PESTICIDE ATLAS

Facts and figures about toxic chemicals in agriculture

2025

MENA Edition

HEINRICH BÖLL STIFTUNG

Friends of the Earth Europe

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Pesticide Action Network Europe

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FOREWORD

In beer and in honey, on fruit and on vegetables, on playgrounds' grass, in urine and even in the air – traces of pesticides used in agriculture can be found everywhere. That pesticides deteriorate human health, biodiversity, water, and soil is not a new insight by any means. As early as 1962, biologist Rachel Carson published her globally acclaimed book "Silent Spring" in which she described the harmful effects of pesticide use. Her work has been groundbreaking for the environmental movement and led to the ban of highly toxic chemicals such as DDT.

But today, sixty years after Carson's book was released, greater amounts of pesticides are being used worldwide than ever before despite stricter approval regulations – and voluntary as well as binding agreements on the handling of pesticides. The cultivation of genetically modified plants like soy, engineered by the same corporations that are producing pesticides, has contributed to the increased use of herbicides, especially in biodiversity rich countries.

With its Green Deal, the EU is now taking a step forward: The EU's Farm to Fork Strategy asks Member States to reduce pesticide use and associated risks by fifty percent by 2030. Whether the target can be met depends on the implementation of the new regulation on pesticides proposed by the European Commission in June 2022. The EU's large Common Agricultural Policy (CAP) funds could provide financial aid for conversion but the CAP has so far failed to provide sufficient support for agriculture that depends less or not at all on pesticides.

Citizens however are aware of the need for pesticide reduction. 1.2 million Europeans have already signed the European Citizens' Initiative "Save Bees and Farmers" to demand more ambitious reduction targets than those proposed by the Farm to Fork Strategy. The initiative is calling for an eighty percent reduction in the use of chemical pesticides by 2030 and a complete phase-out by 2035.

> "Never in history have pesticides been used so pervasively

The global market for pesticides is highly lucrative. A few well-connected and influential agrochemical companies are expanding their control over the market and thriving for always increasing profits. At the forefront: European companies like Bayer and BASF. The EU is the largest pesticide export market in the world, now investing more and more in countries of the Global South, where EU companies are allowed to export pesticides banned on their own countries due to their harmful effects on human health and the environment.

A long-standing demand of international civil society calls for laws that effectively ban these toxic exports. In 2020, the EU Commission has committed to act accordingly in its Chemicals Strategy for Sustainability. The EU Commission's announcement to lower import tolerances for residues of pesticides not approved in the EU could also help to reduce the spread of the most toxic substances. However, agricultural producers in third countries fear being excluded from the EU market when not getting sufficient support for alternative ways to protect their crops. These examples demonstrate that the European Green Deal must also be seen as a tool of foreign policy, as it impacts all countries with trade relations to the EU.

The political debates on sustainable agricultural systems in the EU have gained new momentum since the start of Russia's war of aggression against Ukraine, violating international law. Ukraine is one of the world's most important suppliers of grains, and the war has caused crop losses, blocked supply chains, and increased food speculation, so that food security in many countries of the Global South is under massive strain. The war also affects farmers because the current agricultural system is based on inputs such as pesticides and fertilizers, which in turn are based on fossil fuels or have to be

imported also from Russia.
Various interest groups and EU governments are now questioning the reduction targets for pesticides and fertilizers, or the designated land dedicated to biodiversity protection. Scientists and international organisations, such as the World Food Program (WFP) and the Food and Agriculture Organisation (FAO), emphasise that repealing or postponing environmental measures is the wrong response to the crisis as species loss and climate-related weather extremes are increasingly threatening food security worldwide. These organisations instead outline the need to accelerate the transition towards more sustainable food systems.

To reduce growing pressure on indispensable insect and plant populations, our agricultural systems must adapt to meet these challenges with fewer inputs of pesticides, and fewer fertilizers as well. To do so, they need to diversify, protect and make use of beneficial insects. It is crucial to work with nature – and not against it. We have to set the course now. Agroecology, Integrated Pest Management (IPM), and more biopesticide research can help in this process. That is why we want this atlas to provide data and facts for a lively debate and to contribute to the needed change.
The global version of the Pesticide Atlas was jointly produced by the Heinrich-Böll-Stiftung, Friends of the Earth Europe, BUND für Umwelt & Naturschutz, and PAN Europe. The Pesticide Atlas presents global alternative approaches and examines various aspects through scientific research, emphasizing the need for stricter implementation of integrated pest management, where synthetic pesticides are used only when absolutely necessary.

Jan Philipp Albrecht & Dr. Imme Scholz
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> An ecological turnaround requires an agricultural change – and political will

MIDDLE EAST AND NORTH AFRICA REGION FOREWORD

Pesticides in the Middle East and North Africa are widely used to protect crops and ensure yields. Yet, behind this dependency lies a deeper story about double standards in pesticide trade, weak regulation of agrochemicals, and the struggle for food sovereignty.

While many highly hazardous pesticides are banned in Europe, they continue to be sold and used, in MENA countries such as Palestine, Jordan, Lebanon, Tunisia, and Morocco. These chemicals contaminate soil and water, harm biodiversity, and threaten the health of farmers, farmworkers, and rural communities; in a region already facing acute water scarcity, and fragile soils.

Despite the challenges, change is taking root. Across the region, communities, researchers, and local organizations are proving that farming can thrive without depending on harmful chemicals. Agroecology, permaculture, and integrated pest management offer practical pathways that reduce pesticide use, and restore soil health. Regional innovation, such as locally developed biopesticides in Lebanon, can support ecological agriculture when coupled with enabling policies and institutions.

The Pesticide Atlas - MENA Edition highlights both the problematics that sustain chemical dependency and the local movements that are already forging alternatives. It draws on data and analysis from across the region.

We hope that the atlas will encourage informed debate, empower communities, and contribute to a regional transition toward healthy and sustainable food systems that work with nature rather than against it.

Kirsten Krampe and Mary Deeik
Heinrich-Böll-Stiftung – Palestine & Jordan

12 BRIEF LESSONS

ABOUT PESTICIDES IN AGRICULTURE

1 The global consumption of pesticides is increasing, even though the health and ecological consequences have long been known. International goals of **BIODIVERSITY CONSERVATION** can only be achieved if the use of pesticides is significantly reduced.

2 Herbicides are applied against unwanted plants and are the **MOST USED GROUP OF ACTIVE SUBSTANCES.** Insecticides are effective against insects. Often even in smallest amounts and even against other insects that were not targeted.

4 Pesticides that are **NOT PERMITTED IN EUROPE FOR ECOLOGICAL OR HEALTH REASONS** are still produced here and exported to other countries. European companies are also involved in this business.

5 The EU has strict criteria for the authorisation of pesticides. But the harmful **EFFECTS OF PESTICIDES ON WHOLE ECOSYSTEMS** are not taken into account.

6 Pesticide active ingredients usually do not stay in the place they were applied. They can seep into the soil and **GROUNDWATER,** become airborne, or blow away – some can be found over 1,000 kilometres away.

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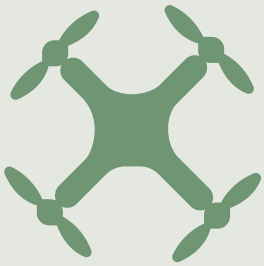
7 Pesticides **CONTAMINATE** water via infiltration, surface runoff and drift. They also accumulate in the soil and exert adverse effects on soil life – sometimes for decades.



8 Pesticide residues in food can be **HARMFUL TO PEOPLE'S HEALTH.** Despite attempts to reach globally harmonized standards, maximum residue levels vary widely from country to country.

9 Four corporations from the Global North control 70 percent of the global pesticide market. They are **EXPANDING THEIR BUSINESS** to the Global South where pesticides are less strictly regulated.

10 Beneficial insects are the **NATURAL ENEMIES OF PESTS** and creating beneficial environments for them can help reduce the use of pesticides.

11 The EU has so far failed to reduce the use of pesticides. Its **FARM TO FORK STRATEGY** aims to change that by introducing a new regulation to half the use of pesticides by 2030. The EU's Common Agricultural Policy is not yet aligned.

12 Unlike industrial monocultures, agroecological cultivation practices, including more crop rotations and combinations, empower farmers to use less or no pesticides. Some regions of the world are going ahead. But a binding international **TREATY ON THE REDUCTION OF PESTICIDES** does not yet exist.

PESTICIDES AND AGRICULTURE

DANGEROUS SUBSTANCES

Parts of global crop production are lost to pests and plant pathogens each year. Pesticides have been designed to prevent these yield losses – but they also give rise to new problems.

Grave famines and economic upheavals resulting from crop failures have occurred throughout history. People have always fought against this existential challenge – for example by using certain cultivation methods and certain crop rotations to avoid weeds and pests. The industrial revolution saw the emergence of the first synthetic chemical pesticides: They were meant to protect crops and reduce workloads. Starting in the 1940s, the chemical industry began marketing broad-spectrum pesticides – they were poisonous to entire groups of organisms and initially proved to be much more effective compared to previously available substances. Global pesticide use has continued to grow steadily for decades: Between 1990 and 2017 by about 80 percent. The interplay of pesticides, fertilizers and technological progress led to a fundamental change of agricultural production. As farmers now kept diseases and pests at bay through pesticides rather than crop rotations and crop combinations, monocultures of single crops repeatedly grown on the same land became the standard. As a result, today's industrial agriculture is dependent on pesticides and is largely unimaginable without them. Capital-intensive inputs increased yields in many industrialized countries since the 1950s. Therefore, the supply of agricultural products grew much faster than the demand; a development that has resulted in lower prices for agricultural products, which become cheaper and cheaper, while wages for farmers and agricultural workers have decreased. Not only has the amount of pesticides applied worldwide increased, but so has the scientific research on pesticide effects – experts have gained more and more knowledge about how pesticides can affect human health and pollute the environment.

Today, pesticide consumption worldwide stands at 4 million tonnes globally. Half of the substances applied are herbicides, which are used against weeds; about 30 percent are insecticides, which are used against insects that can harm harvests. And about 17 percent are fungicides against fungal infestation. The global pesticides market size reached a value of nearly 84.5 billion US dollars in 2019, with an annual growth rate of more than 4 percent since 2015. In the next few years, the rate of growth could increase further. By 2023, the total value of all pesticides used is expected to grow at a rate of 11.5 percent to nearly 130.7 billion US dollars. Many factors, like soil degradation and biodiversity loss, have contributed to the increase. The climate crisis can be another driver for pesticide use. A study from the US-American Seattle University found: Insect activity in crop-growing regions will rise along with temperatures. This will boost losses of rice, maize and wheat by 10–25 percent for each degree Celsius that temperatures rise. There are major reasons for this. For example, climate crisis is altering pest populations and the ratio of pests to beneficial insects. Insects seek out conditions that suit them and move to new areas that lack their natural enemies. This will cause their populations to grow, resulting in more crop damage. Furthermore, the plants' natural potential to resist to pests decreases as a result of climate-related stress.

Depending on the region and the phase of industrial development, usage of pesticides is associated with different intensity. The 1960s are considered the age of the "Green Revolution" that was devised to increase agricultural production, particularly in the Global South – through the use of pesticides, fertilizers, high-yield crops and irrigation. In retrospect, civil society organizations and scientists view the "Green Revolution" as the beginning of a failed agricultural development, which led many farmers into desperate situations.

A small number of corporations from the Global North divide the multibillion dollar market between themselves

EVER GROWING MARKET SHARE

The pesticide divisions' revenues of the four largest companies

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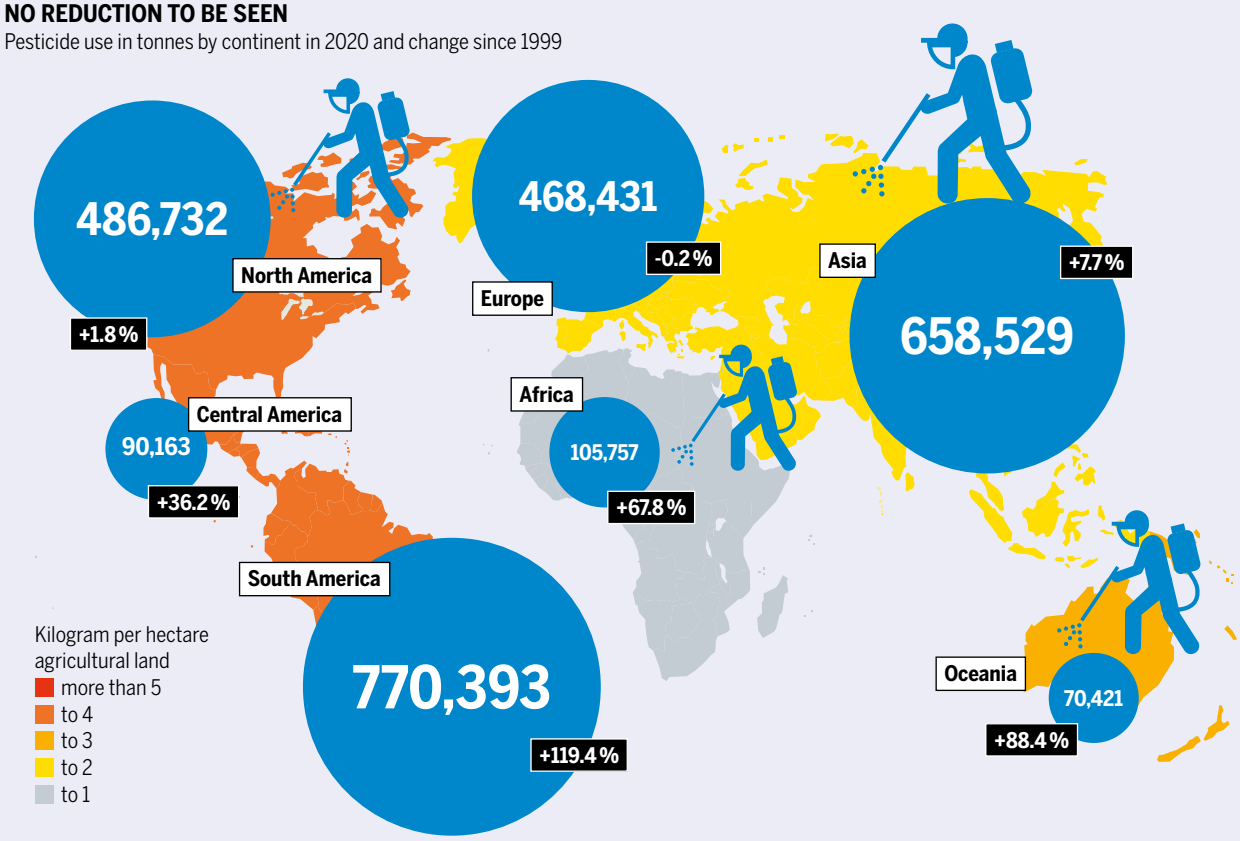
NO REDUCTION TO BE SEEN

Pesticide use in tonnes by continent in 2020 and change since 1999



According to United Nations. Mere volumes do not reflect toxicity

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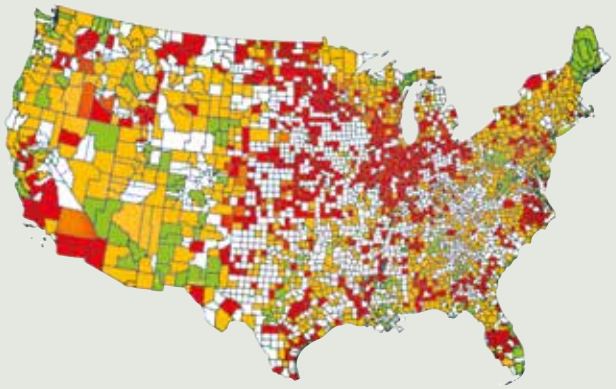
The global pesticide market is growing. South America and Africa are among the markets with the highest growth rates – but differ largely in current use and application rate

Many people in the Global South have gone into debt to buy expensive means of production. Due to high profit margins and insufficient government regulation, the trade in illicit pesticides has increased over recent years. And the sale of counterfeit pesticides has become a profitable business as well: In the first four months of 2020, illegal pesticides worth up to 94 million euros were seized in the EU and six other non-EU countries such as Colombia, Switzerland and the USA. The use of such pesticides puts farmers at particular risk because the ingredients and their concentrations may be misstated or misrepresented – making their effects and toxicity unpredictable.

Pesticides do not stay where they have been applied. They contaminate the environment and contribute to an imbalance in the ecosystem. New research shows that pesticides even contribute to pollution with microplastics when active ingredients are intentionally encapsulated for slower release. A key challenge for governments is to inform farmers worldwide about the dangers of pesticides, to take measures to protect them and to enable manageable crop protection alternatives to chemical pest control. Ideas on how this could work abound, although research in topics such as ecologically-based pest management remains underfunded. ●

SILENT SPRING FOREVER?

Decline in insectivorous bird populations related to neonicotinoid insecticides in the USA between 2008 and 2014



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Neonicotinoids are applied to fields at lower doses than conventional pesticides, but are highly toxic. They have led to annual rates of reductions in insectivorous birds by 3 percent

BIG PROFITS WITH TOXIC TRADE

The global pesticide market is growing – and there are only a few corporations that are dividing it up among themselves. They are increasingly investing in countries in the Global South, where pesticides are less strictly regulated.

Agrochemical companies such as Bayer or Syngenta emerged from chemical or pharmaceutical companies – some of which were founded already in the 19th century. In the mid-1990s, with the advent of genetic engineering in agriculture, they discovered a new business model: combining pesticide sales with seed sales. In order to form new specialized groups, they bought up smaller seed producers in large numbers and, around the turn of the millennium, split off the agricultural division from the rest of the business. In recent years, the shares of these corporations in the global market have increased sharply once again. In 2015, the US corporation Dow Chemicals had announced a merger with Dupont. Both companies combined their pesticide and seed businesses to Corteva Agriscience four years later. In 2017, the Chinese state-owned enterprise ChemChina took over the Swiss agricultural group Syngenta. In 2018, the German chemical company Bayer acquired the U.S. company Monsanto and sold parts of its business to German chemical company BASF, which entered the seed business with the acquisition. And in 2020, Syngenta, the Israeli pesticide company Adama, and Sinochem from China were combined to form Syngenta Group.

The top four firms – Syngenta Group, Bayer, Corteva and BASF – controlled around 70 percent of the global pesticide market in 2018. Twenty-five years earlier, their market share was only 29 percent. In the seeds sector – now led by exactly the same groups – the share of the biggest four rose from 21 to 57 percent over the same period.

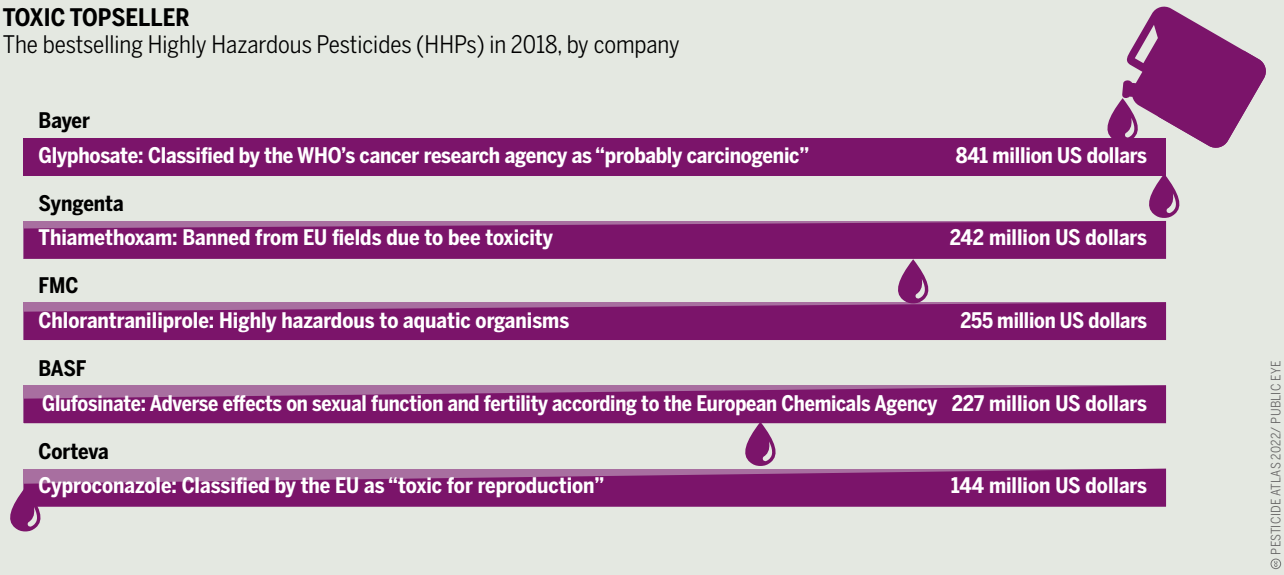
The power of these players and the continued merging of the two business models have implications for product range and agriculture worldwide: Pesticide selling seed producers have an interest in ensuring that their agrochemicals are also used in the cultivation of their seed. The leading global providers of seeds and pesticides focus on selective breeding and genetic modification of a small number of crops. First and foremost, soybean and maize. They account for about two-thirds of the seed market's volume. Bayer generates about 75 percent of its seed sales from maize and soybeans, Syngenta 55 percent and Corteva a full 85 percent.

