham
22. Chlorpyriphos
23. Chlorpyriphos Methyl
24. Clothianidin (FI-WRT)
25. Copper Hydroxide
26. Coumatetralyl
27. Cyfluthrin
28. Cypermethrin
29. Cyproconanzole
30. Deltamethrin
31. Diafenthiuron
32. Dichloro Diphenyl Trichloroethane (DDT)
33. Diclofop-methyl
34. Dicofol
35. Dimethoate
36. Dinocap
37. Dinotefuran
38. Diuron
39. Dodine
40. Edifenphos
41. Emamectin Benzoate
42. Epoxyconazole
43. Ethion
44. Ethofenprox (Etofenprox)
45. Fenazaquin

46. Fenitrothion
47. Fenpropathrin
48. Fenpyroximate
49. Fenvalerate
50. Fipronil
51. Flocoumafen
52. Fluazifop p butyl
53. Flubendiamide
54. Flufenoxuron
55. Flumioxazin
56. Flupyradifurone
57. Flusilazole
58. Fluthiacet methyl
59. Fluvalinate
60. Forchlorfenuron
61. Glufosinate ammonium
62. Glyphosate
63. Hexythiazox
64. Imidacloprid
65. Imiprothrin
66. Indoxacarb
67. Iprodione
68. Iprovalicarb
69. Kresoxim Methyl
70. Lambdacyhalothrin
71. Lufenuron
72. Magnesium Phosphide Plates
73. Malathion
74. Mancozeb
75. Meptyl Dinocap
76. Metaflumizone
77. Methabenzthiazuron
78. Methomyl
79. Methyl Bromide
80. Metiram
81. Metribuzin
82. Milbemectin
83. Monocrotophos
84. Oxadiazon
85. Oxydemeton-Methyl
86. Oxyfluorfen
87. Paraquat dichloride
88. Pendimethalin
89. Permethrin
90. Phenthoate
91. Prallethrin
92. Profenophos
93. Propargite
94. Propetamphos
95. Propiconazole
96. Propineb
97. Propoxur
98. Pymetrozin (FI), TIM
99. Pyrethrin (pyrethrum)
100. Pyridaben (FI- WRT)
101. Pyridalyl
102. Quinalphos
103. Quizalofop P-tefuryl
104. Spinetoram
105. Spinosad
106. Sulfoxaflor
107. Tebuconazole
108. Temephos
109. Tetraconazole (FI)
110. Thiacloprid
111. Thiodicarb
112. Thiomethoxam
113. Thiophanate methyl
114. Tolfenpyrad (TIM)
115. Triallate
116. Triflumizole (FI-WRT)
117. Trifluralin
118. Validamycin
119. Zinc Phosphide
120. Ziram

HHPs and Health effects

WHO classification based on acute toxicity	**Pesticides belonging to WHO Class 1a**	**3**
	Pesticides belonging to WHO Class 1b	11
	Pesticides belonging to WHO Class 2	55
	Pesticides belonging to WHO Class 3	21
	Pesticides belonging to WHO Class U	20
	Pesticides belonging to H330 (PAN HHP List)	23
Long term effects	Pesticides which probably cause cancer (EPA)	24
	Pesticides which probably cause cancer (IARC)	3
	Pesticides which cause mutation (GHS)	1
	Pesticides which cause reproductive disorders (GHS)	20
	Pesticides which cause Endocrine Disruption (EU)	1
	Pesticides which are Choline esterase inhibitors	21
	Pesticides which have Suspected Endocrine activity	33
	Pesticides which can cause reproductive disorders & cancer	16

