



# Pesticides and health hazards

## Facts and figures



A healthy world for all.

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# The focus of this publication

Around the globe, chemical-synthetic pesticides have been used increasingly since the 1940s. Their use leads to considerable health hazards for people, due for example to direct contact during application, pesticide drift from fields, or contamination of food or drinking water. Data from research literature shows that the effects of the dispersal and negligent handling of pesticides are a significant global health problem.

This publication addresses the following issues:

- Who is affected by the health hazards posed by pesticides?
- What is known about the frequency of acute pesticide poisonings and the extent of long-term adverse health effects due to pesticides?
- To what extent do suicides and attempted suicides contribute to the total numbers of pesticide poisonings?
- In view of ongoing increases in global pesticide use, has documentation of pesticide poisonings been improved?
- On the basis of available data on pesticide poisonings, what action should be taken?

## Pesticides

### Pesticide use worldwide

In recent decades, there has been a steady increase in the amount of pesticides marketed for agricultural use. In the European Union alone, more than 200,000 tonnes of pesticides (active ingredients) are used annually.<sup>[1]</sup> Between 2005 and 2010, the total volume of global sales rose from US\$ 31 billion to US\$ 38 billion.<sup>[2][3][4]</sup> The amount of pesticides used internationally has risen fifty-fold since 1950.<sup>[5][6]</sup> China is now the country that both uses and produces the largest amounts of pesticides.<sup>[7]</sup>

### Pesticides are everywhere

Presumably, all populations worldwide are exposed to pesticides. The ubiquitous dispersal of these substances is revealed by data on contamination of food as well as surface, ground, and drinking water.

In almost all parts of the world, low-level poisoning of human beings due to pesticide contamination of food poses a risk of chronic illness and adverse health effects. In Germany, the Federal Office of Consumer Protection and Food Safety [Bundesamt für Verbraucherschutz und Lebensmittelsicherheit] publishes an annual monitoring report on undesirable substances that constitute health risks in food. These reports show that pesticides can be found in all foodstuffs of plant origin. Two percent of all agricultural products of plant origin examined in Germany, including plums and lettuce, for example, showed signs of inadmissible application of pesticides. The levels of contamination detected in eleven samples of pineapple, tomatoes, peaches, nectarines, lettuce, and zucchini were considered to be sufficiently high to possibly pose acute health hazards.<sup>[8]</sup>

## Data and facts . . . . .

### Infobox 1 **What are pesticides?**

Pesticides are substances that are used intentionally in agriculture, forestry, and horticulture and on public lands and in gardens to increase crop yields, improve the appearance of plant products, or to facilitate the care of open spaces. They are also referred to as plant protection products. In Europe, pesticides used outside of agriculture are called biocides.<sup>[9]</sup> Biocides are used, for example in private households, to repel or destroy unwanted or detrimental organisms and are also applied in large quantities in many developing countries to combat pathogenic organisms or species that serve as vectors (carriers) for pathogens (e.g. mosquitoes that are carriers of pathogens that cause malaria).





## Health hazards due to pesticides Facts and figures . . . .

The many chemical substances that are collectively referred to as pesticides intervene in different vital metabolic processes in various organisms. The effects of insecticides range from damage to the transmission of nerve impulses and inhibition of blood clotting to paralysis of the respiratory and circulatory centers. Besides the target organisms such as insects, fungi, or weeds, non-targeted organisms are also always affected by pesticide use. These include wild animals and plants, domestic animals and crops, and human beings. In humans, exposure to pesticides can lead to unspecific adverse health effects that will be referred to here as poisonings.

The following sections offer a survey of acute illnesses that result from contact with pesticides as well as reviewing chronic illnesses that can occur due to long-term contact with pesticides. The text also describes population groups that are especially at risk with respect to acute and / or chronic pesticide poisoning. Based on estimates by the WHO, we then offer an impression of the global extent of pesticide poisonings. Pesticide poisonings are classified here as either suicidal or intentional poisonings, on the one hand, and unintentional poisonings that result from accidents on the job or accidents outside of occupational contexts, on the other.