Aiming to further developing seeds, the big companies have increased their research expenditures in recent years, while research expenditure in the agrochemical sector has been stagnating at the same time. In 2000, 70 percent of global agrochemical sales were patented or proprietary formulations. Since then, patents on popular agrochemicals have expired, with no new patented active ingredients to take their position on the market. Meanwhile only 15 percent are patented. One reason for this can be found in stricter approval procedures, largely in the European Union – which led to an increase in cost for bringing a new active ingredient to market. In light of these costs, major firms tend to use older active ingredients, combined in new mixtures.

The HHP list of PAN International currently contains 338 highly hazardous pesticides with high levels of acute or chronic hazards to health or environment according to internationally accepted classification

TOXIC TOPSELLER

The bestselling Highly Hazardous Pesticides (HHPs) in 2018, by company



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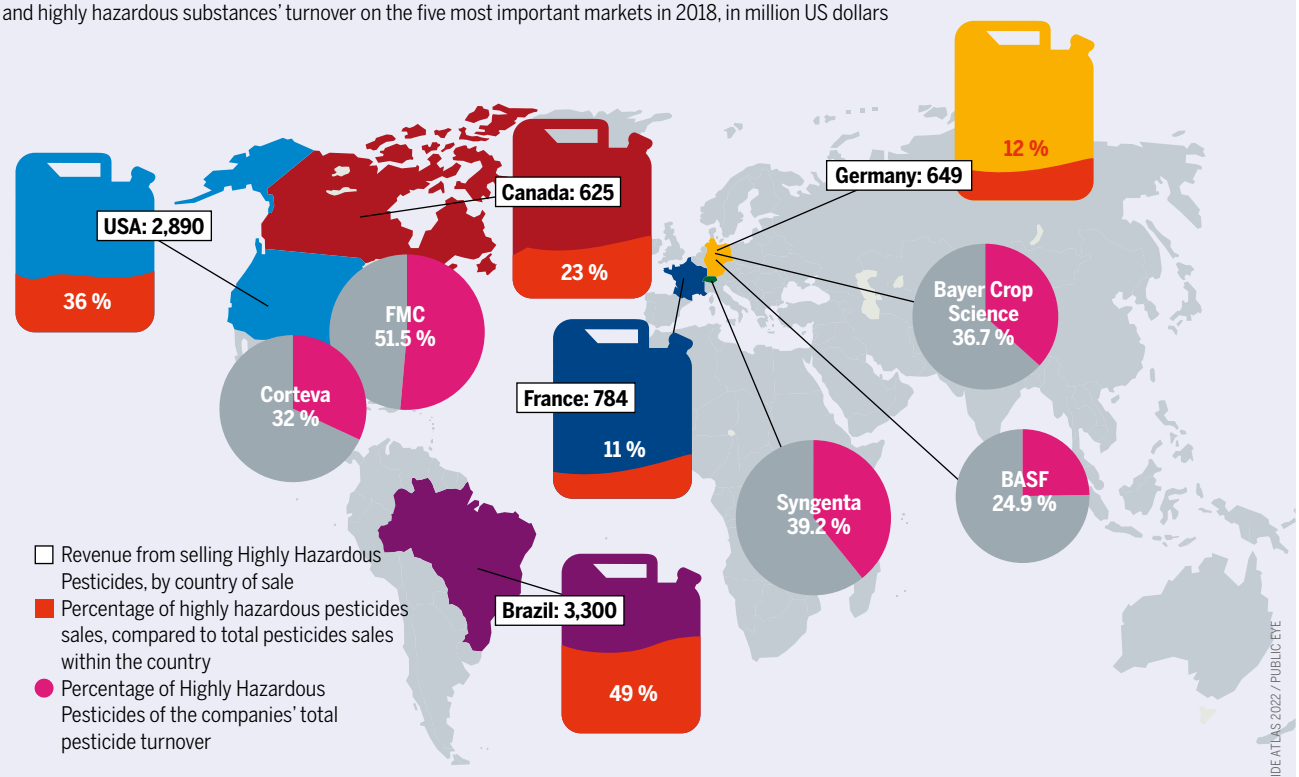
HIGHLY HAZARDOUS AND HIGHLY PROFITABLE

Percentage of Highly Hazardous Pesticides (HHPs) of the five biggest pesticide companies' total revenue, and highly hazardous substances' turnover on the five most important markets in 2018, in million US dollars



Estimates based on available market data

European companies issued plans in 2018 to export 81,000 tonnes of pesticides prohibited on their own fields. Main destination: the Global South

The best-selling pesticide products include the herbicide glyphosate (patented in 1971, on the market since 1974), paraquat (herbicidal effect discovered in 1955, on the market since 1962), the herbicide atrazine (on the market since 1958) and neonicotinoids, a new class of insecticides (on the market since the early nineties). What they all have in common is that they are considered dangerous: Glyphosate for example is suspected of being carcinogenic, paraquat is highly toxic to humans, atrazine is hormone-disrupting and neonicotinoids are highly toxic to bees.

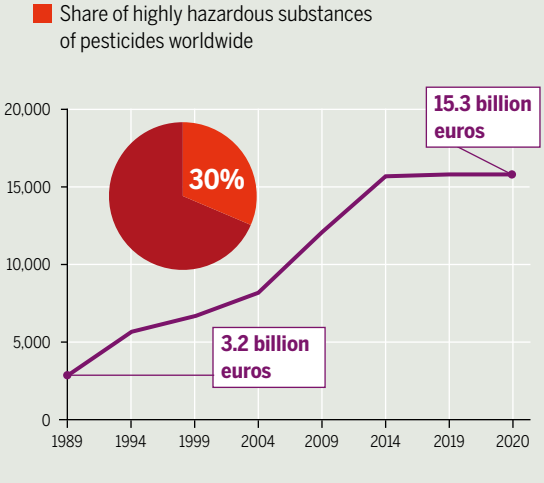
In industrialized countries, the five largest producers sell less highly dangerous pesticides overall than in Asia, Africa and Latin America: While they account for 12 percent of total pesticide sales in Germany and 11 percent in France, they account in Brazil for 49 percent and in India for 59 percent. One reason for this is that the EU and the countries of the European Free Trade Association (EFTA) have banned several Highly Hazardous Pesticides. Elsewhere, however, these substances are still permitted due to incomplete regulation – especially in South America, Asia, and Africa, where pesticide sales are on the rise.

The continuous growth of the global pesticide market by an average of 4 percent annually is mainly due to sales in these world regions. Africa still uses the least pesticides, with an average of less than 0.4 kilograms per hectare of cropland, while worldwide the figure is around 2.6 kilograms per hectare but is starting to catch up with other regions: Industry has long since identified the African continent as its largest growth market. With the increasing presence of the agricultural industry, the use of Highly Hazardous Pesticides is also increasing. ●

In the last 30 years, the value of pesticide exports from the EU has multiplied. Highly Hazardous Pesticides (HHPs) which account for about one third of the more than 1,000 active ingredients worldwide, are also amongst them

SOLD, SHIPPED, POISONED

Pesticide export value in 2020, European Union



PESTICIDE USE IN THE EU

NOXIOUS STATUS QUO FOR PEOPLE AND PLANET

The European Union is one of the world's biggest markets for pesticides. Policies to reduce their use have not been very successful so far. The lack of standardized data makes monitoring and comparing countries difficult.

In the past decade, sales of pesticides in the EU have remained more or less stable at around 360,000 tonnes per year. However, the sales volume of pesticides alone tells us little about the risks to humans, animals, and the environment. Other factors such as the toxicity of the substances, methods of application, application rates, or the frequency of application also play a role. And: Detailed statistics on the use of pesticides per crop and per country are currently unavailable in the EU. Due to the lack of systematic collection of such data at national and European levels, sale volumes serve as proxy.

Almost a quarter of all pesticides are sold in the European Union. The market was valued at 12 billion euros in 2019, compared to 53 billion euros worldwide. It is also the top exporting region, with 5.8 billion euros in exports to third countries that same year. More than 450 pesticide active ingredients are currently approved in the European Union. This figure has remained stable over the last decade. Authorities have removed some substances from the market because of their toxicity, but have continued to approve new ones. Some pesticides that are banned in the EU can still find their way onto European crops. One reason for this can be found in the use of illegal and counterfeit pesticides, which represent up to 14 percent of the EU market. Provisions for temporary exceptions are another reason why pesticides are still used on European crops. In case of a so-called 'emergency', Member States can allow their farmers the usage of a specific substance for a period of 120 days. Over the last six years, 3,600 such exceptions have been granted for the use of non-authorized pesticides in Member States. In addition, the authorisation of some active ingredients keeps getting extended despite their critical toxicity for human and environmental health.

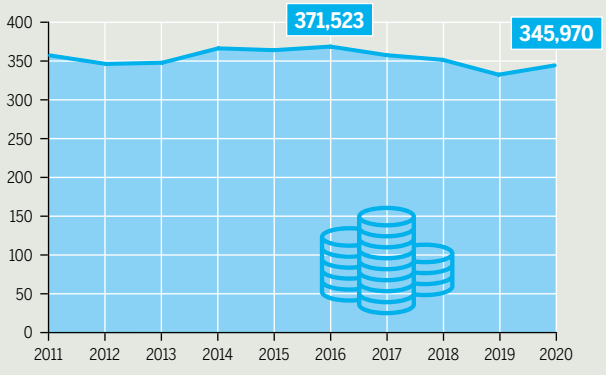
According to Eurostat, France, Italy, Spain and Germany were the biggest markets for pesticides within the EU. Significant differences in sales' evolution exist between EU Member States. For example, in 2019 the volume of pesticides sold in Denmark was 42 percent lower than in 2011, but significantly higher in Cyprus and Latvia. However, the volumes of pesticides sold in these latter countries in absolute terms are relatively low.

When looking at the pesticide application per area of land instead of overall sales, regional differences can be significant: In Romania for example, many pesticides are applied in intensively farmed areas whereas use is negligible in the Carpathians in the North. An important reason for differences in pesticide use between Member States is the type of production that characterizes the country's agricultural model. Countries such as Italy with large areas of permanent cropland for fruit and ornamental plants use more pesticides than countries where pasture makes up more than 80 percent of agricultural land. Farmers may treat the same area of permanent cropland more than 30 times a year with fungicides. Varying degrees of policies pushing for the uptake of non-chemical alternatives to pesticides are another factor.

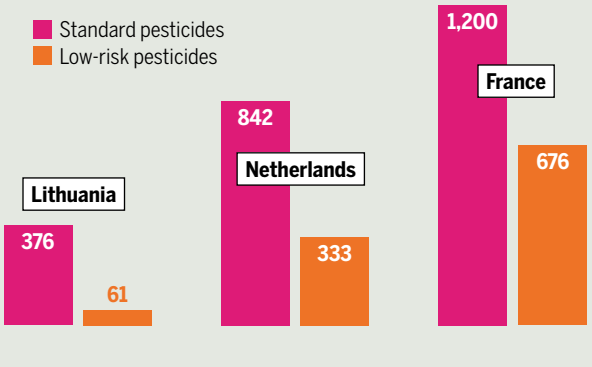
A recent study finds that European costs directly attributable to pesticides are twice as high as the net profits directly made by the industry

THE OLD AND NEW NORMAL

Sales of pesticides in the European Union, in 1.000 tonnes



Average length of national authorisation procedure 2015–2018



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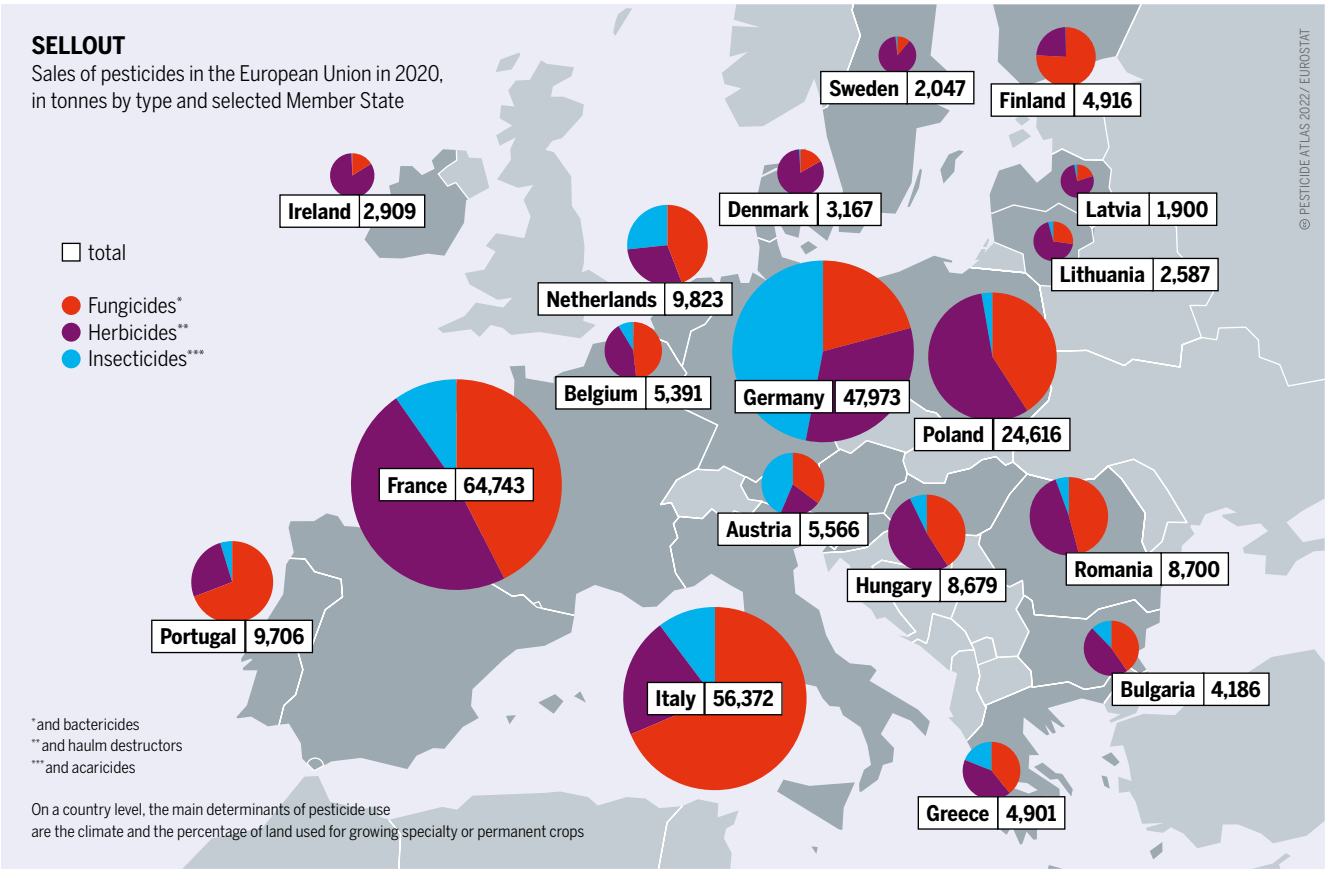
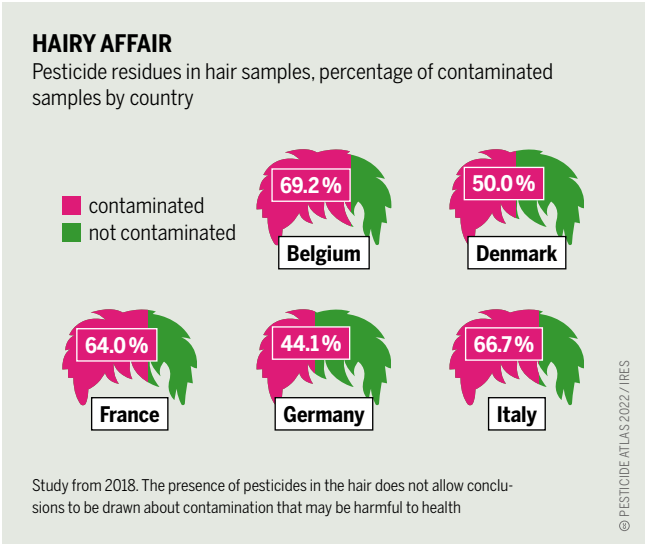


Agricultural land area, crops grown and the climatic conditions as well as national policies play a role in pesticide use

For example, Luxembourg is the only European country that banned the use of all products containing the herbicide glyphosate from 1 January 2021. The country also uses funding from the EU's Common Agricultural Policy to phased out all uses of insecticides in their vines and replace them with non-chemical alternatives. On the other hand, some Member States, such as France or Belgium, provide derogations, on a yearly basis, for the use of pesticides that were banned in the EU because of their toxicity.

The most significant decrease in pesticide use has been observed in Denmark. The Scandinavian country first implemented a pesticide fee in 1972 and supplemented this with a pesticide tax in 1982. Since July 2013, the tax is not linked to the nominal value, but the toxicity of the substance on human health, environment, and groundwater. All of the revenue generated by the tax is reimbursed to the agricultural sector, which eased resistance among farmers' organizations. The experiences made in Denmark indicate that a risk-based levy can bring down the total sales of plant protection products as well as the sales of particularly hazardous pesticides. The EU could also introduce its own specific taxation concept. Other policy measures that could reduce pesticide use include trainings for farmers, investments in more research for agroecology or more conditions around integrated pest management for funds of the Common Agricultural Policy.

In 2020, the European Commission presented its Farm to Fork and Biodiversity strategies. Among the objectives of these plans are to reduce by 50 percent the use and risk of chemical pesticides by 2030 and to reduce by 50 percent the use of more hazardous pesticides by 2030. The diversity of pesticide use in the EU appears to be a point of contention for Member States to agree on the respective national reduction efforts. Changes within this new legislative framework could also make it possible to better monitor how much, how often, where and which pesticides are used in food production in Europe – data we do not have up to this day. ●



Human hair grows quickly – and is often used to check for the presence of chemicals. High hit rates show how omnipresent pesticides are in the environment

APPROVAL PROCEDURES

UNDERESTIMATED RISKS

Before they are put on the market, pesticides go through an approval process in which their impacts on human health and the environment are tested. But their indirect effects on food chains and biodiversity receive little attention, neither do the effects of pesticide mixtures that are hard to predict.

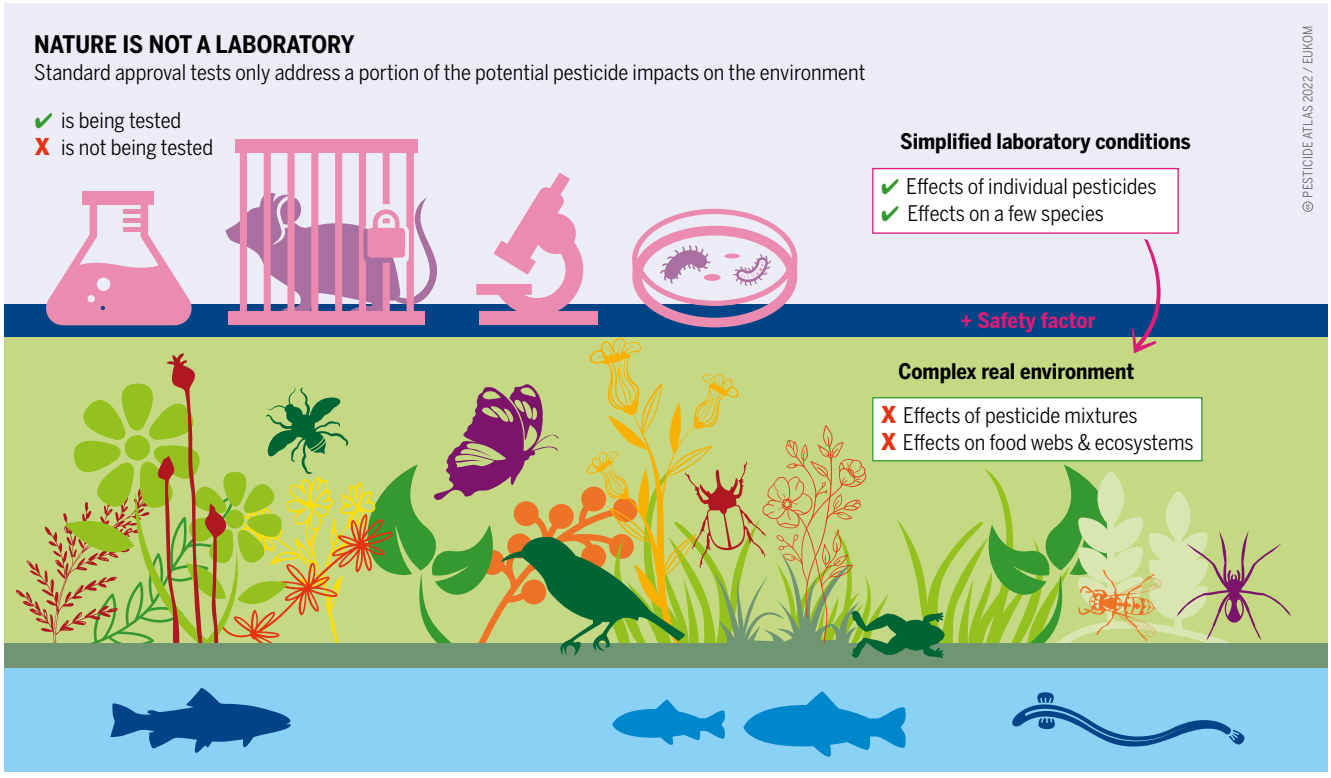
EU approval of pesticides is carried out in a two-stage process overseen by the European Food Safety Authority (EFSA). In the first step, active ingredients are approved at the European level, which is divided into different geographic areas: EFSA distinguishes three European zones with comparable ecological and climatic conditions, namely North, Central and South. In the second step, the pesticide products containing these active ingredients are approved by individual EU Member States. The pesticide manufacturers submit their scientific information and studies at the EU level which provides the data necessary to conduct the environmental and health risk assessment. EFSA then commissions different Member States – appointed as rapporteurs – to review these dossiers. The rapporteur prepares a Draft Assessment Report with regards to the risks for humans and the environment which EFSA peer reviews, together with the Member States. If this process concludes that there are no unacceptable effects on environment and human health to fear, the agency gives approval. This ultimately means that adverse effects on the environment or on non-target organisms can not stop registration if they are considered acceptable. This may occur, for example, if a beneficial insect population of for instance ladybugs was to recover after pesticide application.