Table 4: List of HHPs and their long-term health effects

EPA probable or likely cancer-causing	Butachlor, Captan, Chlorothalonil, Dichloro Diphenyl Trichloroethane (DDT), Diclofop-methyl, Diuron, Epoxyconazole, Fluthiacet methyl, Hexythiazox, Iprodione, Iprovalicarb, Kresoxim Methyl, Mancozeb, Metiram, Oxadiazon, Oxyfluorfen, Permethrin, Propineb, Propoxur, Pymetrozin (FI), TIM Thiacloprid, Thiodicarb, thiophanate methyl, Propargite
GHS mutation	Carbendazim
GHS reproduction	Brodifacoum, Bromadiolone, Carbendazim, Chlorpyriphos, Chlorpyriphos Methyl, Coumatetralyl, Cyproconanzole, Deltamethrin (Decamethrin), Dinocap, Epoxyconazole, Flocoumafen (FI-WRT), Flumioxazin, Fluazifop p butyl, Flusilazole, Glufosinate Ammonium, Meptyl dinocap, Mancozeb, Propiconazole, Thiacloprid, Triflumizole (FI-WRT)
EU EDC	Mancozeb, Meptyl dinocap
GHS C2 & R2 (carcinogenic and reproductive toxicant)	2,4 D, Bifenthrin, Captan, Chlorpropham (TI), TIM, Dichloro Diphenyl Trichloroethane (DDT), Epoxyconazole, Fenitrothion, Forchlorfenuron, Mancozeb, Metiram, Metribuzin, Quinalphos, Quizalofop P-tefuryl, Tebuconazole, tetraconazole (FI), Trifluralin
IARC prob cancer	Dichloro Diphenyl Trichloroethane (DDT), Glyphosate, Malathion

Table 5: List of HHPs and their short-term health effects, Neurotoxicity, and Suspected Endocrine Activity

WHO 1a	Brodifacoum, Bromadiolone, Flocoumafen
WHO 1b	Abamectin, Beta Cyfluthrin, Carbofuran, Coumatetralyl, Cyfluthrin, Edifenphos, Methomyl, Monocrotophos, Oxydemeton-Methyl, Propetamphos, Zinc phosphide
H330	Abamectin, Aluminium Phosphide, Beta Cyfluthrin, Brodifacoum, Bromadiolone, Carbofuran, Carbosulfan, Chlorothalonil, Copper Hydroxide, Coumatetralyl, Cyfluthrin, Dodine, Ethion, Fenpropathrin, Fenpyroximate, Flocoumafen (FI-WRT), Fluvalinate, Lambda-cyhalothrin, Magnesium Phosphide, Monocrotophos, Paraquat dichloride, Tebuconazole, Ziram
Choline esterase inhibitor	Acephate, Bendiocarb, Benfuracarb, Carbofuran, Carbosulfan, Chlorpyriphos, Dimethoate, Edifenphos, Ethion, Fenitrothion, Malathion, Methomyl, Monocrotophos, Oxydemeton-Methyl, Profenophos, Propetamphos, Propoxur, Quinalphos, Temephos, Thiodicarb, Triallate
Endocrine activity suspected	Abamectin, Acephate, Bifenthrin, Carbendazim, Carbofuran, Chlorpyriphos, Cypermethrin, Dichloro Diphenyl Trichloroethane (DDT), Dicofol, Dimethoate, Diuron, Epoxyconazole, Etofenprox (Etofenprox), Fenitrothion, Fenvalerate, Fipronil, Iprodione, Malathion, Mancozeb, Methomyl, Methyl Bromide, Metiram, Metribuzin, Oxydemeton-Methyl, Paraquat dichloride, Pendimethalin, Permethrin, Phenthoate, Propiconazole, Quinalphos, Tebuconazole, Trifluralin, Ziram

One of the biggest challenges to our food security is the widespread use of Highly Hazardous Pesticides in our food crops. These Pesticides pose severe acute as well as chronic harm to human health and the environment. This report provides an overview in the direction of analyzing the synergistic effects of HHP use and ill effects among people and environment. The potential avenues for future research stem from analyzing how these HHPs affect our health and ecosystem. This booklet is an effort to understand the status of HHPs in India, where it exposes gaps in nationally approved uses of pesticides and recommendations for HHPs. A major share of pesticides registered in India is HHPs and they are estimated to account for the largest share because of their high usage in the agriculture sector. This pesticide use scenario eventually will lead to an unpropitious outcome. The fastest way to achieve higher living standards for the nation's workers and farmers is only through producing healthy viable alternatives based on agroecology to these chemical pesticides and not through repeated use of potentially harmful chemicals.

This booklet is meant to function as a helping tool to penetrate every level of stakeholders and policymakers to help in analyzing the future of our farming sector, which does not compromise our health and food safety.

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