### Acute illnesses

Among the typical symptoms of poisoning in humans that are relatively easy to diagnose as acute pesticide poisoning are fatigue, headaches and body aches, skin discomfort, skin rashes, poor concentration, feelings of weakness, circulatory problems, dizziness, nausea, vomiting, excessive sweating, impaired vision, tremors, panic attacks, cramps, etc., and in severe cases coma and death.<sup>[22][23]</sup>

Diagnosis of acute pesticide poisoning generally occurs when one or more of these symptoms, which appear a short time after contact with pesticides, are detected, so that patients or physicians can link them to pesticide exposure. However, these symptoms can also frequently be attributed to other illnesses. Analysis of blood, urine, or stomach content to detect pesticide residues can lead to an unequivocal diagnosis. But clearcut proof will only be forthcoming if a sufficiently high concentration of the poison is present and there is reason to suspect that a specific agent among the hundreds of substances available might potentially be responsible for the symptoms. Appropriate analytical methods are often very expensive or lacking altogether.

The severity of symptoms is frequently classified on a scale ranging from mild to moderate to severe or lethal.<sup>[24]</sup> However, a standardized definition of what constitutes poisoning does not exist, so that comparing and summarizing different statistics on poisoning is difficult. The WHO proposed guidelines for identifying acute poisonings in 2008.<sup>[25]</sup>





## More suicides where hazardous pesticides are available

On a global scale, pesticide poisoning plays a significant role as a method for committing suicide; at 31%, it is the most frequently used method. The proportion of pesticide-related suicides within the total number of suicides varies regionally from 4% in Europe to as much as 50% in the western Pacific region. This distribution does not correlate with the distribution of pesticide use. In Europe (where 2% of pesticide suicides occur), sales of pesticide products amount to 29% of world sales; in Asia (where 91% of pesticide suicides are reported), 25% of the global sales of pesticides are made.<sup>[42]</sup>

It has been suggested that more people poison themselves with pesticides when products with a high acute toxicity are readily available.<sup>[23][42]</sup> Documented cases often involve various substances that belong to the class of organophosphates and the herbicide paraquat. In Korea, 85% of pesticide poisonings are the result of suicides; every year, 2,000 people poison themselves with paraquat and 60 to 70% of these cases end in death.<sup>[43][44]</sup> In China, an estimated 175,000 people poisoned themselves intentionally each year between 1996 and 2000. Organophosphates are freely available there.<sup>[45]</sup>

Some studies show a significant correlation between contact with pesticides and depression and other psychological disorders. Moreover, some reports point to a connection between thoughts of suicide and increased suicide rates and chronic pesticide exposure.<sup>[45][46]</sup> However, the results of various studies with respect to this issue are inconsistent.<sup>[47][48]</sup>

Since suicides are frequently appellative, we can assume that many of these lethal poisonings might have been prevented if access to highly hazardous pesticides had been limited, pesticides in rural areas were stored under more secure conditions,

Year	Country / extent of study	Suicidal poisonings	Occupation-related poisonings	Accidental poisonings	Reference
1999 – 2000	India: 20 hospitals 1,531 poisonings	85,2%	5,4%	4,7%	WHO (2002) <sup>[20]</sup>
1999 – 2000	Indonesia: 125 poisonings	43%	37%	16%	WHO (2002) <sup>[20]</sup>
1999	Thailand: 10 hospitals, 130 poisonings	62%	28%	not specified	WHO (2002) <sup>[20]</sup>
1983	Indonesia, Malaysia, Sri Lanka, Thailand: 273 poisonings	36 – 68%	2 – 32%	9 – 29%	Jeyaratnam et al. (1987) <sup>[49]</sup>
not specified	Southeast Asia	68%	18%	14%	WHO (2009) <sup>[50]</sup>
1998 – 2002	Japan: 65 hospitals, 346 poisonings by agrochemicals	70%	16%	8%	Nagami et al. (2005) <sup>[51]</sup>

and availability and quality of medical care were improved in these regions. In most hospital records, the number of intentional pesticide poisonings (suicides and attempted suicides) is higher than the number of unintentional poisonings. In the statistics evaluated for this publication, the percentages of intentional poisonings range from 36% to 85% of all pesticide poisonings reported (Table 1). According to WHO estimates, there are two million cases of intentional pesticide poisoning globally each year (two-thirds of all severe pesticide poisonings). The number of suicidal deaths through pesticides was estimated as being as many as 370,000 in 2007. In Asia alone, more than 300,000 people die this way each year.<sup>[42]</sup> The numbers reported from Sri Lanka are especially alarming. In several rural areas there, pesticide suicides are the most frequent cause of death in hospitals.<sup>[36]</sup>