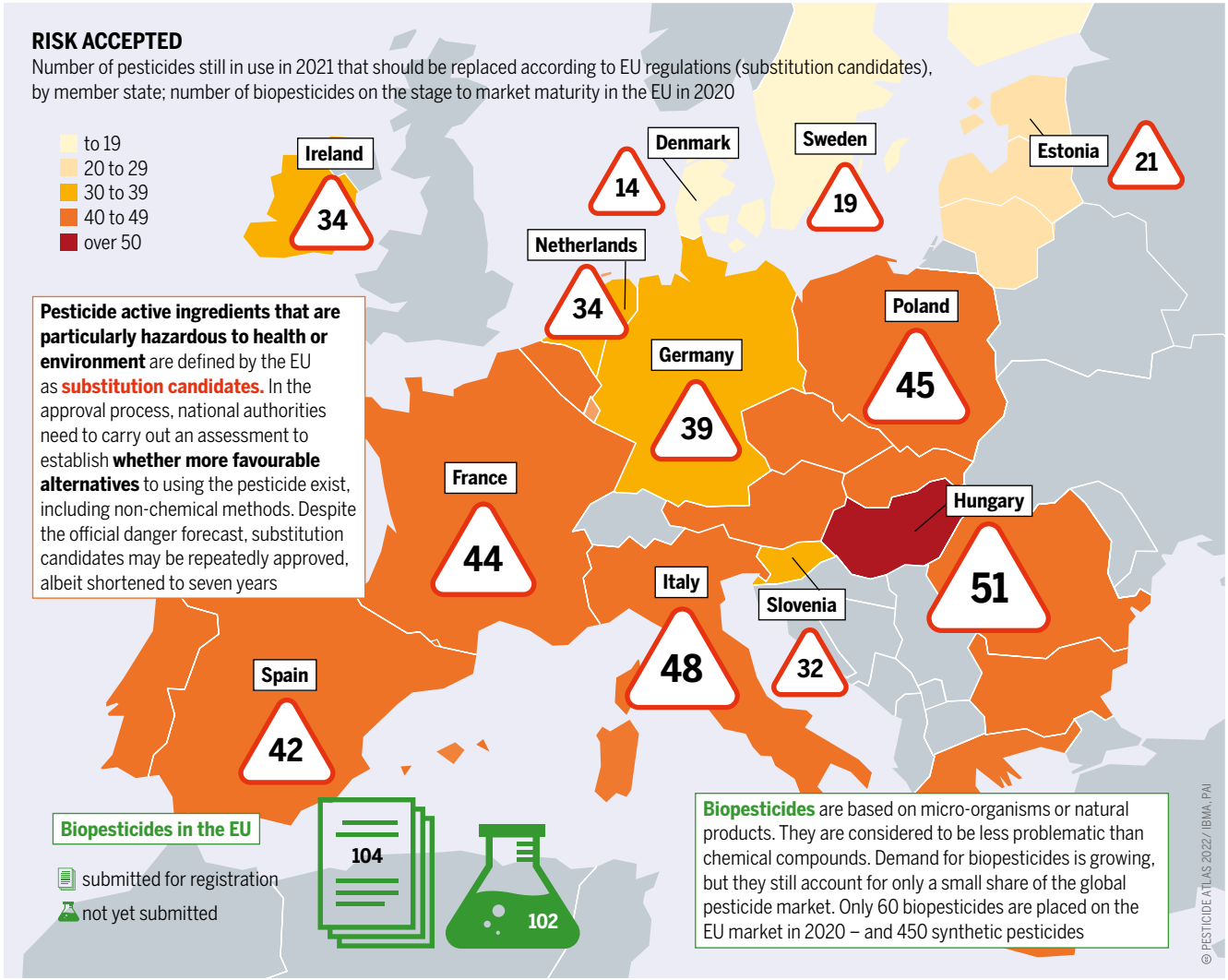
During the review process, EFSA works with the EU Commission and Member States, and carries out public consultations which includes stakeholder surveys designed to collect the views of stakeholder organizations and Member State Authorities. EFSA prepares a final draft report and a committee of Member State representatives votes on the draft decision. The decision on whether to approve the substance is taken by the European Commission in consultation with Member States.

The approval of an active ingredient is granted for a defined number of years, not exceeding 10 years. For a renewal new data must be included in the decision-making process. It is important to note that active ingredients which meet with certain cut-off criteria – a classification as mutagenic, carcinogenic or harmful to reproduction and endocrine system – will not be approved in the EU.

Despite independent studies suggesting otherwise, the herbicide glyphosate was granted re-approval by the EU in 2017. The controversial herbicide was first approved in 2002

The results from approval tests with only a few species are subject to uncertainties. To compensate for these uncertainties, safety factors are supposed to help





Dangerous pesticides must be phase out. Biopesticides can be an option for substitution if other measures within the framework of integrated pest management have failed.

under the new EU pesticide legislation. Previously, it was only permitted in some Member States. The re-registration of glyphosate was scheduled for 2013, and Germany served as rapporteur country, with Slovakia as co-rapporteur. The process received widespread attention due to environmental and health concerns; meanwhile, the International Agency for Research on Cancer (IARC), which as part of the World Health Organization (WHO) has devised a system of categories to evaluate the carcinogenicity of an substance to humans, has classified glyphosate as "probably carcinogenic" to humans. However so far only Luxembourg was the first EU country to ban glyphosate. However so far only Luxembourg was the first EU country to ban glyphosate. The main reason for differing assessments was that the IARC used independent studies for evaluation, while the national regulatory authorities relied on manufacturer studies. Furthermore, the IARC assessed glyphosate containing products and occupational exposure, while national authorities mainly considered the pure active ingredients only, dietary exposures and risks to the general population. As a compromise, the approval of glyphosate was only granted for another five years instead of ten years. An alliance of glyphosate manufacturers called Glyphosate Renewal Group (GRG) has already submitted a dossier to EFSA to ensure that the herbicide continues to be approved after 2022. It comprises 180,000 pages. To address this, the Commission appointed four Member States acting jointly as 'rapporteurs', known as the Assessment Group on Glyphosate (AGG), consisting of EU Member States France, Hungary, the Netherlands, and Sweden.

Although pesticides must meet the strict EU approval criteria, the current environmental impact assessment does not seem to prevent the approval of pesticides that have harmful effects on the environment. The EFSA guidelines focus on how to evaluate the impact of active ingredients with consideration to surrogate species of birds, mammals, honeybees, wild bees or earthworms. Ecologists and civil society organizations demand that the impacts on fungi, amphibians, bats, reptiles, or wild plants are also considered. Interactions between organisms and indirect pesticide effects are left out the approval process as well. Another important aspect not considered in environmental risk assessments is the fact that most agricultural crops are treated not only with a single pesticide but with a variety of pesticides each season. These mixtures' environmental effects are still largely unknown – evidence is mounting that they are stronger than the effects of individual substances. Because of these fundamental flaws pesticides can not be considered safe for the environment. ●

SEVERE CONSEQUENCES

385 million people fall ill every year from pesticide poisoning. The United Nations intend to improve the worldwide handling of pesticides to prevent harm, but there is little effective legal regulation.

People can be unintentionally exposed to pesticides in various situations: on the field, in the forest, through food or drinking water. The clinical diagnosis of pesticide poisoning is made when typical symptoms develop after exposure. Some health effects may occur right away, while other symptoms may occur several hours after exposure. Short-term adverse health effects are called acute effects, including stinging eyes or rashes. The victim may feel tired and listless and suffer from headaches and aching limbs. The digestive tract is also frequently affected – the consequences are nausea, vomiting or diarrhoea. In serious cases of poisoning, the victim's organs can fail: the heart, lungs or kidneys stop functioning. The total number of fatalities around the world from unintended pesticide poisonings are estimated at some 11,000 per year.

Farmers are at a higher risk of getting exposed to pesticides, but the substances can also pose risks to people outside the agricultural sector as pesticides are mobile and difficult to control. They often contaminate the environment and end up in our food.

The lack or misregarding of safety precautions can result in serious injuries or fatalities as the following two examples show: In 2013, twenty-three school students in Bihar, India, died within minutes of eating a meal of rice and potato curry that was part of a lunch program against malnutrition. The forensic investigation found that the meal had been prepared with cooking oil that contained the pesticide monocrotophos. In the same year, an airplane sprayed an insecticide over a rural school in the Rio Verde for a full 20 minutes. Children and their teachers were eating their lunches under the open sky when the toxic chemicals were sprayed on them. Dozens of children and adults were hospitalized. The school – located among vast maize and soy plantations – was doused in the pesticide Engeo Pleno, produced by the seed and chemical company Syngenta.

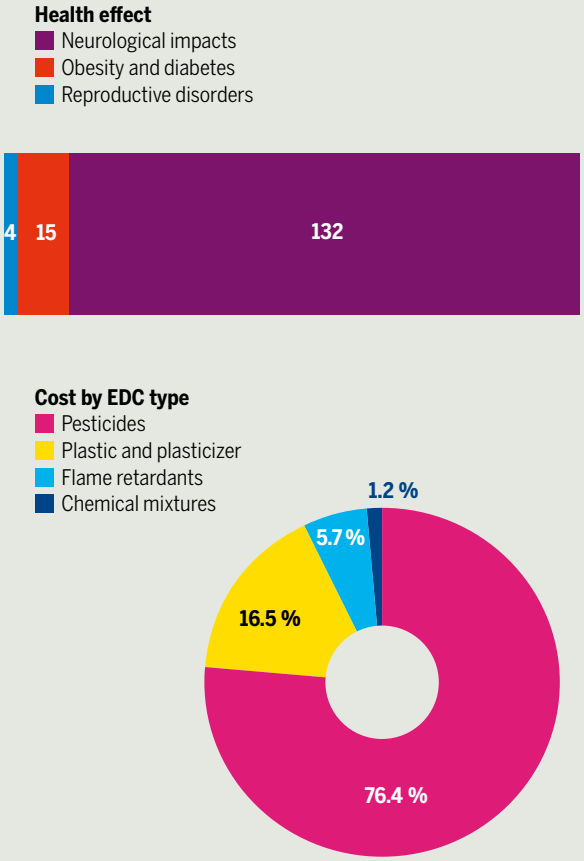
Many of those affected by poisoning suffer from long-term effects: There is a substantial body of evidence on the relationship between exposure to pesticides and elevated rate of chronic diseases such as Parkinson's or childhood leukaemia. Pesticides have also been linked to an increased risk of liver and breast cancer, Type 2 diabetes and asthma, allergies, obesity and endocrine disorders.

Birth defects, preterm births and growth disorders can also be traced back to contact with pesticides. In recent years, a widely publicized debate has centered on glyphosate. Several people who developed cancer after being exposed to the herbicide have sued its manufacturer Bayer for damages, who has lost various lawsuits already. About 96,000 plaintiffs reached settlements estimated at 11.6 billion euros; around 30,000 of these lawsuits are still ongoing.

In March 2015, the International Agency for Research on Cancer (IARC) – an intergovernmental agency that forms part of the World Health Organization (WHO) of the United Nations – classified glyphosate as "probably carcinogenic to humans". A 2019 University of Washington scientific meta-study found that the overall meta-relative risk of non-Hodgkin lymphoma in individuals that were exposed to glyphosate-based herbicides increased by 41 percent.

BAD FOR BOTH HEALTH AND FINANCES

Estimated health care costs of endocrine disrupting chemicals (EDCs) in the European Union, in billion euros



Study from 2015, conservative estimates. Actual total numbers are likely to be significantly higher. Various diseases associated with EDCs such as Parkinson's disease are not included due to lack of data

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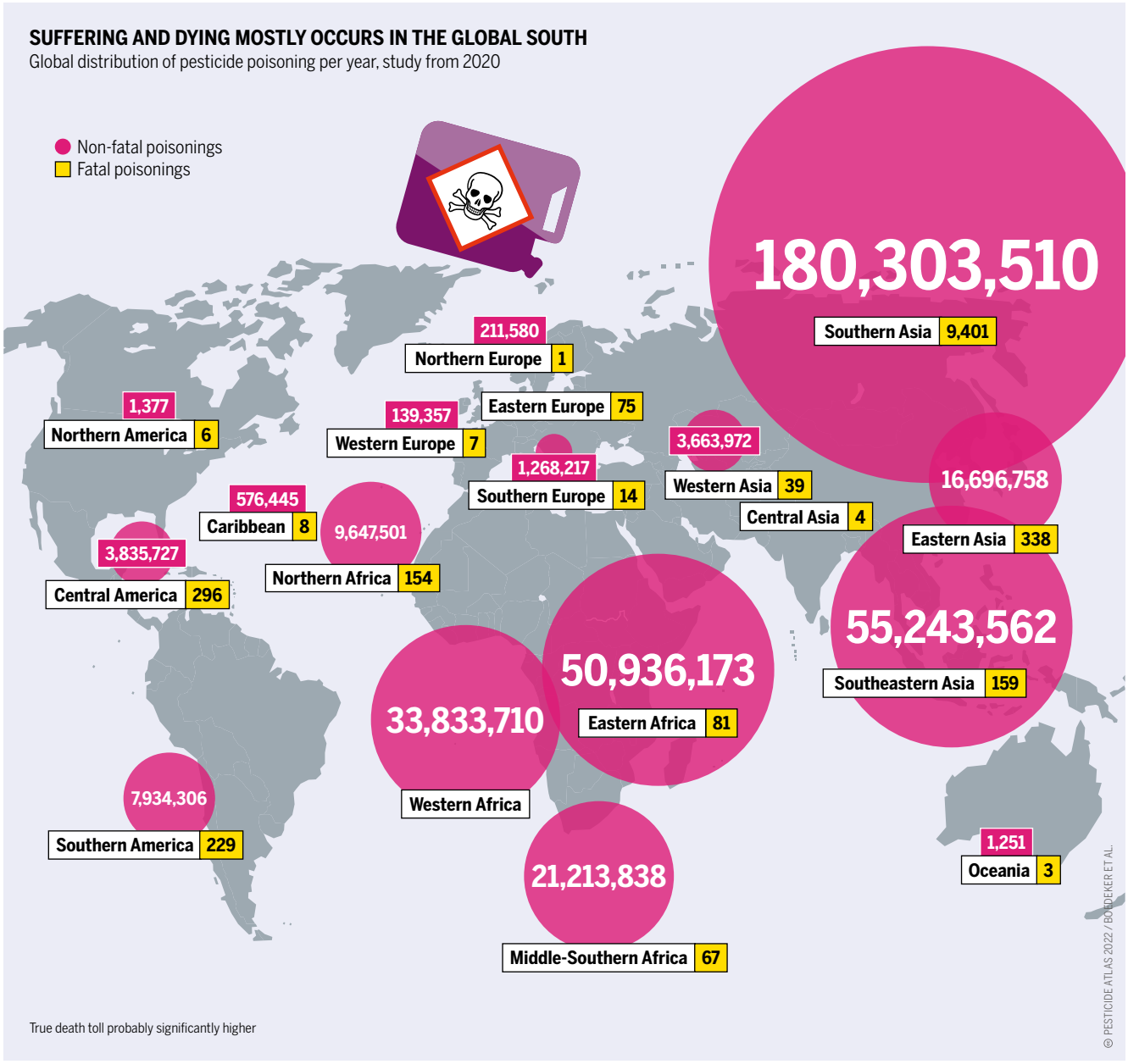
Even at low concentrations, endocrine disrupting chemicals (EDCs) are a clear health risk. For example, they are found in cosmetics, plastic packaging – or pesticides



Poisoning affects 44 percent of all agricultural workers worldwide – and in a low-income country like Burkina Faso as many as 83 percent

Several studies show that pesticide poisonings have been rising sharply for years – today about 385 million cases of acute poisonings occur each year. In 1990, a WHO task force estimated that about one million unintentional pesticide poisonings with severe manifestations occur annually, leading to approximately 20,000 deaths. Because many states do not have central reporting offices, it can be assumed that the actual number could be significantly higher as many cases remain unreported: Scientists point out that the total number of occupational poisonings in 1990 was even twenty-five million. One reason for the increase to 385 million poisonings today is probably the intensified pesticide use all over the globe: the worldwide tonnage increased by almost 81 percent between 1990 and 2017. This includes a 484 percent increase in South America and a 97 percent increase in Asia.

Most victims live in the Global South, where environmental, health, and safety regulations are often the weakest. The use of Highly Hazardous Pesticides (HHPs) is also a reason for the high poisoning rate. 60 percent of deaths related to pesticide poisonings occur in India.

In order to reduce the high number of pesticide poisonings, the WHO and the Food and Agriculture Organization (FAO) – a specialized agency of the United Nations that leads international efforts to defeat hunger and improve nutrition and food security – have developed a voluntary framework and standards for pesticide management. Among other things, the code of conduct recommends avoiding pesticides that require personal protective equipment too uncomfortable or expensive to use. The guideline recommends also the use of agroecological alternatives and a ban on Highly Hazardous Pesticides (HHPs). However, these recommendations have hardly been implemented so far, they are still non-binding and without legal obligation. ●

IMPACT ON THE INVISIBLE ECOSYSTEM

Insufficient attention is being paid to pesticides accumulating in the soil, where they exert direct and indirect adverse effects on soil life – sometimes for decades.

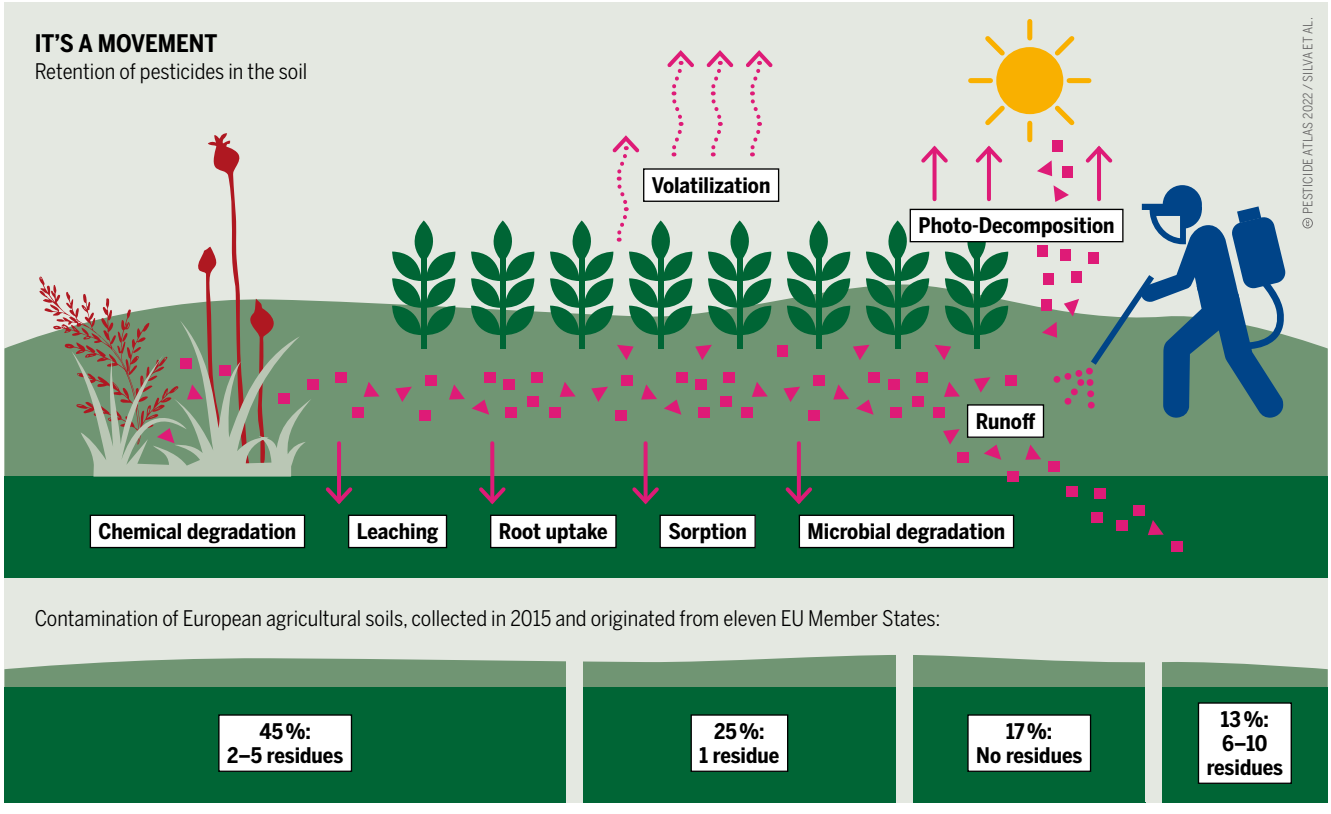
In healthy soils very high levels of biodiversity can be observed: Soil is home to a quarter of all known species on Earth. Soil life is so abundant that a shovelful of healthy soil contains more living organisms than there are people on Earth. It is hard to overestimate what all this teeming life in the soil is capable of achieving – tens of thousands of underground species of invertebrates, bacteria, and fungi are constantly filtering our water, recycling nutrients, counteracting soil-borne diseases, building humus, sequestering greenhouse gases, and regulating the climate. So soil is not only the substrate on which we grow our food – but also a non-renewable resource that must be treated with care.

