

How Do We Live With the Use of Chemicals to Feed the World?

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Without Poisoning the Earth?"
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"To Poison"

The exposure of an organism to a substance that kills or weakens the organism, or otherwise undermines its fitness.

The basic question – to what degree are agricultural pesticides poisoning the earth?

Poisoning Whom?



Vulnerable Organisms

- Non-crop vegetation in fields
- Birds
- Small aquatic invertebrates
- Earthworms, bees, and other beneficial insects
- Fish in some ecosystems
- Those at the top of food chains, e.g. people

Vulnerable Places

Farm fields and surrounding areas – about 11 percent of the globe's land area

Surface waters and estuaries near intensively farmed regions

Forests and rangelands where pesticides are routinely applied – a small share of the total

Inside organisms at the top of food chains, virtually anywhere in the world

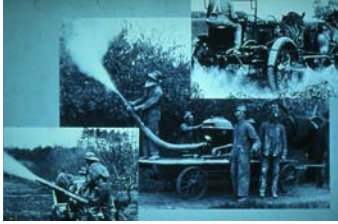
Pesticide Risk Drivers

The capacity of a pesticide to poison nontarget organisms is a function of –

- Extent of use
- Physical and chemical properties
- Toxicity

Key Point

A small share of pesticides, and pesticide uses, account for the lion's share of risk to each category of nontarget organisms, including people.



Avian Risks



Farming is the biggest single threat to the 1,923 threatened or near-threatened bird species worldwide (Green et al., 2005).

Avian Risks

Habitat conversion poses huge one-time risks to birds, but annual pesticide use has killed far more birds than the conversion of land to intensive farming.



Avian Risks

Even in North America, pesticide use in agriculture remains a deadly threat to many birds, although not as acute as in the 1960s and 1970s.

In most of the developing world, pesticide avian risks and impacts are rising, in some cases appreciably.

Avian Risks

Advanced avian risk models project "probability of kill" from defined pesticide uses in a given crop.

"...several pesticides present clear risk to birds and are expected to be causing mortality on a frequent and routine basis" (Mineau, 2002).

Avian Risks: California Peaches

Mineau model has been used to rank pesticide risks to birds in multiple crops: e.g., peaches in California.

Active Ingredient	Trade Name	% Acres Treated	Probability of Kill
Phosmet	Imidan	36%	100%
Diazinon	Diazinon	22%	99.9%
Azinphos methyl	Guthion	1%	9.9%
Esfenvalerate	Asana	92%	<0.00001%

Avian Risks: California Peaches

Out of about 70 pesticides applied on peach crops in CA:

- Three pose avian risks above a 50% probability of kill
- Two pose risks in the 7% to 10% range
- Sixty-five pose risks below 1%
- Risks are below one-tenth of 1% for 60

Avian Risks Largely Untouched by Regulation

EPA has never canceled a pesticide because of avian risks, despite solid evidence of multiple kills.

Owls and raptors are at greatest risk because pesticides concentrate up food chains.

Regulation based almost solely on acute toxicity; behavioral, reproductive, and food chain impacts almost certainly occur at far lower levels of exposure, and more frequently.

Other Ecological Risks

Organophosphate (OPs) and carbamate insecticides account for less than 5% of pesticide use, yet trigger 75% or more of bird, bee, fish, and beneficial insect acute mortality.

Toxicity levels within the OP and carbamate families of chemistry vary by two or more orders of magnitude to most nontarget organisms. By phasing out the most toxic compounds, adverse ecological impacts could be dramatically reduced.

The Human Dimension



Pesticides and Human Health

Impacts are far more pervasive than most people realize.

Applicators and farm workers bear the brunt of acute and chronic exposures, especially in the developing world. The number of people harmed continues to rise, despite efforts to curtail acute exposures.

Human Health Risks: Indonesia Case Study

21% of farmers spraying pesticides in shallot fields in 1993 experienced three or more symptoms of pesticide poisoning (Murphy et al., 1999).

Farm families in Indonesia had, on average, six pesticides in their homes, most stored on the ground.

87% of women sprayed pesticides, on average, twice weekly.

Human Health Risks: Indonesia Case Study

On average, 4 pesticide active ingredients were mixed together in each application; 48% were insecticides.

Over 75% of women applicators applied an organophosphate (OP) or carbamate insecticide.

Over 10% applied WHO Class I "highly hazardous" pesticides

97.5% applied WHO-Class II pesticides – "moderately hazardous".

Human Health Risks: Indonesia Case Study

19% of women sprayers experienced 6 or more symptoms of pesticide exposure.

About two-thirds experienced 2 to 6 symptoms and/or signs of exposure.

"This study demonstrated that small scale Sumatran female farmers apply pesticides without personal protection in a highly unsafe manner" (Murphy et al., 1999).

Human Health Risks in Developing Countries

Cases of acute poisoning have risen from about 500,000 per year in 1972 to an estimated 25,000,000 in the early 1990s (Levine and Doull, 1992; Jeyaratnam, 1990).