## Global statistics on unintentional acute pesticide poisonings

In 1990 the WHO estimated that one million unintentional acute pesticide poisonings occurred worldwide annually. However, only the most severe cases registered in hospitals were included in this figure. WHO later reported that the extent of poisonings was significantly underestimated at the time. Despite this admission and the fact that, after more than twenty years, this figure is now without a doubt outdated, it is still cited. What is more, funding for a WHO project on the epidemiology of pesticide poisoning was discontinued several years ago.<sup>[52]</sup>

The number of people who died worldwide as a result of unintentional poisonings was estimated at 20,000 in 1990.<sup>[53]</sup> More current statistics have become available since 2008. According to this WHO data, 346,000 people die annually worldwide as a result of unintentional poisonings, two-thirds of them in developing countries.<sup>[54][55]</sup> Here, too, the WHO admits that this figure may be too low.<sup>[52]</sup> The substances involved are not specified, but presumably most of these poisonings are caused by toxic chemicals such as pesticides.<sup>[56]</sup> Researchers have noted that probably 71% of these fatalities might have been prevented by improving chemical safety measures.<sup>[55]</sup>

## Global statistics on chronic pesticide poisonings

Statistics on chronic poisonings are very limited, since registration systems and regional studies only include poisoning cases that can be proven without any doubt to have been caused by pesticide exposure. According to a 1990 WHO estimate, it was expected that 735,000 cases of specific chronic effects and 37,000 unspecific health effects such as forms of cancer would occur annually.<sup>[41]</sup>

## Inadequate documentation and high numbers of non-reported cases

**In order to estimate the frequency of pesticide poisonings, the WHO uses hospital records, population surveys, and data registered by governmental authorities.**

**However, global documentation and data transfer is inadequate.** One case in point is Germany. In 1990, Germany introduced mandatory documentation of poisoning; all cases must be reported to the Bundesinstitut für Risikobewertung [Federal Institute for Risk Assessment, BfR]. BfR receives reports from Giftinformationszentren [Poison Information Centers, GIZ], from Berufsgenossenschaften (employee occupational health compensation boards), or directly from physicians who have provided treatment. The GIZ provide toxicological advice for physicians and private individuals and register, according to their own assessment, a large portion of non-occupational poisoning incidents. Work-related incidents are usually reported to BfR by the respective Berufsgenossenschaften.

In 2009, six of the nine GIZ reported a total of 2,954 cases of pesticide exposure. Only a few of the GIZ supplied data on the severity of these incidents in their statistics. When this information was included, 15% to 43% of these pesticide exposures were cases of mild to fatal poisoning; 57 to 85% of the cases involved exposure to pesticides that resulted in only minimal or no adverse health affects (Table 2). According to the GIZ, for technical reasons, only the most severe cases are reported to BfR.

Table 2 **Number of pesticide exposures and poisonings registered by the GIZ in Germany in 2009**

(GIZ)	Registered pesticide exposures	Registered pesticide poisonings (mild to fatal)
Göttingen	614 <sup>[24]</sup>	251 <sup>[24]</sup>
Bonn	360 <sup>[58]</sup>	not specified
Berlin	791 <sup>[59]</sup>	121 <sup>[59]</sup>
Erfurt	not specified	not specified
Freiburg	416 <sup>[60]</sup>	182 <sup>[60]</sup>
Homburg	51 (children only) <sup>[61]</sup>	not specified
Mainz	722 <sup>[62]</sup>	not specified
Munich	not specified	not specified
Nuremberg	not specified	not specified
<b>Total</b>	<b>2,934</b>	<b>554</b>