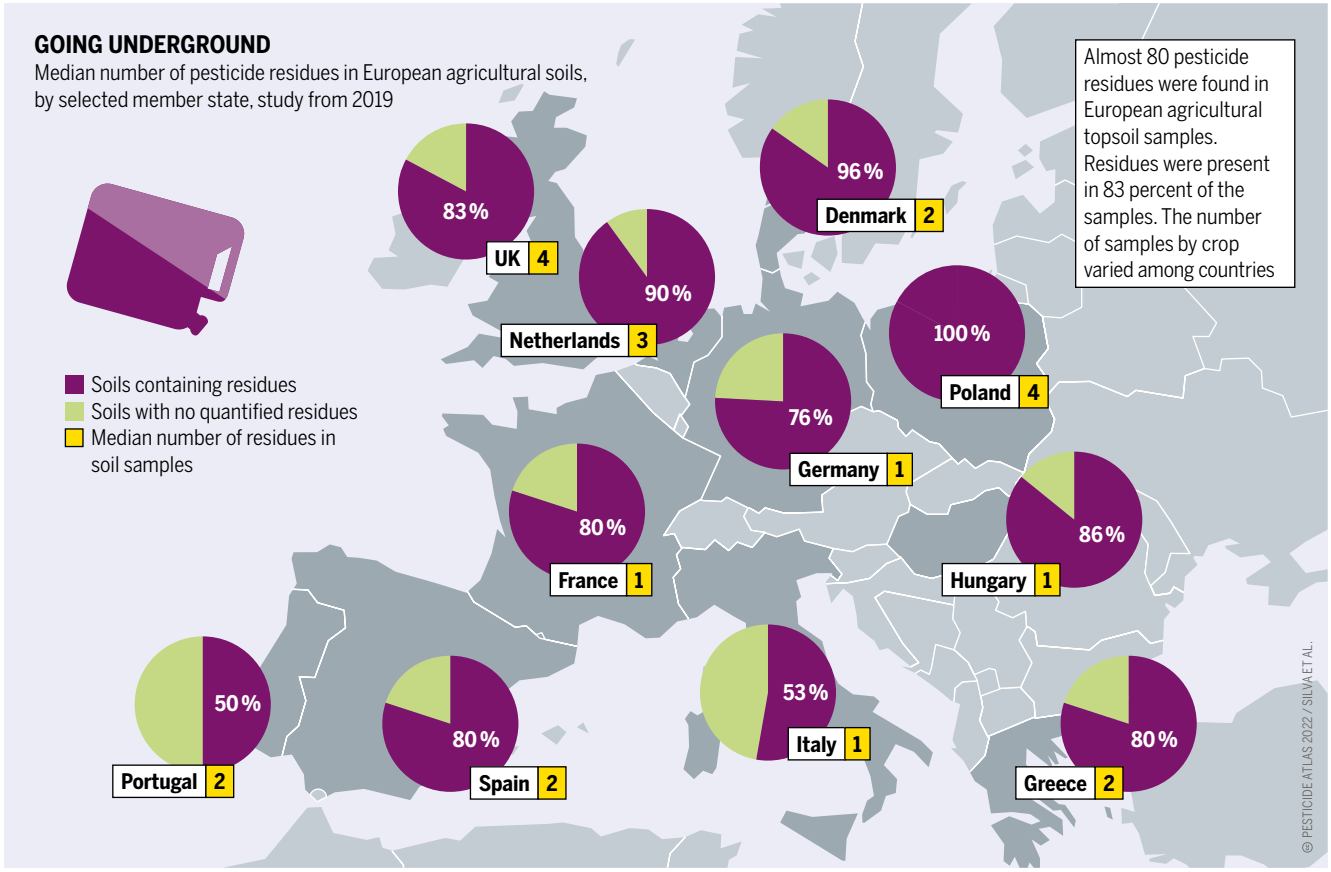
Most pesticides are designed to be toxic to organisms and it is all the more concerning that nearly two-thirds of all agricultural land worldwide is contaminated with at least one pesticide active ingredient. In Europe, soil analyses revealed that more than 80 percent of 317 agricultural topsoils tested contained pesticide residues. The most commonly found and most highly concentrated pesticides were the long-banned insecticide DDT, the herbicide glyphosate as well as its degradation product AMPA, and broad-spectrum fungicides such as boscalid, epoxiconazole, and tebuconazole.

Pesticide residues in the soil affect soil life. A systematic review of nearly 400 published studies found: Pesticides harm organisms that are vital for maintaining healthy soils in over 70 percent of the more than 2,800 experiments included in this review. These effects were observed at all organismic levels: bacteria, fungi, and soil fauna. Pesticide residues in soil are also associated with the decline of earthworms, microorganisms, and symbiotic mycorrhizal fungi – which provide not only nutrients to plants but also keep them healthy.

Ecotoxicological research on pesticides has always focused specific effects, for example on how insecticides affect beneficial soil insects, or how fungicides affect soil fungi. However, pesticides have an impact that goes far beyond that: They usually have negative effects on a wide range of non-target organisms. One example is glyphosate – the most

317 agricultural topsoil samples from across the European Union were examined: Almost half contained up to 5 different residues





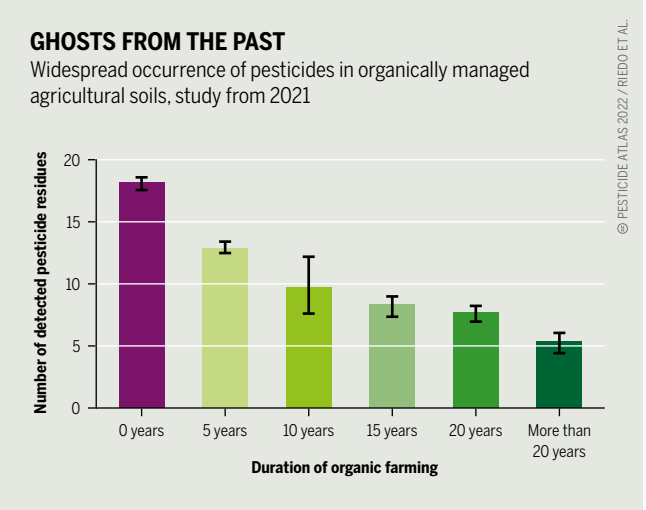
widely used herbicide in the world. It affects soil life in a variety of ways, directly and indirectly: The use of glyphosate can harm soil bacteria and mycorrhizal symbiosis with the roots of grapes. Even 11 months after application, the herbicide can still be affecting the nutrient composition of the entire grape plant. Glyphosate herbicides reduce activity and reproduction of earthworms and can force tiny springtails from the soil to the surface, making them more vulnerable to predators. These impacts on soil life can further impair water infiltration after heavy rains – and lead to more glyphosate contamination in water bodies.

Pesticide use can also harm subsequent crops. Nevertheless, this is hardly taken into account in risk assessment. Persistent glyphosate residues in soil have been shown to alter many plant processes: They change the regulation of plant defence systems against diseases and harmful soil-borne fungi. Glyphosate residues in livestock feed can even be transferred to manure and affect the growth of fertilized crops the following year. Pesticides containing intentionally added microplastics also contribute to the pollution of soils. The use of such plastic-coated synthetic agrochemicals is rising, with producers marketing their controlled-release function. According to a 2019 report from the European Chemicals Agency (ECHA), microplastics added intentionally to fertilizers, pesticides and seed coatings account for nearly half of the approximately 51.500 tonnes of microplastics used each year in the European Economic Area.

Even after two decades of organic agriculture, up to 16 different pesticide residues were present in soil samples from 60 agricultural sites throughout Switzerland

Even years after pesticide use, the soil contamination is a problem: It has become an issue of increasing concern in Europe due to high soil persistence and toxicity to non-target species

Environmental experts are troubled by the many negative effects that pesticides have had on soil life for decades. They are calling for greater consideration of biodiversity and soil health issues when assessing the environmental risks of pesticides. In addition to common soil life, many other species also spend part of their life cycle in the soil: ground beetles, ground-nesting bees, or amphibians. Soil contamination with pesticides should therefore be considered as part of the context of the drastic decline in biodiversity as a whole. ●



RESIDUES

TOXIC SIDE DISH

Pesticide use leads to residues in food to which many people are exposed – especially in the Global South. But as an import, contaminated food can also end up on European plates.

Chemical residues can be problematic to both wildlife and humans. The daily intake of pesticide-contaminated food can pose severe health risks. Sensitive groups such as pregnant women or children are particularly at risk. To protect consumers from residues in food, governments are taking regulatory action. This legislation generally provides for the limitation of residue levels that may be allowed in food items entering or leaving various countries. These maximum residue levels (MRLs) are set almost everywhere in the world. Since 1963, the United Nations publish the Codex Alimentarius, a collection of standards for food safety and product quality. The maximum residue levels contained therein are considered an important international reference. Nonetheless, there are big differences in the maximum legal intake quantity of pesticide residues depending on the country and region.

For each approved active ingredient the European Union specifies the maximum concentration of a pesticide residues to be legally permitted in various food. If goods exceed the limits, they may not be placed on the European market.

EU maximum residue levels are based on the cultivation practices, the toxicity of the active ingredient, and food consumption. Baby food must meet stricter specifications.

The European Food Safety Authority (EFSA) publishes annual reports on food commodities that are tested on the basis of random samples: In 2019, 3.9 percent of all samples exceeded the limits. Just over half of the food checked was free of detectable contamination, whereas 27 percent contained two or more pesticide residues. Multiple residues were found particularly in fresh products, such as black currants, sweet cherries, grapefruits, rocket, and table grapes. A sample of raisins headed the list of most-contaminated food – the EFSA detected twenty-eight different pesticides.

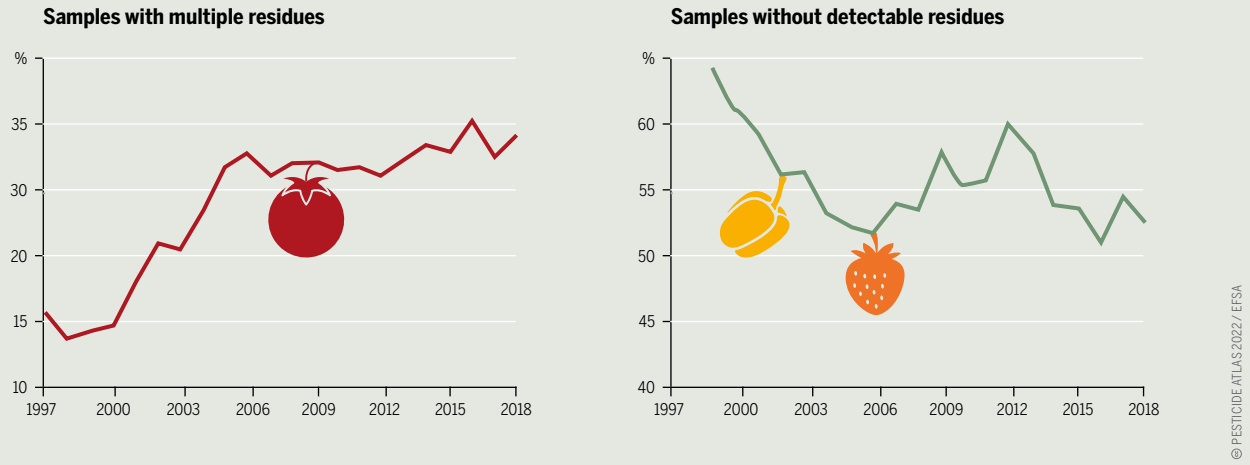
Health experts criticize the absence of maximum legal limits for multiple residues in food. A further criticism is that companies can circumvent regulations. If active ingredients lose their EU approval for example because they are classified as carcinogenic their maximum residue level is automatically lowered to protect human health. Usually, the limit is lowered to 0.01 milligrams per kilogram, which also applies for imported goods. To avoid this, pesticide manufacturers who have to fear a ban of one of their active ingredients for health reasons often just let EU permits expire. Without a formal denial of approval for health reasons they can apply for "import tolerance": A higher MRL set for imported products to meet the needs of international trade. EU law forbids granting this for pesticides that have lost their approval because of health effects.

The EU has a tighter regulation than many non-EU countries. In Japan, for example, almonds may be contaminated with one milligram glyphosate per kilogram – which is ten times as much as the EU permits. In tomatoes, Japan allows two micrograms imidacloprid per kilogram. This is four times the residue level currently possible in the EU. In the Eastern Mediterranean, an area that is home to nearly 680 million people and includes countries from the Middle East to Central

The EU has set strict rules for maximum residue limits. However, just like for the approval processes, it fails to take into account the effects of multiple residues

AN APPLE A DAY BRINGS PESTICIDES YOUR WAY?

Pesticide contamination of fruits and vegetables in the European Union in 2018



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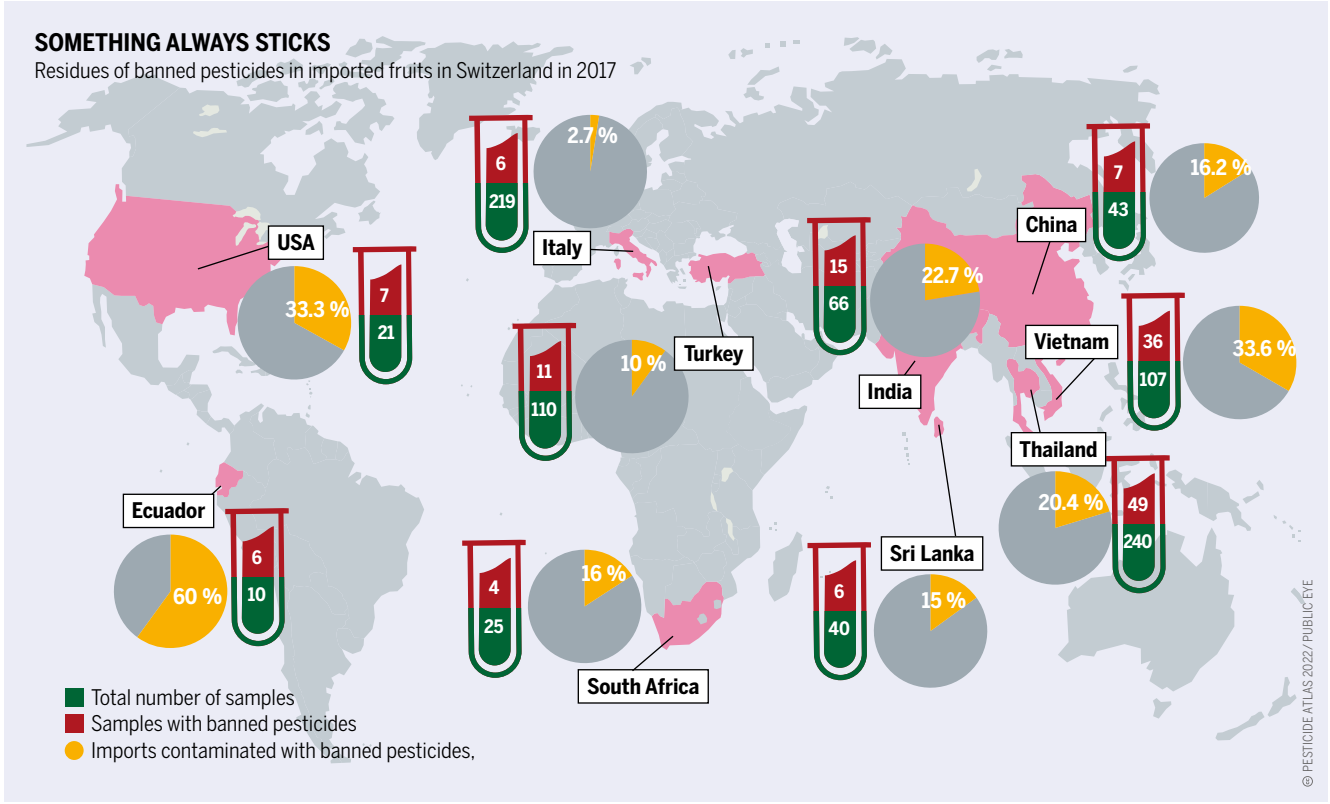
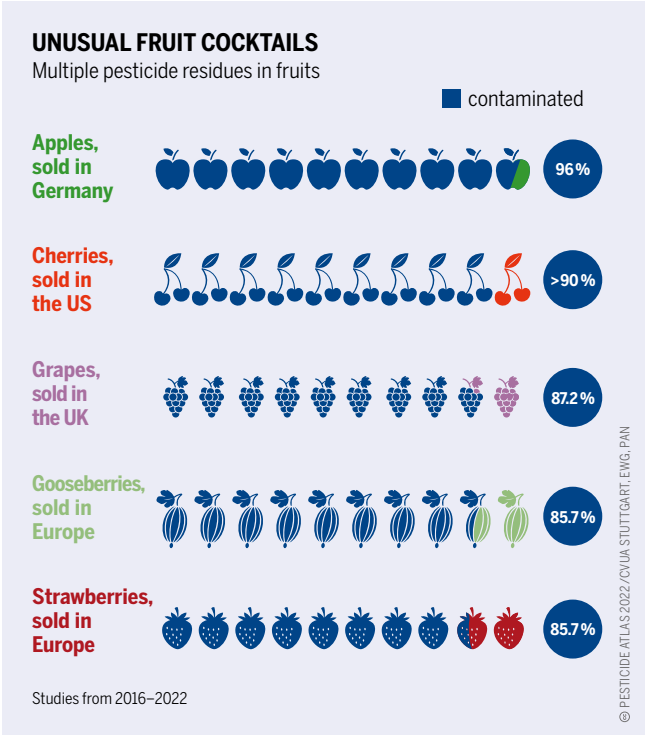


Asia, maximum residue levels have been exceeded in up to 61 percent of food samples over the past 15 years. Repeatedly, residues of globally long banned pesticides are detected there. Brazil is another example for a lack of efficient regulation that imposes on its population maximum residue levels in food that are two or three times higher than the maximum residue levels in the EU in some cases and even hundreds of times higher in other cases. According to the official Brazilian residue report, in 2019, 23 percent of all samples exceeded even the already high national maximum residue levels. EU-banned active ingredients have also been detected as residues in Brazilian cereals, fruits and vegetables. As export goods, these pesticide residues end up again in Europe or other regions. Put differently: A pesticide which is forbidden in Europe can be exported to a third country, used on crops, and then imported back as a residue onto European plates.

In Kenya in 2020, a total of 25 different active ingredients were found in tomato and kale samples – 51 percent of the detected active ingredients were already withdrawn from circulation in the EU long ago. Of the total of 25 samples, 60 percent exceeded the maximum residue levels. It is alarming in particular, because these two vegetables are part of the staple foods of Kenyan population. In Nigeria, elevated levels of residues were also detected in tomato samples, including traces of permethrin. The US Environmental Protection Agency (EPA) classified this insecticide as "probably carcinogenic". In the last years, beans from Nigeria showed high levels of contamination. The samples contained up to 0.3 milligrams per kilogram of dichlorvos; the legal limit in Europe is 0.01 milligrams per kilogram. Dichlorvos can cause difficulties breathing, diarrhoea, and vomiting among other effects. The EU has reacted and issued an import ban on beans from Nigeria. Timely and sufficient support for non-chemical plant protection practices can prevent such exclusions from the EU market. ●

Scientists do not only detect contaminants in fruit: 93 percent of vegetable samples sold in Germany showed residues of 226 active pesticide ingredients

A European ban on toxic pesticides does not translate into their immediate disappearance. In the last years, a increase to exposure can be observed



EXTINCTION IN FULL SWING

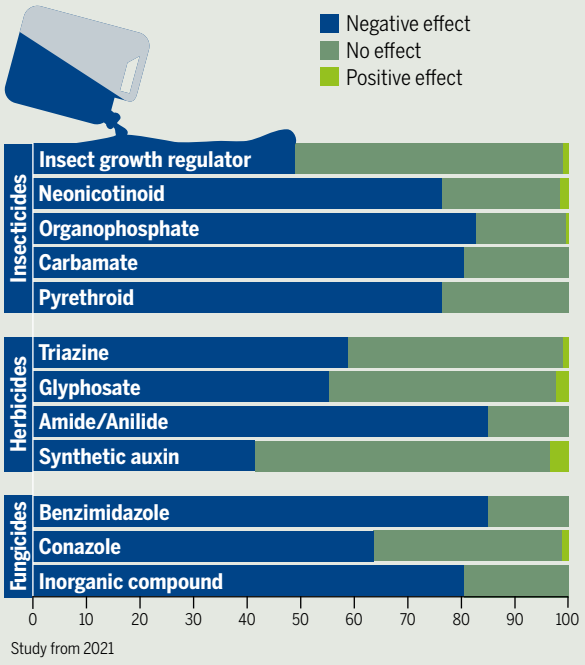
Experts have been warning for years that biodiversity is at stake. Pesticides have been identified as one of the causes for why the abundance of animals and plant species is deteriorating so quickly and disastrously.