An estimated 3% of agricultural workers are impacted annually.

About three million cases/year are severe.

Human Health Risks in Developing Countries

"In parts of the developing world, pesticide poisoning causes more deaths than infectious diseases."

"...the many health and environmental costs of intensive pesticide use have become starkly apparent" (Eddleston et al., 2002).

Suicide via pesticide ingestion is by far the leading cause of pesticide mortality.

Dietary Risks in Developing Countries

"51% of food commodities (in India) are contaminated with pesticide residues and out of these, 20% have pesticide residues above the maximum residue level values on a worldwide basis" (Gupta, 2004).



Dietary Risks in Developing Countries

In Hong Kong in 1992, methamidophos in vegetables led to 47 documented outbreaks of poisoning symptoms impacting 329 people (Chan et al., 1996), and 100's more unreported cases.

Imported produce was identified as the most common source of contaminated vegetables.

Street vendors in urban and peri-urban areas increasingly sell fresh produce that is contaminated, sometimes dangerously so.

Pesticides and Human Health in Developed World

In developed world and the U.S., the major risks associated with pesticide exposures are –

- Early infant and child development
- Reproductive system abnormalities and related problems
- Long-term degenerative diseases, especially cancer and various forms of dementia

Farm Worker Exposure to Pesticides

Research | Article

Agricultural Task and Exposure to Organophosphate Pesticides Among Farmworkers

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Fetal Exposures

Essentially all infants are exposed to pesticides during fetal development.

Pesticides are present in the amniotic fluid and placentas of virtually all infants born in the U.S. and readily cross the blood-brain barrier during fetal development and in the first months of life.

Reproductive problems and birth defects spike nine months after spring spray seasons in Midwest farming regions.

Prenatal Exposure to Pesticides May Impair Growth and Neurodevelopment

Children's Health | Article

In Utero Pesticide Exposure, Maternal Paraoxonase Activity, and Head Circumference

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G.S. Berkowitz et al.
Environmental Health Perspectives
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Cancer

"The probability that a resident of the United States will develop cancer at some point in his or her lifetime is 1 in 2 for men and 1 in 3 for women."

Opening sentence, 11th Annual Report on Carcinogens, NCI

Cancer Etiology

Profound paradigm shift underway.

Doll and Peto "conventional wisdom" – 3% of cancers triggered by chemicals in the environment.

New consensus emerging that environmental factors (air and water pollution, chemicals, diet) account for the majority of cancers (NCI, Nature, Lancet).

Human Health Risks: All Countries

Organophosphates and carbamates are the most common causes of acute poisoning episodes, especially severe ones.

"...well designed studies have shown chronic subclinical damage to the central and peripheral nervous system among those previously poisoned by organophosphates" (Steenland, 1996).

Pesticide Health Risks: All Countries

The scope and magnitude of reproductive and developmental impacts almost certainly dwarf the public health consequences of acute poisoning episodes.

Pesticide Health Risks: All Countries

Based on best available data, acute poisoning episodes reach between 5% and 10% of farm families worldwide. Applicators are by far the most vulnerable.

Reproductive impairment and developmental problems, from mild to severe, are likely occurring in at least twice as many farm families, if not an even higher percentage.

Can We Feed the World Without Poisoning Nontarget Organisms?

The evidence reviewed herein suggests the answer is clearly "no."

The frequency and magnitude of adverse impacts on birds, fish, bees and other beneficial insects are almost certainly declining in many developed countries, but are increasing in most of the developing world.

Can We Feed the World Without Poisoning People?

Again, regrettably, the answer is "no."

Human health impacts are likely far more pervasive and serious than most people realize.



Can We Feed the World Without Poisoning People?

Acute poisoning remains a serious problem in the developing world, despite efforts to curtail use of high-risk active ingredients (Murray and Taylor, 2000).

Developing world problems will likely worsen because old, high-risk chemistry is cheap, widely available, and largely unregulated in rural areas.

What Can Be Done to Curtail Poisoning Impacts?

The pesticide industry should act on the sound advice from WHO, health experts, and activists – stop selling Class I acutely toxic pesticides in developing countries –

- Just a handful of products would be impacted
- Ample numbers of safer alternatives would remain accessible.

What Can Be Done to Curtail Poisoning Impacts?

Use regulation to drive up the costs of old, high-risk chemistry and to reduce the costs of new, safer chemistry.

Today, regulation does just the opposite.



What Can Be Done to Curtail Poisoning Impacts?

Promote research on, and adoption of biointensive Integrated Pest Management -- a contemporary "orphan technology."

Resist "silver bullet" quick fixes, like most of today's genetically engineered plants.



Curtailing Pesticide Poisonings

Long-term and safe solutions will rest on the design and management of agricultural systems that –

- Reduce pest populations at multiple life-stages through multiple tactics,
- Enhance biodiversity and biocontrol, and
- Strategically deploy biopesticides and lower-risk chemicals at times when pests are most vulnerable and in ways that minimize human exposures and risk.

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