Year	Segment of the population	Country / region	Percentage of poisoned farmers	Reference
2004	190 rice farmers	Vietnam (Mecong Delta)	35% pesticide poisonings (21% chronic poisonings) through blood tests	Dasgupta et al. (2007) <sup>[67]</sup>
1999	123 women exposed to pesticides (application and handling)	Myanmar	40% chronic poisoning	WHO (2002) <sup>[20]</sup>
n.s. <sup>1</sup>	5,025 farmers	Indonesia (Java)	21% of pesticide applications were linked to 3 or more symptoms (direct observation), 9% reported severe poisoning	Kishi et al. (1995) <sup>[16]</sup>
1985	5,317 farmers who had been exposed to pesticides	Malaysia and Sri Lanka	2 – 7% reported they had suffered poisoning within the past year	Jeyaratnam et al. (1987) <sup>[49]</sup>
2001	Families in 2 rural districts	China (Sichuan)	20% reported pesticide poisonings	Organic Consumer Association (2003) <sup>[66]</sup>
n.s. <sup>1</sup>	210 farmers	Cambodia	35% reported moderate poisoning symptoms e.g. nausea; 1 – 5% reported serious symptoms such as loss of consciousness	Sodavy et al. (2000) <sup>[88]</sup>
2000/ 2001	50 farmers	Vietnam	61% of the pesticide applications are associated with mild symptoms of illness; 31% are associated with at least one definite poisoning symptom (self-reported)	Murphy et al. (2002) <sup>[89]</sup>
n.s. <sup>1</sup>	85 vegetable growers (most do not wear protective clothing)	Ivory Coast	55% report symptoms of illness such as stomach pain or headaches after applications	Doumbia, Kwadjo (2009) <sup>[90]</sup>
2007 – 2009	2,220 people exposed to pesticides	Africa, Asia and Latin America	21 – 59% of those interviewed who have been exposed to pesticides subsequently suffer from symptoms such as headaches, dizziness, impaired vision, increased sweating	PAN (2011) <sup>[7]</sup>
2003/ 2004	female cotton farmers in 3 villages	India	83,6% of pesticide exposures (application, mixing, or work in the fields) were linked to poisoning symptoms; of these 10% were linked to 3 or more symptoms that typically occur with organophosphates; 6% with extremely severe poisonings; no one consulted a physician	Mancini et al. (2005) <sup>[84]</sup>
2009	105 tobacco farmers	Pakistan	The majority reported headaches, dizziness, nausea, shortness of breath, muscle weakness, skin rashes in connection with pesticide use; reduction of cholinesterase activity was measured for 55%	Khan et al. (2009) <sup>[85]</sup>
<b>Legend:</b> 1. not specified				



Number of cases of acute pesticide poisoning (deaths) per year for countries and regions\*



Notes: 1. only intentional poisonings, 2. only unintentional poisonings, 3. severe and mild cases, 4. only poisonings treated in hospitals, 5. estimate, 6. only registered cases, \* data collected for this publication, incomplete; for references see Table 3

## Summary

Since the 1940s, the amount of synthetic chemical pesticides used annually worldwide has increased, resulting in considerable human health hazards. Due to contamination of the environment, presumably all populations worldwide are effected by pesticide contamination and face the threat of chronic health disorders. Particularly at-risk are people employed in agriculture because they are directly exposed to pesticides and frequently suffer from acute as well as chronic poisoning symptoms. Moreover, especially in developing countries, a large number of highly hazardous pesticides are easily available, many of which are used in agriculture, often even without appropriate protective clothing. Because of their availability, intake of these pesticides is a frequent suicide method.

Many hospital records show that a high proportion of severe acute pesticide poisonings are in fact suicides, especially in Asia. The WHO estimates that there are about 2 million pesticide suicides and suicide attempts worldwide every year. However, these statistics do not reflect the fact that cases of non-suicidal pesticide poisoning among farm workers are generally poorly documented, in particular in developing countries. Poisonings with milder symptoms that generally subside rather quickly are often not registered, so that such cases are presumably underestimated. In 1990, the WHO assumed that one million severe cases of unintentional pesticide poisoning occurred annually. What is remarkable is another, much higher WHO estimate from the same year that is rarely cited in the relevant literature. This figure refers to 25 million unintentional poisonings annually of farm workers in developing countries alone, with on average 3% of agricultural workers in developing countries suffering an episode of pesticide poisoning per year.<sup>[41]</sup> Since the sales volume of pesticides worldwide has increased and the rate of poisonings in regions is much higher than 3%, it is probable that the number of unintentional poisoning incidents





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