A significant loss of biodiversity has been observed in the European agricultural landscape for many years. For example, populations of field birds and meadow butterflies have declined by more than 30 percent since 1990. The structure of agricultural landscape is the most common cause, mainly the size of fields, lack of landscape features such as hedgerows or ponds – and the usage of chemicals such as artificial fertilizers and synthetic chemical pesticides.

There is a consensus that pesticides play a significant role in biodiversity loss – they harm biodiversity directly and indirectly. The control of weeds by broad-spectrum herbicides such as glyphosate leads to a decimation of flowers and blossoms and thus to a shortage of food for insects that feed on flowers and wild herbs. In 2017, the total sales of glyphosate are estimated at more than 46,000 tonnes across the EU. In the same year, glyphosate sales were highest in France followed by Poland and Germany. In the latter Country 40 percent of all agricultural land is treated with the herbicide.

SCORCHED EARTH

Percentage of tested parameters showing negative, positive, and no significant effects on soil invertebrates



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2021 study results show the impact of pesticide applications on biodiversity. A German institute recorded and analyzed floral diversity relative to methods of cultivation in the agricultural landscape. The ratio in terms of species diversity and coverage in fields and of the actually flowering species and their flowering intensity was 3 to 52 to 100 from fields managed conventionally for many years to fields managed organically for many years and fields which never faced the usage of chemical pesticides. Because wild plant species in fields are important sources of nectar and pollen their decline as a result of intensive management with herbicides can also be expected to have a significant impact on the diversity and abundance of insects in the arable-dominated agricultural landscape.

The sharp decline in insects in agricultural landscapes has been documented by many studies. The population of grassland butterflies in European countries has decreased by about one third between 1990 and 2015. EU Red Lists show that almost 10 percent of bees are threatened with extinction in Europe mainly because of agricultural practices including the use of pesticides and fertilizers. The most widely used insecticides are neonicotinoids, which are very toxic to insect pollinators like bees. Therefore, 4 out of 5 active ingredients are now only allowed with exceptional approval. Bees and other pollinators can be exposed to pesticide through different ways. For example, pollen and nectar from pesticide treated plants may contain residues: A study published in 2017 found pesticides in honey from across the world. 75 Percent of all honey samples contained at least one neonicotinoid. More than one third of honey samples were contaminated with concentrations of neonicotinoids like imidacloprid that are known to be detrimental to bees. Similar substances were detected in a study the German environmental organization BUND conducted. More than half of the samples – ordinary honey sold in German supermarkets – were showing residues of pesticides like acetamiprid or thiacloprid. Based on the available data, thiacloprid has been classified as likely to be carcinogenic in humans. Studies found that a chronic exposure to thiacloprid significantly impaired honeybees' foraging behavior, immune system and navigation – or kills them directly.

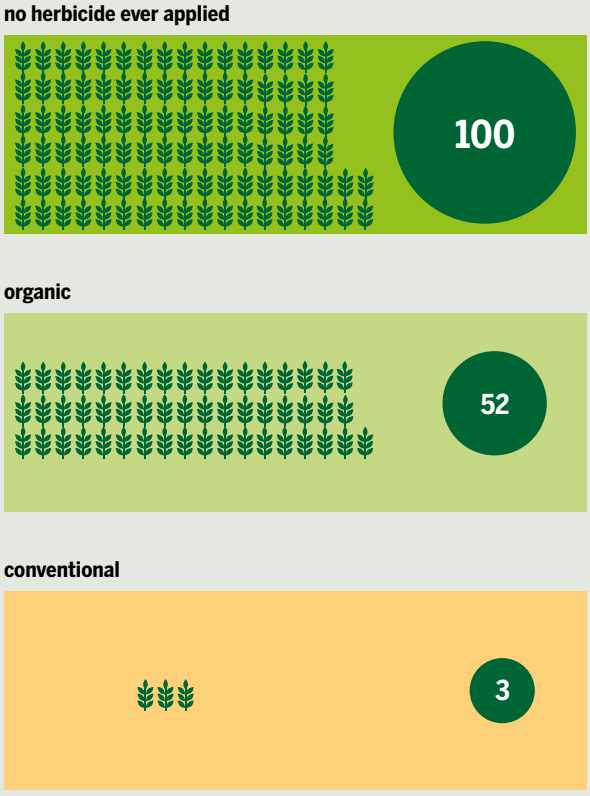
There is a growing body of research showing pesticides can become more harmful when mixed – even when components were combined at concentrations below its individual no-observed-effect-concentration (NOEC). For example, some fungicides can increase the toxicity of pyrethroid insecticides for bees. Scientific knowledge of pesticides suggests that it is insufficient to reduce the amount of pesticides used – even in very small quantities many substances can endanger biodiversity. It is more decisive how toxic

Soils contain nearly a quarter of the planet's diversity. Pesticides often harm organisms that are essential for their conservation

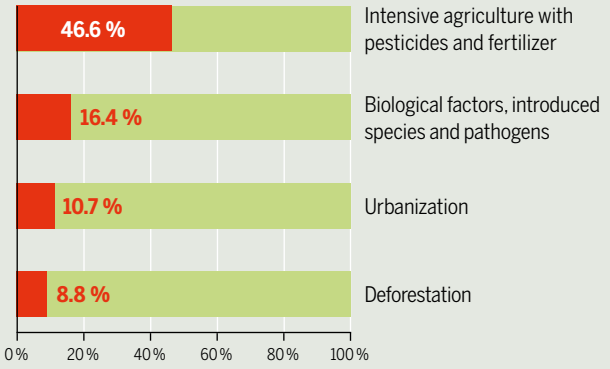
THE WORLD IS LOSING ITS DIVERSITY

Environmental impact of pesticide use

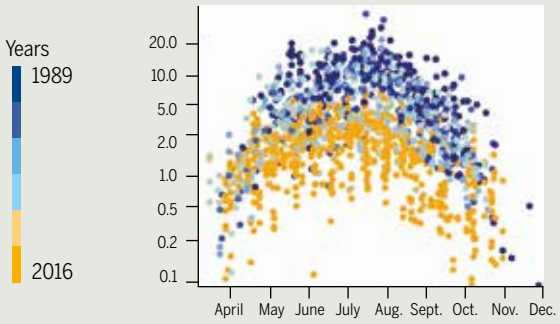
Floral diversity and flowering intensity in relation to cultivation methods on arable land



Main drivers of insect decline



In sharp decline: Seasonal distribution of insect biomass (grams per day), representative of Western European low-altitude nature protection areas embedded in a human-dominated landscape



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the active ingredients are for certain animals and plants. A study of the University of Landau (Germany) found that the total amount of insecticides used in the USA was reduced by 40 percent between 1992 and 2016. Fish, mammals and birds benefited from this, as this decrease was mainly due to decreasing use of certain classes of insecticides such as organophosphates and carbamates, which are problematic for these groups. However, a different picture emerges for invertebrates such as crustaceans or insects and especially pollinators insects such as bees. Despite the decline in the amount of insecticides, toxicity for these groups more than doubled between 2005 and 2015.

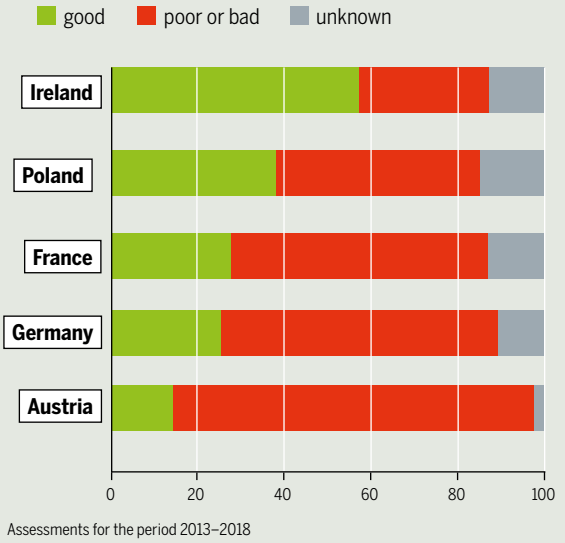
Factors like the amount applied per acre or other unit and the persistence of pesticide residues in water or soils shed light on how certain pesticides cause adverse effects on nature. In addition, efficacy should not be underestimated: Highly effective pesticides can have the same hazard potential as older substances in higher doses. For this reason, European civil society organizations are not only calling for a reduction in the amount used, but also for a ban on particularly harmful pesticides. ●

The use of organic management practices in field cropping has big effects on floral biodiversity: on longstanding organic farms it is 17 times higher compared to conventional fields

The EU did not meet its latest target to improve the situation of protected species. More than two-thirds of species assessments result in a concerning conservation status

UNPRECENTED DECLINE

Conservation status of species, by member state level, in percent



Assessments for the period 2013–2018

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BENEFICIAL INSECTS

NATURE'S LITTLE HELPER

Insects such as ladybugs or predatory wasps act as natural enemies against pests and as effective plant protectors. They are good for the environment and help cutting costs – but their habitats are under threat from pesticide use.

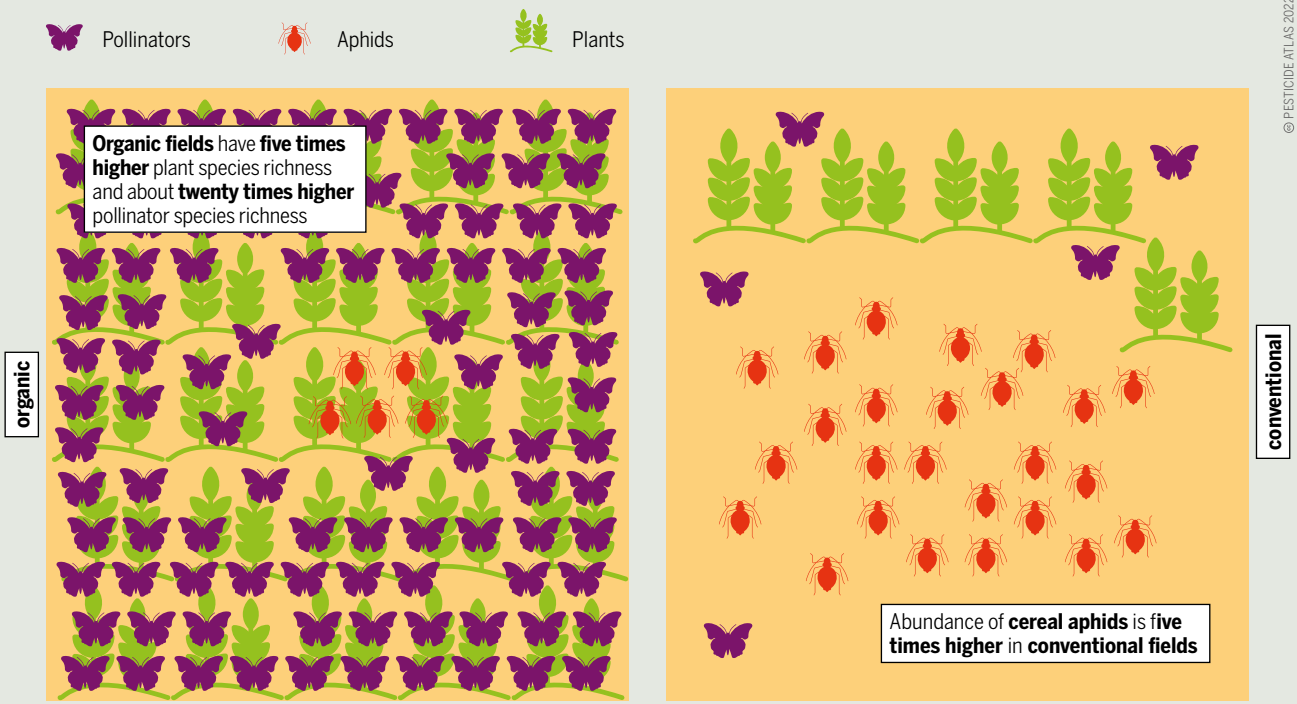
In agriculture, beneficial insects are the natural enemies of pests. Beneficial organisms can also be tiny organisms such as bacteria or fungi including miniscule filamentous fungi of the genus Trichoderma, which are naturally found in soil everywhere. Trichoderma are used as pest control in agriculture on pathogenic fungi due to their ability to parasitize them. Studies found that Trichoderma are also capable of controlling insect pests directly through the production of insecticidal metabolites; as well as indirectly through the activation of systemic plant defensive responses, attracting natural enemies or the parasitism of symbiotic microorganisms. But not only fungi also mites, insects, spiders or birds can protect crops. In Israel and the US, barn owls are introduced in agricultural areas to successfully reduce mouse populations in fields. To be able to reduce the use of pesticides in agriculture, the development of new efficient and safe alternatives are required – and smaller organisms are of particular importance. They either eat the pests directly – or parasitize them by laying their own eggs into the pests.

There are diverse types of beneficial insects: Some specialize in controlling specific pest species, while others eat many different species. Aphids, for example, can be successfully controlled by lacewings, hover flies, or earwigs. Ladybugs are probably the most well-known beneficial insects used against insect pests. Their larvae are voracious predators and will feed on aphids and other small insects like cereal chafers, canola gloss beetles, whiteflies, and Colorado potato beetles. A single ladybug can eat about 50 aphids a day – and about 40,000 aphids in its entire life. There are various species of such bugs or flies preying on parasitic pests. The green lacewing larva for example eats up to 500 aphids in its two to three-week life span.

Plant and pollinator species richness is higher at field margins compared to the center of fields. Pesticide use deteriorates biodiversity in both areas

PESTICIDES MAKE THE DIFFERENCE

Biological diversity in organic cereal fields and in conventional crop fields



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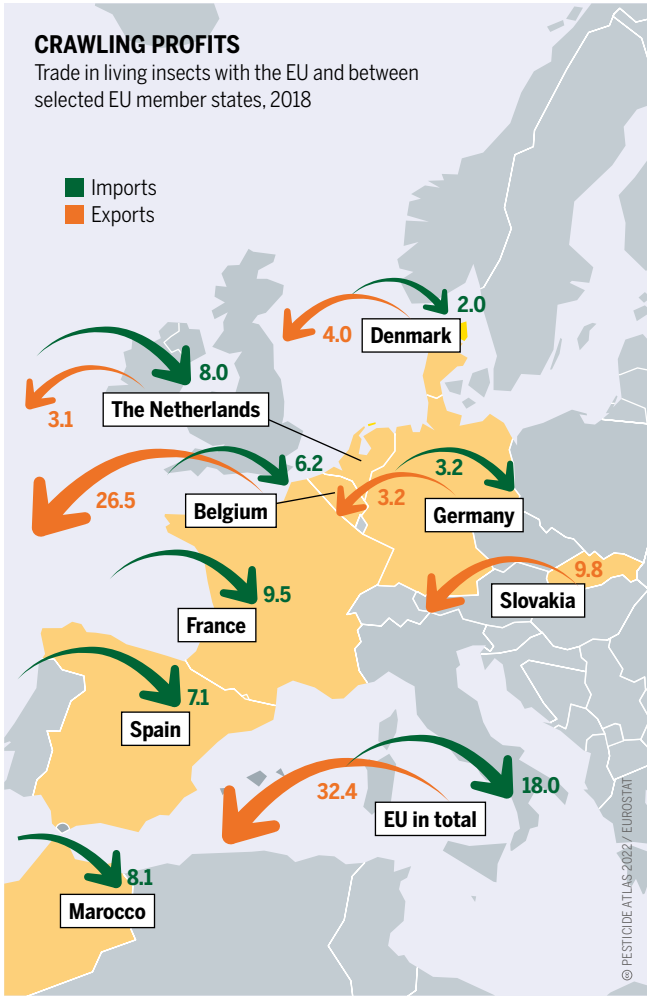
30 fields in Upper Franconia, Germany, were compared in this study from 2011: 15 organic fields (cultivated under the EU regulation 2092/91 based on a prohibition of inorganic fertilizers and pesticide application) and 15 conventional fields (treated with herbicides and inorganic fertilizers)



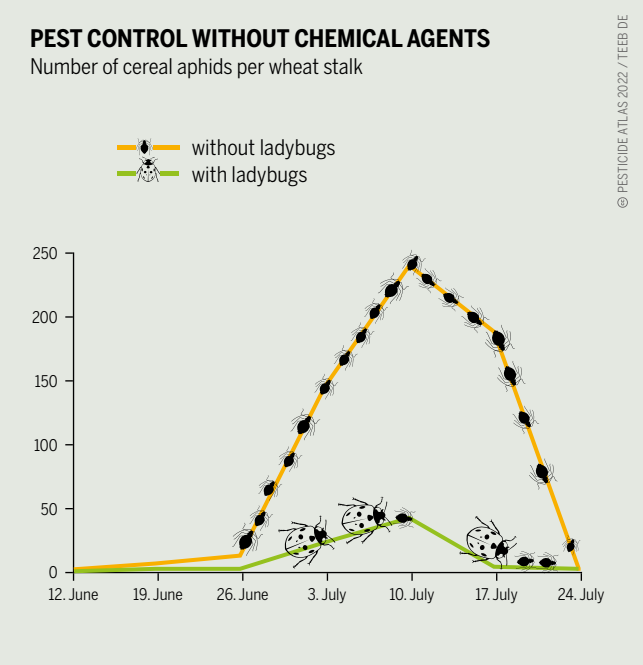
Ecosystem services that insects provide, such as pollination or pest control, account for 12 percent annually of the EU agricultural sectors' profits. As a commodity traded all over the world they are valuable as well

Currently, there are various options to buy commercially bred native beneficial insects. In open fields, in greenhouses, or in storage, customers can use them as a biological alternative to pesticides. For example, ichneumon wasps can be deployed against greenhouse whiteflies infesting vegetable plants such as beans, cucumbers and tomatoes. In grain storage, wheat weevils in particular are a major problem. Starting from a small initial infestation with a few beetles, uncounted offspring can develop within a short time that destroys the grain – ichneumon wasps are particularly suitable for their control.

However, it is not enough to just apply beneficial insects in the fields themselves. They must also find good living conditions throughout the agricultural landscape. Hedges and trees, cairns or dry stone walls provide space to breed and survive the winter. Fallows, strips of old grass, or flowering areas are also effective refuges. A study from England shows that flowering understoreys below apple trees support significantly more natural enemies like spiders and earwigs as well as fewer aphid colonies, fewer aphid-damaged fruits, and higher pollinator visitation – compared to those above mown understories early in the season. As a result, aphid colonies can be reduced naturally and apple crops are protected in an ecological manner. In order to ensure a good living environment for beneficial insects, fields should not be too large, but should be interspersed with hedges or flower strips, and bordered by varied field margins. This can provide an effective population of beneficial insects on crop land.

Significant presence of beneficial insects can reduce the need for expensive pesticides and working hours for farmers. Scientists estimate that the annual value of natural enemies of insect pests contribute to crop protection in the United States to the tune of 4,5 billion US dollars. Large-scale ecological enhancement of agricultural landscapes would make it possible to naturally reduce the number of pests and secure yields. However, currently beneficial insects are having a challenging time in most agricultural areas. A form of agriculture has long since emerged that is largely decoupled from natural regulation: Large-scale cultivation of only a few crop species in hardly varied crop rotations leads to increasing pesticide use to the detriment of natural helpers of pest control. This creates a vicious cycle: A decreasing number of beneficial insects results in increasing pesticide use, which further reduces beneficial insects, which in turn increases pesticide use. Policymakers on all levels are called upon to create economic incentives for organic farming and to define an ecological damage threshold. This damage threshold should take into account not only the economic but also the ecological follow-up costs of pesticide use – such as the damage to beneficial insects. Civil society organizations, science and environmental authorities are calling for agricultural landscapes and land management to be designed in such a way that native beneficial insects find sufficient and safe habitat. ●

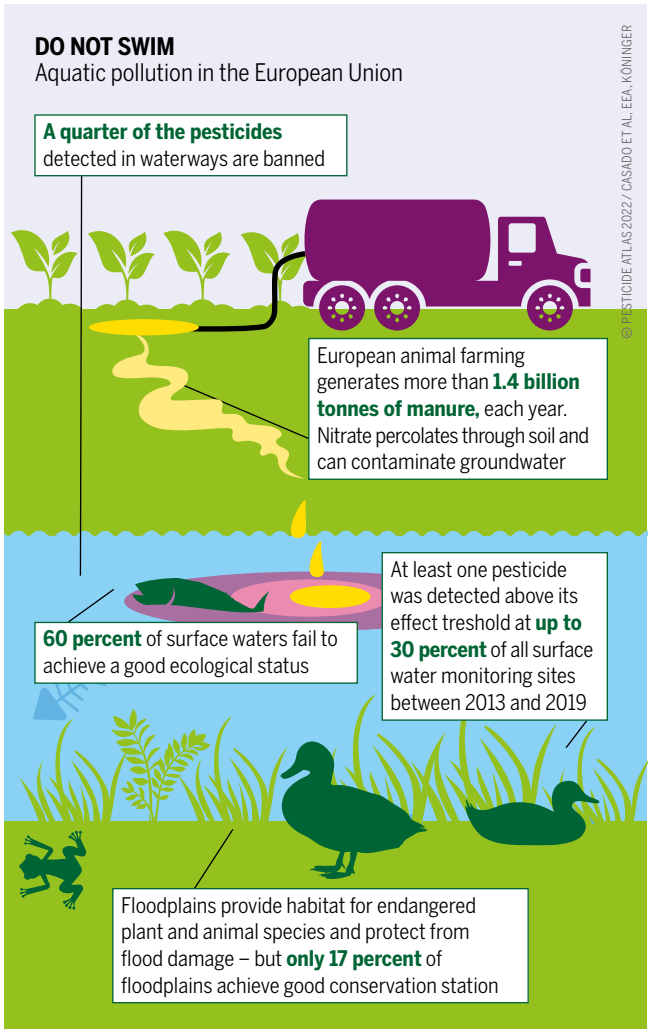
Ladybugs eat aphids, but pesticides kill these beneficial insects – agrochemicals contribute to the comeback of harmful insects. Pesticides kill these beneficial insects



GO WITH THE FLOW

Studies regularly reveal how pesticides contaminate rivers, lakes, coastal waters and groundwater. The pollutants often originate in agriculture and enter surface water via infiltration, surface runoff and drift.

Mixtures of chemicals such as pesticides, biocides, pharmaceuticals and industrial chemicals have been detected in rivers, lakes, and other surface water all over Europe. These pollutions affect the living conditions of aquatic organisms and the general ecological status of water bodies in Europe. Stressors such as climate and land use change or water scarcity make the situation worse. In other parts of the world such as China or South Africa the water quality of rivers, lakes, and groundwater is even more threatened by pesticides. There, pollution has particularly far-reaching consequences because there is less overall availability of freshwater and the water bodies harbour a great deal of biodiversity.



With regards to water pollution by pesticides, one figure in the European approval process is particularly meaningful: the regulatory acceptable concentration (RAC) per active ingredient. The assumption is that the harmful effects of pesticides on aquatic life are low as long as this concentration is not exceeded in the water. Despite this requirement, small streams, which make up a large proportion of European watercourses, are regularly contaminated with pesticides, according to environmental monitoring. They are often located in the middle of agricultural land and thus particularly exposed to pesticides, as a recently published study by the Helmholtz-Centre for Environmental Research together with the German Environment Agency proved.

A study by the European Environmental Agency shows that levels of pesticides exceeding national thresholds were measured in up to one-third of all reported monitoring sites in European surface waters from 2013 to 2019. The pesticides that most often exceed thresholds are the insecticides imidacloprid and malathion, and the herbicides metolachlor and metazachlor.

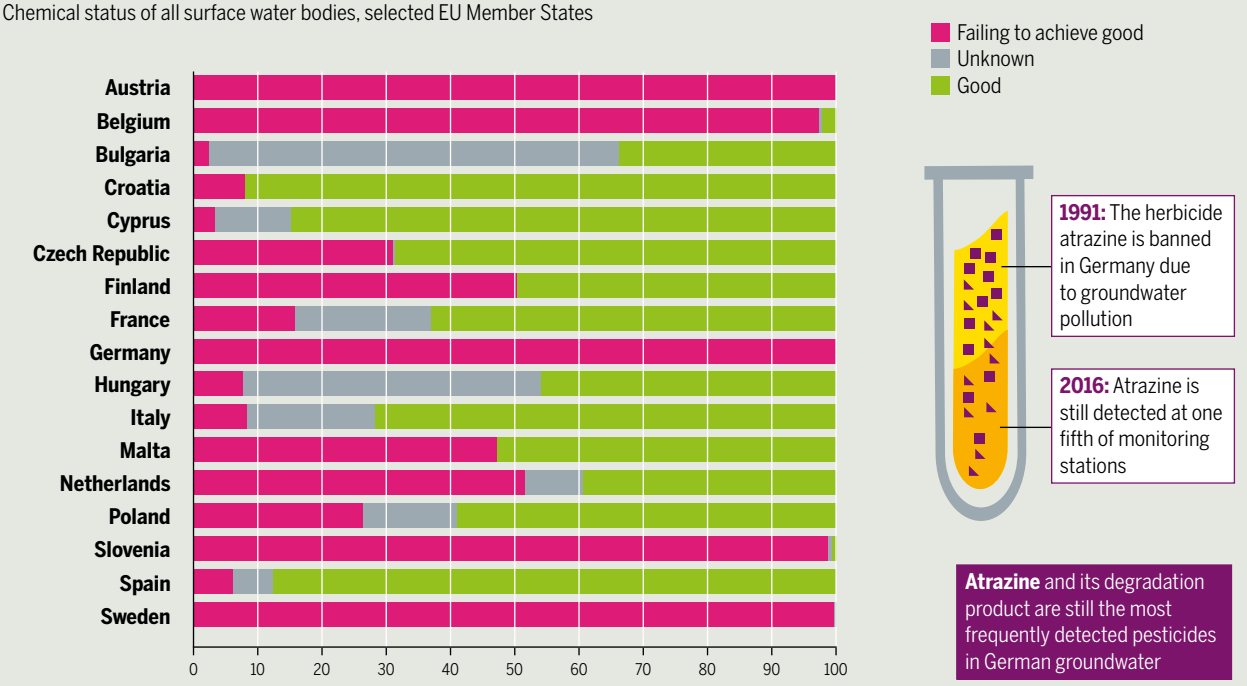
At global scale, the situation is even more alarming. A study from scientists from a German University provides a comprehensive meta-analysis of 838 peer-reviewed studies that evaluates the exposure of surface waters to insecticides. Among the 11,300 insecticide concentrations detected, more than half exceeded their threshold levels – so the biological integrity of global water resources is under substantial threat. Because residue analyses are too expensive for many local scientific institutes and there is a lack of national monitoring data in the Global South, one can assume that the figures would likely be even greater with more data. What is already clear, though, is that global chemical pollution levels have exceeded planetary boundaries.

It is certain that agricultural pesticides are a crucial environmental stressor for insects in small water bodies. Studies show that in polluted streams in Germany, populations of sensitive species such as dragonflies and caddisflies decrease significantly. But not only small streams are at risk: Pesticides ultimately end up in the sea via rivers. Environmental experts have been studying the presence of pesticides in harbor seals and other marine mammals in the EU LIFE APEX project. The results show that the pesticides that are particularly problematic are those that persist for long periods of time in the environment and can accumulate and pass from one species to the next through the food chain. One example is hexachlorobenzene (HCB). This pesticide, which was originally used as fungicide, has

Many factors contribute to the bad ecological status of water bodies. Exceeded legal limits on pesticides concentration are one of them. In Germany's small water bodies for example, 81 percent of all monitoring stations showed levels above the limit

INFILTRATED ENVIRONMENT

Chemical status of all surface water bodies, selected EU Member States



Study from 2018

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been banned in European agriculture for 40 years. And yet dolphins, porpoises and seals in European seas are still heavily contaminated today.

Through rain infiltration or leaching, pesticides move into the ground water, where they degrade slowly. A study in Germany detected active ingredients at almost one third of the monitoring sites. Degradation products were found at even 58 percent of the monitoring sites. In Italy, about one third of the groundwater bodies investigated showed pollution by pesticides. Frequently detected pesticide compounds in surface water and groundwater include glyphosate and its degradation product AMPA. A mandatory threshold also for degradation products would allow better regulation – so far there are only non-binding recommendations. Another important measure that could protect water bodies from pesticides is establishing continuous riparian buffer zones, which additionally provide an important habitat for plants and migration corridors for animals. Such riparian buffers in which the use of pesticides is prohibited are mandatory only in a few countries. In many regions of the Global South they are practically not feasible at all, as the agricultural area is often smaller than the required width of the riparian buffer zone.

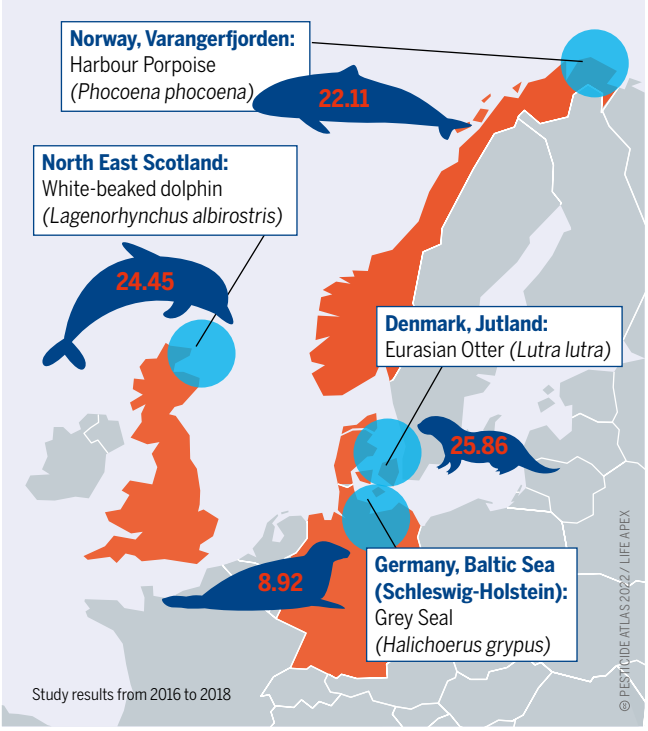
Environmental experts point to the need of an agricultural turnaround: A comprehensive reduction of pesticide pollution of water can only succeed through restructuring conventional agriculture towards less use of chemical pesticides. Protecting soils and improving their quality could prevent erosion which in turn reduces the runoff of pesticides.

Active ingredients banned due to their hazardous properties stay a long-term problem – even long after their ban

According to the European Environment Agency, many lakes, streams, transitional and coastal waters are not in good ecological status. And even groundwater is polluted

LONG LASTING IMPACTS ON MARINE INHABITANTS

Contamination of mammals with the fungicide Hexachlorbenzene (HCB) banned in 1981, in nanogram per gram wet weight



Study results from 2016 to 2018

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LONG-RANGE TRANSPORT

GONE WITH THE WIND

Pesticides rarely stay in the place where they have been applied. Wind can move dust, particles, and droplets to residential areas close to agricultural land – or carry it to places many kilometres away. Approval processes are largely ignoring this problem.

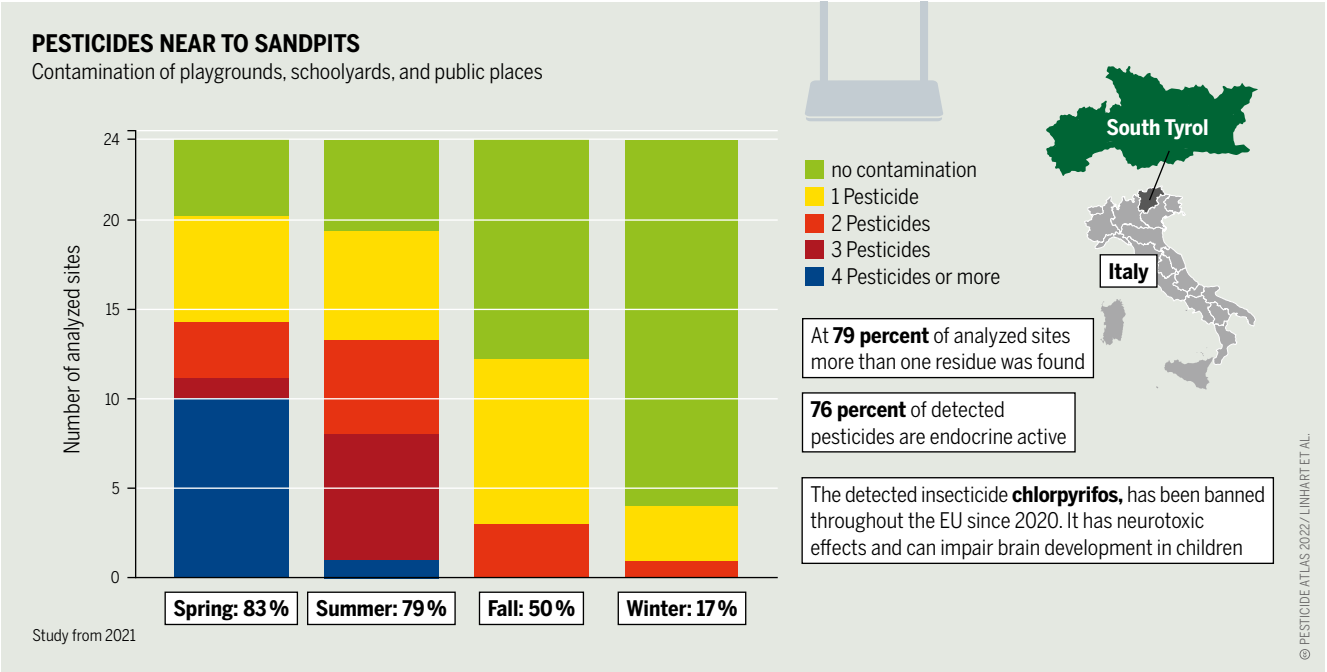
When pesticides are applied with spray nozzles, droplets or mist can be blown by the wind onto neighboring land. This phenomenon is called pesticide drift. Incorrectly adjusted and inappropriate nozzles or excessive speed of the spray vehicle intensify the effect. Active ingredients may also travel much longer distances, from a few hundred metres to over 1,000 kilometres. This is called "long-range transport". Active ingredients can rise into the air; because of ground warming, evaporation or adhering to tiny dust particles being blown up by the wind from uppermost soil layers. In this case, air currents distribute small suspended particles – so-called aerosols – in all directions. Cooling and rain cause them to sink back to the ground. They can end up almost everywhere: in nature reserves, in city parks and in human lungs.

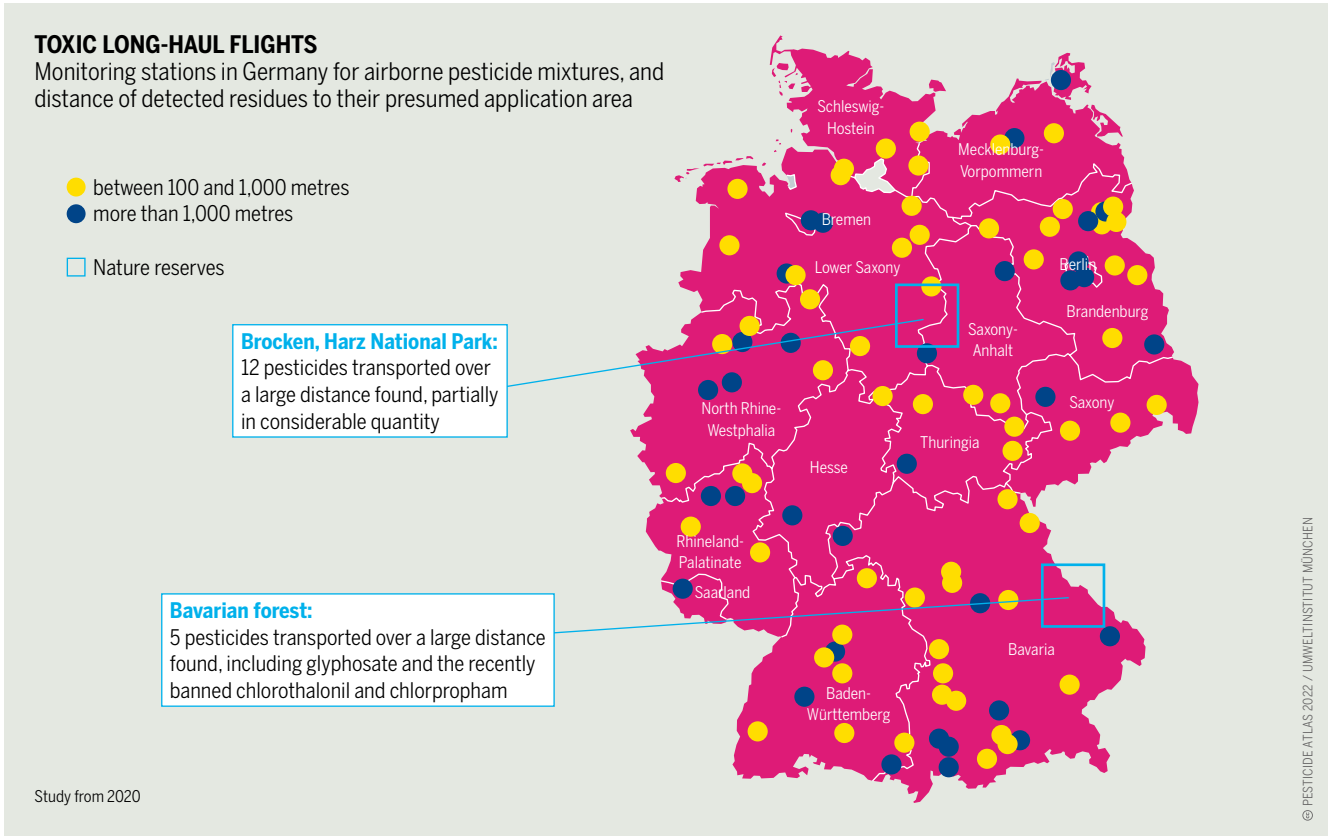
The possibility of long-distance transport of pesticides has long been known. As early as 1999, a study collection drew attention to the fact that 30 pesticides were found throughout Europe, in some cases at measuring points far away from where they were applied. For a study published in 2020, two German NGOs (Bündnis für eine enkeltaugliche Landwirtschaft and Umweltinstitut München) examined pesticide contamination of air. At 163 sites throughout Germany – including protected areas, cities and organic fields – traces of 138 pesticides were detected.

30 percent of the substances found are not or no longer permitted in Germany, for example DDT, a long-lived organic compound that is difficult to degrade and prohibited in most western countries since decades. Cocktails of 5 up to 34 pesticides and their degradants were found at three quarters of the sites. Glyphosate, the most widely used herbicide in the world, was detected at all sites that were equipped with technical filters. This is significant because it disproves the assumption that glyphosate does not spread through the air – glyphosate and all its salts are considered non-volatile, which is why the European Food Safety Authority (EFSA) has so far ruled out the possibility of long-range glyphosate transport.

Another 2020 study examined airborne pesticide concentrations at 50 sites across France over a 12-months period. Glyphosate was detected at 80 percent of the sites investigated. This is further evidence for large distance transport of glyphosate through the air. The fact that long-range transport and drift occur worldwide is demonstrated by other recent studies. To assess possible contamination of non-target areas in South Tyrol, 71 grass samples of public playgrounds and schoolyards located next to intensively managed apple and wine orchards were examined. At least one pesticide and sometimes even pesticide cocktails were detected in 96 percent of the samples. The majority of the

Residue data were analyzed from grass samples by an international research group. They found endocrine active substances – some of them are suspected human carcinogens





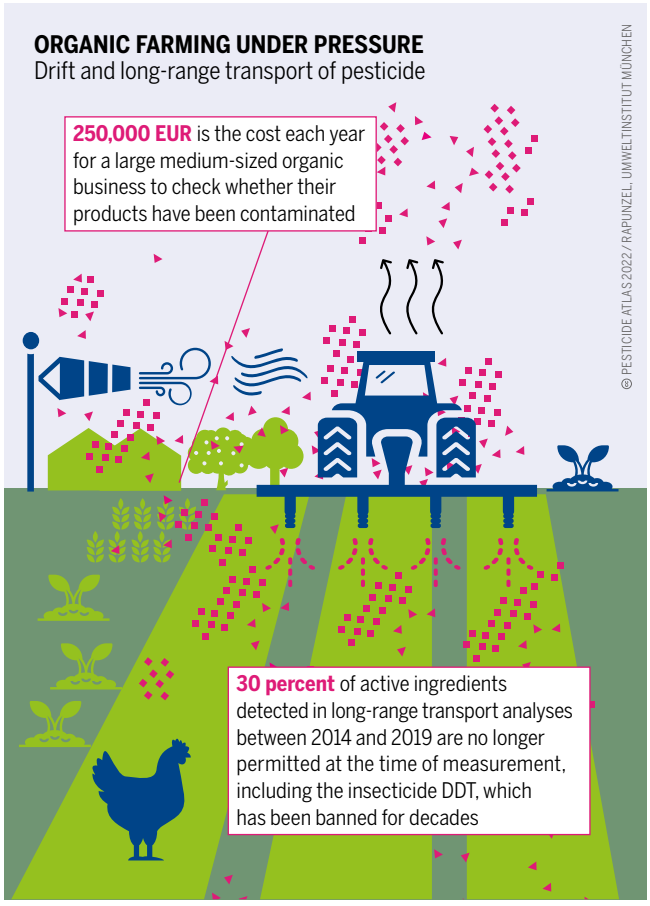
detected pesticides are classified as endocrine disruptors, which can affect the health of humans and animals, even in miniscule amounts. Another example from the USA shows air pollution probably caused by pesticide drift. According to a 2021 study, more than one million acres of soybeans and at least 160,000 acres of a conservation area were affected by exposure to the herbicide dicamba from adjacent agricultural fields.

For years, civil society organizations in South Africa and other countries have been advocating for mandatory buffer zones as a risk mitigation measure. A new measure was also imposed in France to protect residential areas from drift of hazardous pesticides – farmers must respect now a buffer zone of 20 metres.

A national air monitoring program of pesticides exists only in Sweden. And in approval processes for pesticides and active ingredients, little attention is paid to the phenomenon. The risk of a possible long-range transport is only estimated theoretically. A verification of the contamination in practice, however, does not take place.

The estimated amount of pesticides that people can consume on a daily basis without any immediate risk to health is only based on digestive tract absorption and only for a single active ingredient at a time. In contrast, pesticide exposure through drift and long range transport takes place primarily through the respiratory tract – and the long term effects of pesticide cocktails entering the human body through the lungs are still largely unknown. ●

Air quality under threat: A cocktail of five to 34 pesticides was found at 75 percent of all monitoring stations



Organic farms that forgo pesticides are under threat from volatile substances – wind carries them onto organic fields and this can threaten their business

INSECT DECLINE

AN ECOLOGICAL ARMAGEDDON

Insects provide pollination services to flowering plants, control pests, and ensure abundant harvests. For a long time their populations have declined dramatically – causing disaster for humans and nature. Pesticides are considered a major reason for the decline.

Insect populations have declined sharply in recent decades. These downturns are of direct concern to humankind as we rely upon insects to deliver vital 'ecosystem services' such as pollination, recycling of nutrients and pest control. A review by the University of Sydney in 2018 compiled information from research studies in various regions. It found that the populations of 41 percent of species are in decline, and one-third of all insect species are threatened by extinction. While cautioning that the available evidence was relatively thin, the researchers estimated that total insect biomass is declining by 2.5 percent a year. Most of the research studies they included in their review came from Europe, some from North America and only a few from Asia, Africa or Latin America. Some examples: UK butterfly populations have fallen by about 50 percent since 1976, the biomass of flying insects in German nature reserves declined by 76 percent in the 27 years to 2016. In North America, populations of the Eastern monarch butterfly have fallen by 80 percent in 30 years, and in the Netherlands numbers of caddis flies fell by 60 percent between 2006 and 2016. There are many data gaps, particularly for tropical regions, but the evidence suggests that insect declines are a global phenomenon, and that they are ongoing.

There is broad agreement amongst scientists that insect declines are driven by a range of factors, including habitat destruction, climate crisis, light pollution, increasing fertilizer use, and the impacts of invasive species. Pesticides play a key role as well. Impacts of pesticides on insect populations have been examined in most detail for butterflies, a group of insects for which exists relatively good population data. For example, organic farms have been found to have more butterflies than non-organic neighbors, and pesticide-treated gardens had about half as many butterfly species as untreated ones. Use of neonicotinoid insecticides in particular have been found to correlate with patterns of butterfly decline, in both UK and California. However, it is not possible to accurately specify to which extent the decline is linked to the use of pesticides, not least because habitat loss, farming intensification and pesticide use are all strongly correlated with another.

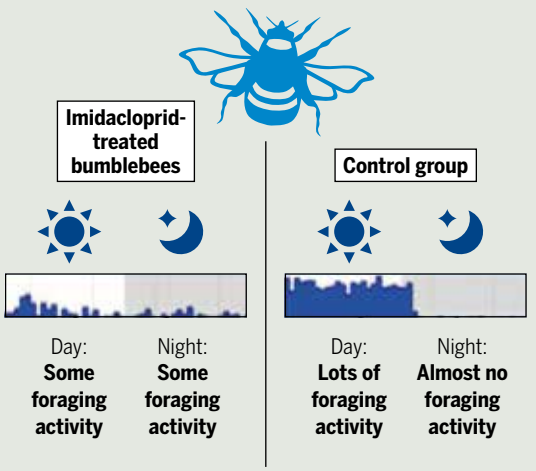
The impacts of pesticides on the environment were first highlighted in 1962 by Rachel Carson in her book Silent Spring, which drew attention to the problems being caused by the extensive use of early insecticides such as DDT (dichlorodiphenyltrichloroethane) and organophosphates. Although these early chemicals were eventually banned in most countries, they have been replaced with successive generations of new compounds, many of them much more toxic to insects. For example the neonicotinoid insecticides, introduced in the 1990s and now the most popular insecticides in use globally, are approximately 7,000 times more toxic to insects than DDT.

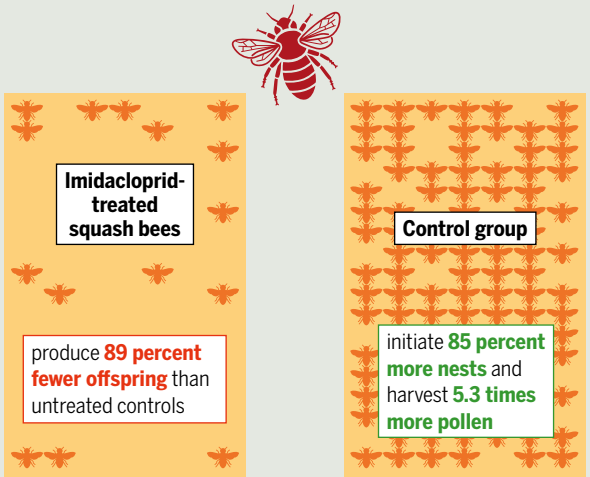
According to their effect different pesticides have a different impact on insects: Even though insecticides should protect plants from pests they harm all insects, both the pests and beneficial insects. Since pesticide applications

Neonicotinoids like Imidachloprid have been described as a worldwide threat to biodiversity – but some EU countries continue to use and export them

NO MORE BUZZING

Sublethal impacts of insecticides on bumblebees and squash bees





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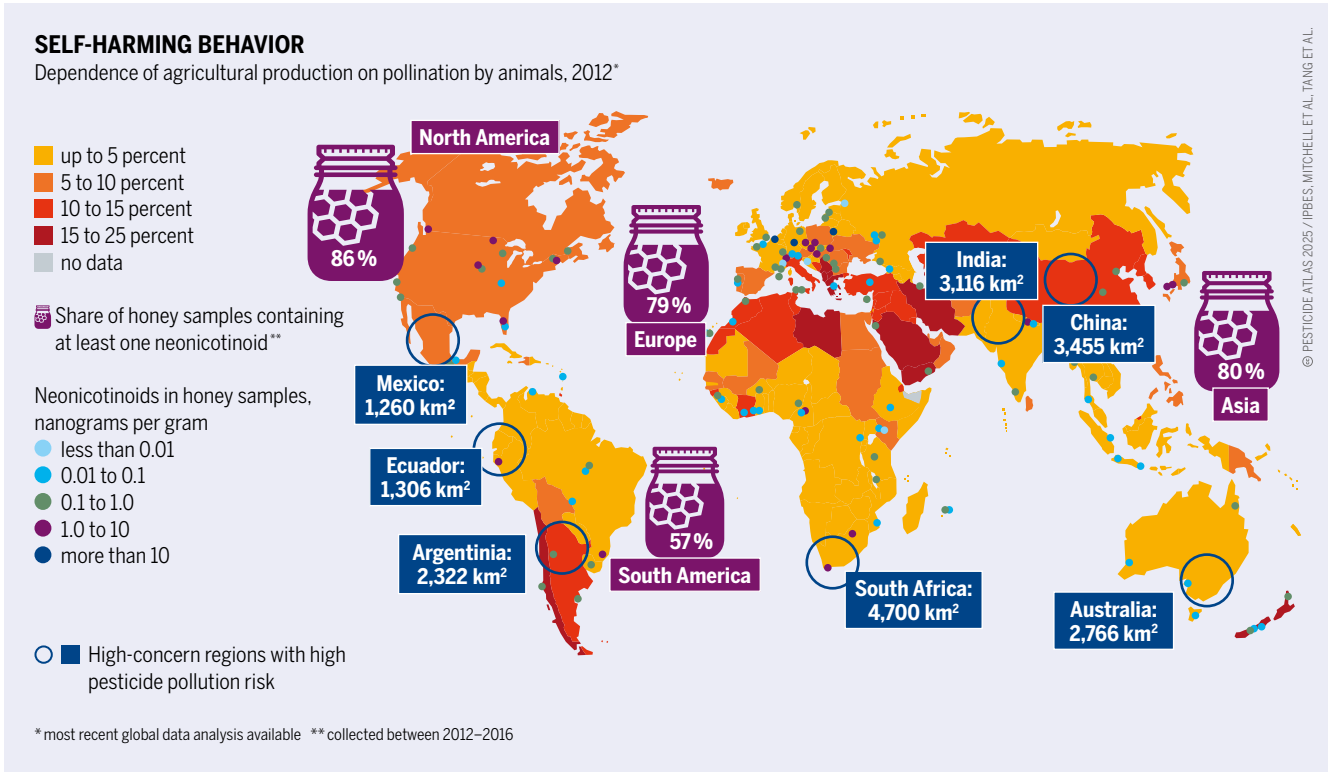


kill natural enemies of crop pests (insects such as ladybirds, hover flies and lacewings), populations of crop pests such as aphids often bounce back rapidly.

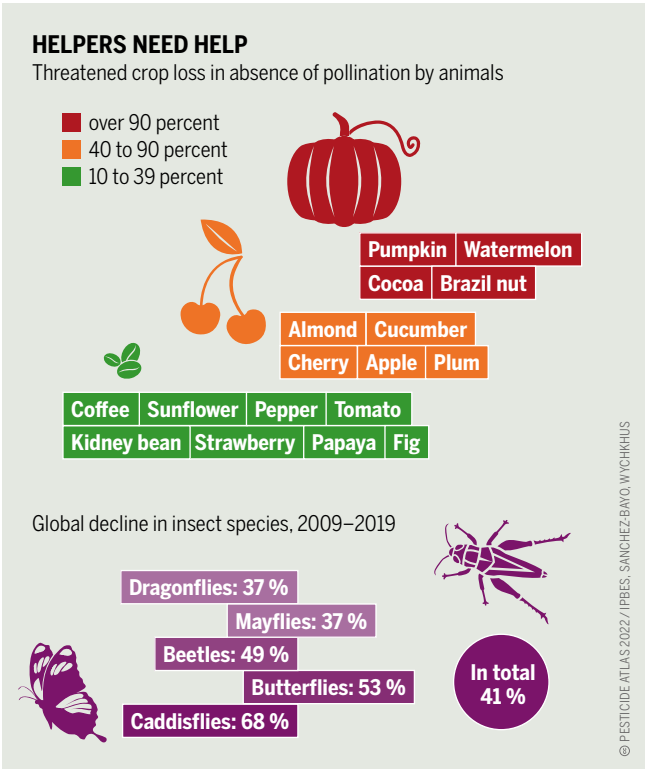
But also fungicides and herbicides are harmful to insects. For example some fungicides act synergistically with insecticides, rendering them more toxic if an insect is exposed to both at the same time. The herbicide glyphosate has recently been found to be harmful to bees, damaging their beneficial gut microbes and also affecting their learning abilities. Further, herbicides remove weeds such as wildflowers and foodplants which removes vital resources for insects for their larvae, thus indirectly impacting insect populations.

Systemic insecticides such as neonicotinoids contaminate soils and are taken up by the roots of wildflowers, so contaminating the nectar and pollen. Neonicotinoid insecticides have a range of sublethal impacts on bees, including impaired learning which interferes with communication and navigation; reduced immune function rendering them more susceptible to diseases; and reduced fecundity. A recent study found neonicotinoid insecticides in 75 percent of honey samples collected from around the world. Honey samples often contain not just neonicotinoids but a cocktail of ten or more pesticides, often including other insecticides, herbicides and fungicides. If honeybees are being exposed to these mixtures then it is very likely that thousands of other species of beneficial pollinating insects are also consuming them when they visit flowers. All these impacts are not taken into account enough in the regulatory process. Some negative impacts on pollinators are not even detected by regulatory studies. A progressive decline in insects threatens vital ecosystem services

Pesticides pose a threat to insects and to the economy: The pollination services provided by insects are worth 153 billion Euros per year

In absolute terms, the losses seem relatively limited. Many cereals are not dependent on pollination – unlike the majority of fruit and vegetable species from which we obtain vital vitamins and minerals

such as pollination, recycling, and biocontrol of pests, as well as removing a vital component of food webs, and ultimately endangers human wellbeing through the quality and quantity of our harvests. ●



HIGHLY HAZARDOUS PESTICIDES

A GLOBAL HUMAN RIGHTS CONCERN

Substances that are proven to present a particularly high level of acute or chronic risk to health or the environment are commonly referred to as Highly Hazardous Pesticides (HHPs). Far too rarely are these substances withdrawn from circulation – especially in the Global South they cause great harm.

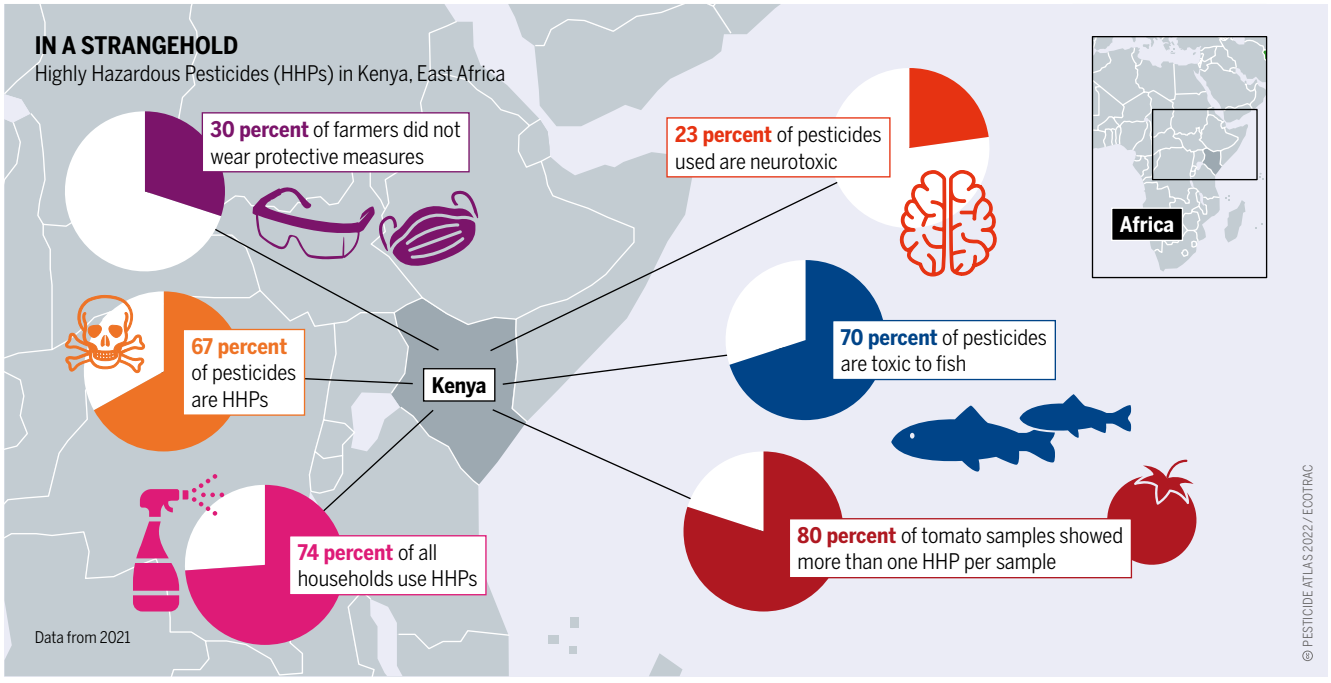
To identify HHPs, the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) have outlined eight criteria: Pesticides are considered to be highly hazardous if they have an acute lethal effect, cause cancer or genetic defects, impair fertility, or harm unborn children. Likewise pesticides are classified as highly hazardous if they cause serious or irreversible damage to health or the environment under normal conditions of use or are listed in internationally binding conventions like the Stockholm Convention on Persistent Organic Pollutants, the Rotterdam Convention, or the Montreal protocol.

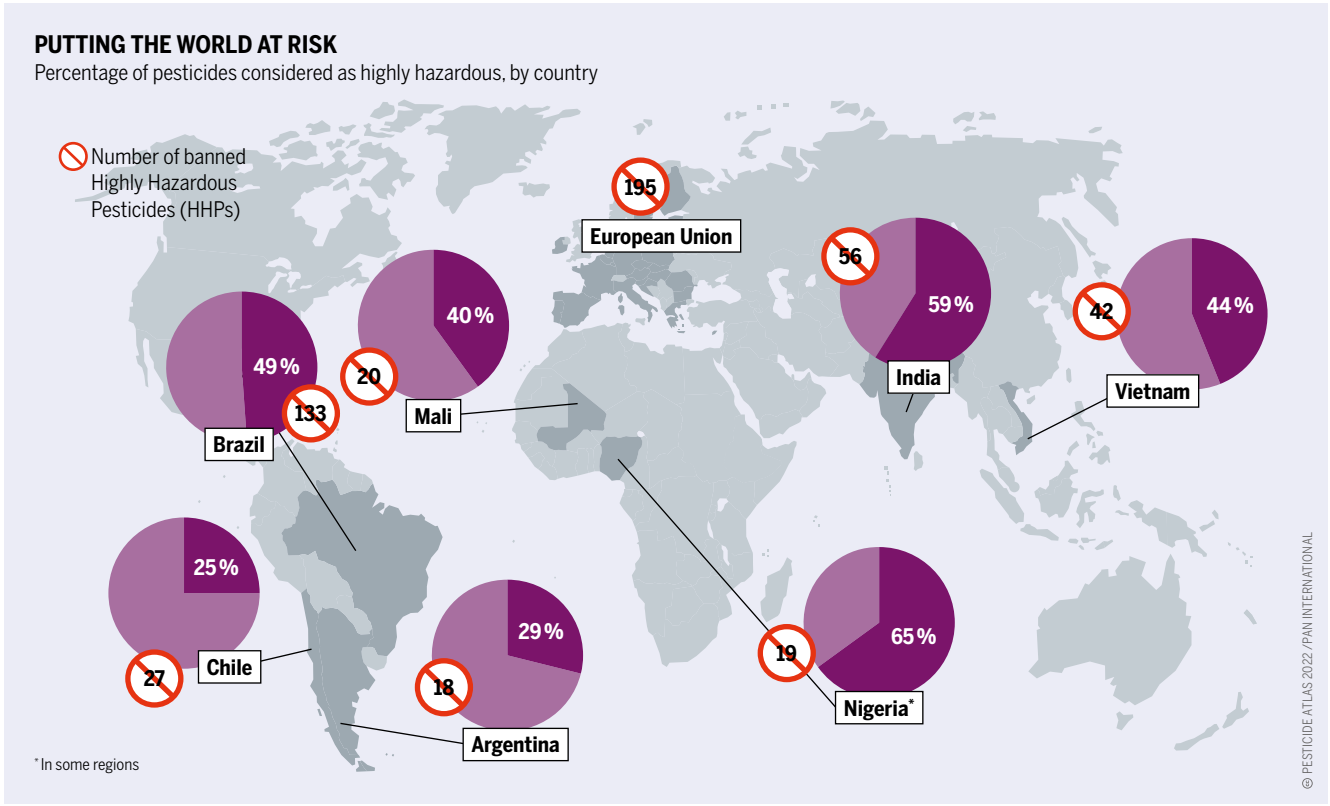
Although the FAO and WHO developed these criteria, they have not published an official list that includes all HHPs used worldwide yet. This makes it challenging for governments, agricultural extension agents, distributors, and appliers to identify and replace HHPs with less hazardous alternatives. The international Pesticide Action Network (PAN) has filled this gap and has published a periodically updated HHP list since 2009. It takes into account environmental criteria as well as additional human health impacts compared to WHO and FAO.

For years, studies have shown that HHPs cause great damage especially in countries in the Global South, and yet massive amounts of these specifically harmful pesticides are still applied to a vast extent there. In 2018, 40 percent of all pesticides used in Mali were highly hazardous, in Kenya 43 percent at the same time. In 2021, even 65 percent of all pesticides used in four states of Nigeria were highly hazardous. In Chile, one quarter of all 400 active ingredients registered were HHPs in 2019, and in Argentina as many as 126 out of a total of 433. The use of HHPs in agriculture is also widespread in Eastern Europe, the Caucasus and Central Asia. Investigations could show that between 2019 and 2021 more than 70 HHPs were used in Georgia, Kyrgyzstan and Ukraine, and as many as 95 in Armenia. Even though the EU has banned many HHPs, some specifically dangerous pesticides remain in use, even though they should be substituted according to EU regulations.

In many countries, the system of pesticide regulation is inadequate. Capacity with regards to quality and use control, advisory services and monitoring of pesticides are often insufficient or even entirely lacking. Many of the workers applying the pesticides are also poorly trained or not trained at all: The lack of safety trainings frequently leaves them unaware of the health hazards involved in handling pesticides. A lack of information about hazardous substances and difficulties in accessing disposal centers for empty pesticide containers impedes the return process. In some

Contaminated food, a large number of highly hazardous substances and hardly any means of protection: NGOs call such a situation a humanitarian catastrophe





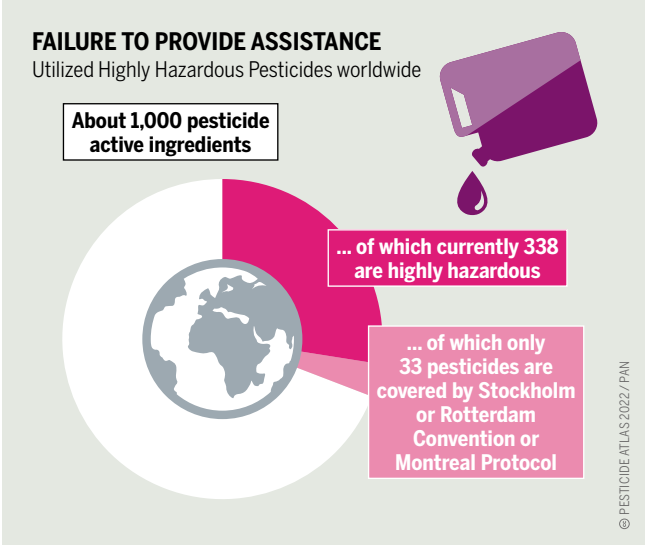
countries, disposal centers do not even exist. And in many cases there is not even access to personal protective equipment or hot climate makes wearing such impossible which creates additional problems. This results in a high number of injuries and deaths: 95 percent of 385 million people who suffer from unintended pesticide poisoning each year live in the countries of the Global South. United Nations experts have considered HHPs a global human rights concern for a long time: Pesticides threaten among others the right to live in dignity, the right to bodily integrity, and the right to a healthy environment. Also, pesticides are often applied disregarding mitigation measures like buffer zones to protect surface waters, or specific spraying times to protect pollinators, and even though these measures are practically not feasible in many regions, the pesticides still remain on the market.

Despite their dangers, using HHPs seems normal these days – but it does not have to be. Many regional projects in both the South and the North have demonstrated that agroecological farming practices are a viable alternative. However, this transformation can only succeed if governments and the international community set appropriate priorities. It is particularly important to raise awareness of the risks of pesticides and to push for the development of non-chemical alternatives. Key elements include research funding, and the collection and dissemination of information on viable alternatives to HHPs, ranging from ecological and cultural management measures to biological control measures and as a last resort a restrictive use of biopesticides.

There are criteria for identifying HHPs, but no international agreed convention or protocol addresses all of them. Not even 4 percent of all pesticides used globally are regulated by binding international conventions

Regulatory measures often correlate with the country's prosperity. Civil society organizations are calling for a global legally binding mechanism for the lifecycle management of pesticides

A progressive ban on HHPs was recommended by the FAO as early as 2006. Developing safer alternatives is the goal of the Strategic Approach to International Chemicals Management (SAICM), which aims to reduce the usage of Highly Hazardous Pesticides. Nevertheless, there is still no globally binding legal framework that addresses pesticides in their full scope – from production to use to disposal, and with strict deadlines for phasing out HHPs. ●



GENETIC ENGINEERING

MODIFIED CROPS, MORE PESTICIDES

Genetically modified crops were supposed to reduce the use of chemicals in agriculture, reduce workloads, and increase crop yields. These promises could not be kept.

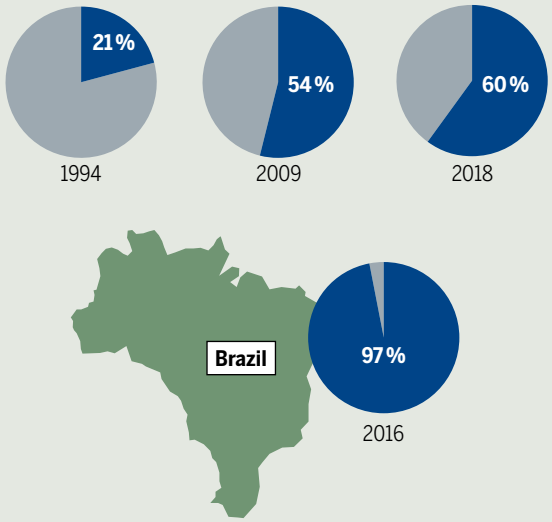
More often than any other substance, glyphosate has been at the center of many controversial debates about pesticides in recent years. In 2017, EU Member States had voted to extend the license for the herbicide for at least five years, despite cautionary voices and demonstrations in numerous countries. How does the herbicide actually work? In short: Glyphosate is applied to food and nonfood field crops such as soybeans and field maize. Glyphosate inhibits the EPSPS enzyme, which is required in plants for the production of vital amino acids. This interrupts the metabolism – and the plant dies. Genetically modified crops are protected against this interruption of the metabolism and can therefore continue to produce amino acids and survive despite sprays. For this reason a genetically modified soybean in its growth phase can be treated with glyphosate without being harmed – while all surrounding plants, that compete with it for water, space and nutrients, die. In times before genetic modification, competing plants usually had to be controlled either by pre-emergence herbicide application, by crop rotation or manual weeding.

Today, 74 percent of soybeans grown worldwide are genetically modified. The increased use of genetically modified organisms (GMO) has been associated with a massive increase in glyphosate use. From 1995 to 2014 the agricultural use of glyphosate in the US rose ninefold, reaching 113,000 tonnes per year – one-third of the total amount of herbicides applied. From 2012 to 2016 an average of approximately 127,000 tonnes of glyphosate were applied to 120 million hectares annually. Most glyphosate was applied to soybeans (53,000 tonnes), maize (43,000 tonnes) and cotton (9,000 tonnes). Globally, the total use

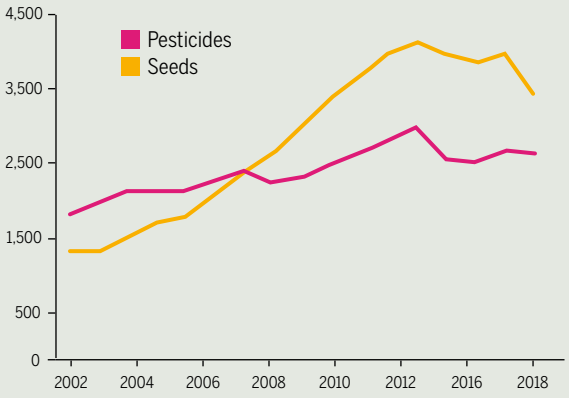
Investments and buyouts:
A few companies have taken over the market for seeds, especially in the Global South

BILLION-DOLLAR BUSINESS

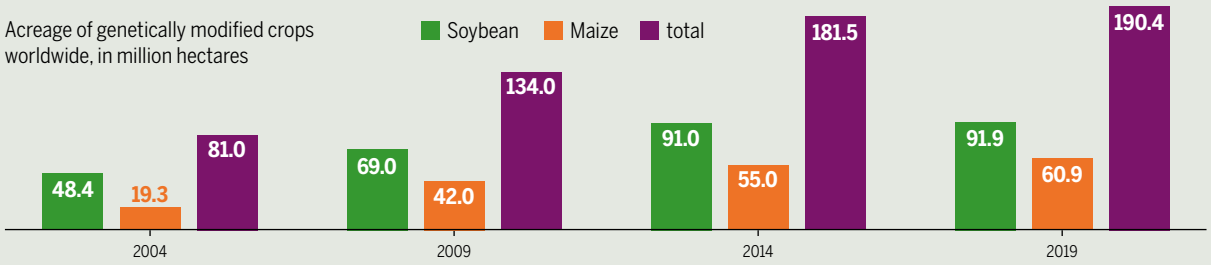
Market share of the four largest seed companies, worldwide and in Brazil



Research and development expenditure worldwide of the six largest companies between 2012 and 2018, in million US dollars



Acreage of genetically modified crops worldwide, in million hectares



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of glyphosate rose almost 15-fold, from 51,000 tonnes in 1995 to 747,000 tonnes in 2014. This increase correlates with the expanded cultivation of GM soy in Latin America. After its introduction in Argentina in 1996, the glyphosate volume there had doubled within just one decade. In Brazil, herbicide use in soybean cultivation tripled from 2002 to 2012 to 230,000 tonnes per year, mainly due to glyphosate. Despite the drastic increase in herbicide rates applied, yields per hectare increased by only about 10 percent. Brazil and Argentina are now among the countries with the highest herbicide consumption in the world, in third and fourth place globally after China and the USA.

Intensive use of glyphosate has led to the appearance of glyphosate-resistant weed species worldwide. First reports from Delaware, USA, made global headlines in the year 2000. They found that the Canadian horseweed could no longer be controlled with glyphosate. By 2012, herbicide resistant weeds have already spread across 25 million hectares of arable land in the United States. There are now 53 weed species that have developed glyphosate resistance, including amaranths in cotton and soybean crops. In order to combat such weeds less sensitive to glyphosate, farmers have increased glyphosate application rates and the use of other herbicides was intensified again as well.

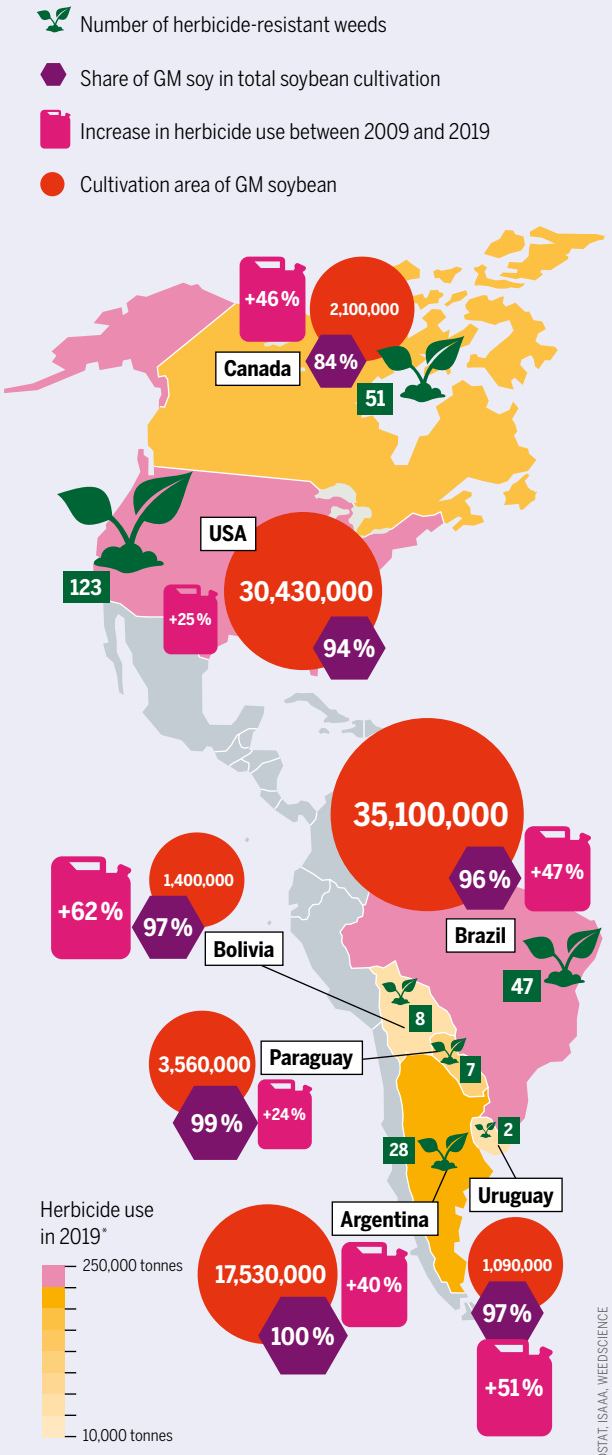
Another genetic modification intended to contribute to pesticide reduction was the insertion of specific DNA sequences into crop plants to enhance their resistance to insect pests: A gene transfer from the bacterium Bacillus thringiensis leads to the formation of proteins known as Bt toxins in the plants. Those proteins are lethal to several types of insects. Insect-resistant crops were cultivated in the mid-1990s for the first time, nowadays they make up 57 percent of all genetically modified crops grown around the globe, predominantly maize and cotton. The fact that plant-incorporated toxins in all parts of the plant act as insecticides throughout the entire vegetation period has consequences for the environment. For example, butterflies and other insects can be harmed. And just like the weeds in soybean cultivation, pests also develop resistance.

In the USA, specimens of the Western corn rootworm are already resistant to more than one Bt toxin. At the beginning of Bt crop cultivation, the number of pesticides used actually decreased. But only impermanently: Sales of insecticides in corn production in the US have increased significantly. In 2018, Indian farmers spent 37 percent more money per hectare on insecticides than before the introduction of genetically modified cotton in 2002. In addition, the cost of seed and fertilizer increased.

These complaints are not new: Already more than ten years ago, twenty civil society organizations from India, South Africa and all over the world stated in their declaration “A Global Citizens Report on the State of GMOs” that genetic engineering has failed to increase food crop yields but has vastly increased herbicide use and the growth of resistant weeds. While big companies gaining seed market control and pushing up prices, farmers have to go into debt. The high levels of indebtedness among farmers is, for example, thought to be behind many of the hundreds of thousands deaths by suicide of Indian farmers over the past years. ●

PATH COMPANION

Cultivation area of genetically modified soybean (GM soy) in North America and South America in 2019, in hectare



There has been a substantial increase in the usage of herbicides in soybean production. It appears to be linked to genetically modified beans

SMALLHOLDER FARMERS

NEW MARKETS, LESS REGULATION

In Africa, fewer pesticides are used than in other regions of the world. Nevertheless, the 33 million smallholders are increasingly becoming the focus of pesticide companies. There they also sell what has been banned in the European Union.

In 2015, the African agrochemical market was valued at about 2.1 billion US dollars. It accounts for only 2 to 4 percent of the global usage. According to the Food and Agriculture Organization of the United Nations (FAO), an average of 0.4 kilograms of pesticides were used per hectare of cultivated land in Africa in 2019. This is less than the 3.7 kilograms in North and South America. But the African market for pesticides is projected to witness high annual growth rates, for example in West Africa. Pesticide use increased there by 177 percent between 2005 and 2015. In the same period total pesticide imports into the region roughly tripled, with particularly rapid growth in the three largest agricultural markets – Ivory Coast, Ghana, and Nigeria. Coupled with population growth, and the need to improve productivity, pesticide companies are increasingly seeing the 33 million small farmers on the continent as an attractive market.

Major players in the African pesticide market are Adama Agricultural Solutions, Sumitomo Chemicals, UPL Limited, and Bayer AgroScience AG. Companies use specific selling strategies to unleash market potentials in African countries. In Kenya, for example, social media, local radio stations, and broadcasts in local dialects are some of the most used mediums for product advertising. The documentary film "The Food Challenge" shows that prior to the COVID-19 pandemic, dominant pesticide companies frequently sponsored agriculture trade shows.

Depending on the crop, capital availability, and geographic location, farmers use pesticides very differently. Field studies from Mozambique and Zambia show the widespread use of Highly Hazardous Pesticides (HHPs) – according to a Michigan State University study, 76 percent of farmers in Zambia and 87 percent in Mozambique use them.

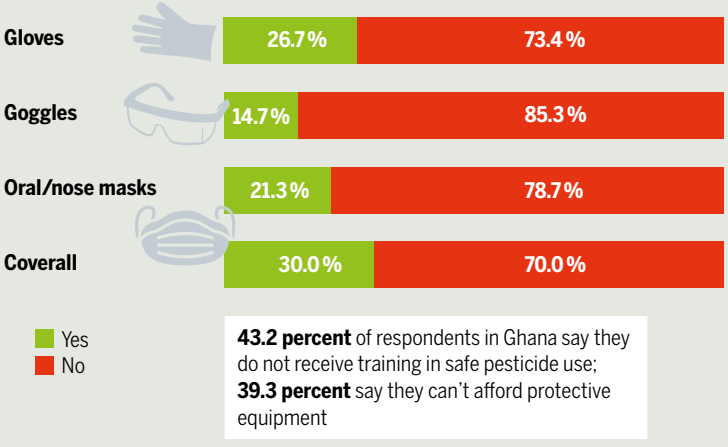
Small scale farmers and farm workers are particularly vulnerable when it comes to pesticide use. Mitigation measures are not practical because they are expensive or the farming context does not make risk management possible. In regions such as Africa, Asia and Latin America, smallholder farmers cannot afford proper backpack sprayers, masks, protective clothing, and gloves. In addition, buffer zones are not maintained because farm sizes are small and closely situated to each other and other homesteads. Pre-harvest intervals are often not known by the farmers or ignored because there is financial pressure to sell produce. Pesticides are also decanted from one container to another after they are bought from the agro-vet store, which means that instructions on how to use a product 'safely' have been removed. Civil society organizations blame weak regulations and the lack of information by industry for exposing farmers to these risks.

Further, different scientific studies show that pesticide markets in various African countries are not regulated in a way which protects farmers' health and the environment. Another problem is that rules, laws, approvals, and con-

Safety training is insufficient. A study published in 2020 found that 6.2 percent of small-scale farmers in Ghana mix agrochemicals with their bare hands, and 25 percent burn empty canisters

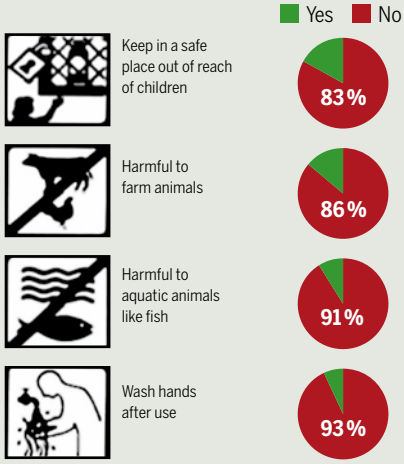
LEFT ALONE

Statements of smallholder farmers in Ghana about protective measures they use during pesticide application, 2020



43.2 percent of respondents in Ghana say they do not receive training in safe pesticide use; **39.3 percent** say they can't afford protective equipment

Statement of smallholder farmers in Ethiopia whether they know the meaning of pictograms on pesticide labels, 2015



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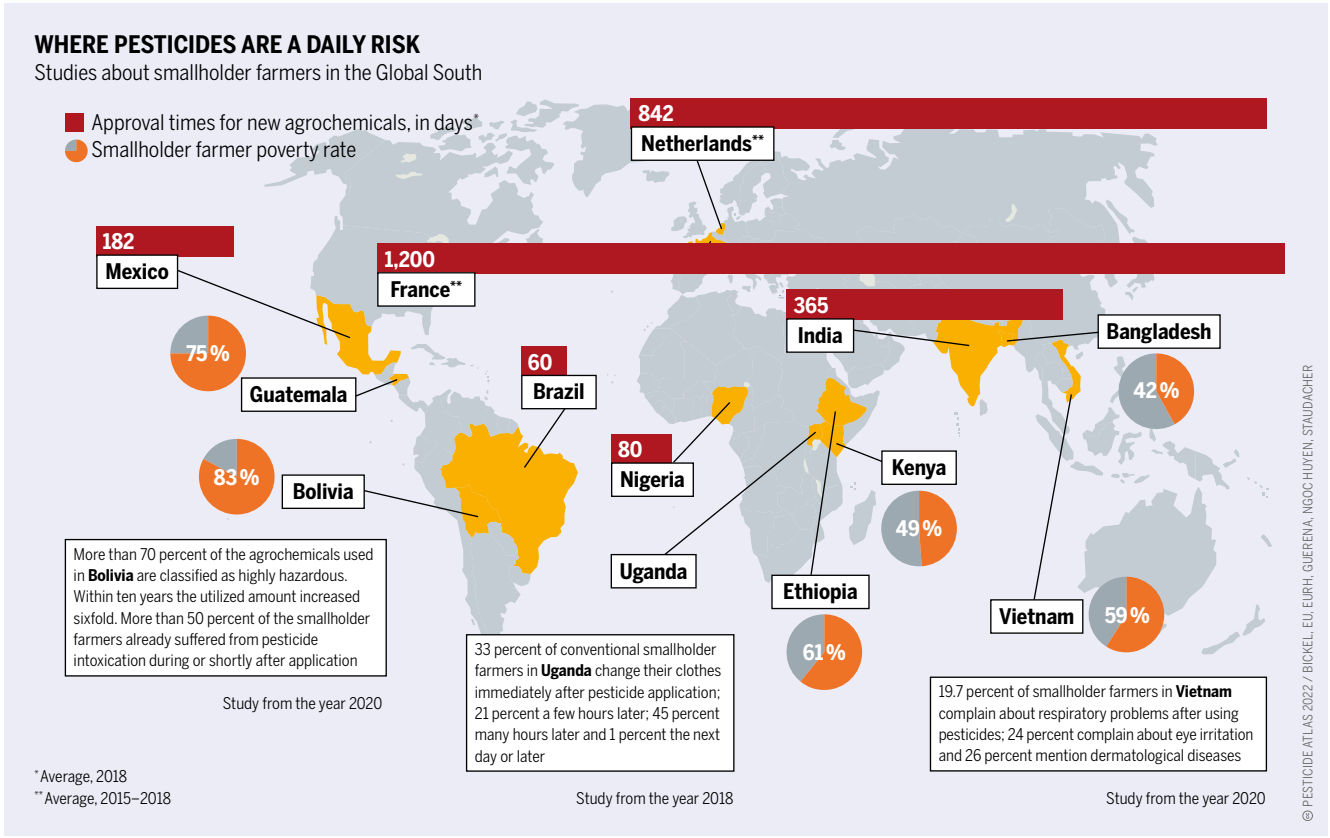


trols could not keep pace with the increasing demand for pesticides – that is why a lucrative market for cheap generic and illegal pesticides has developed. Industry and academic sources estimate that up to 20 percent of the African market, and as much as 34 percent the West African market, are illegally produced and traded. In extreme situations, that number exceeds 40 percent of pesticides. Empty packaging and canisters are also filled with counterfeit products and sold as originals – with serious risks for farmers and the environment.

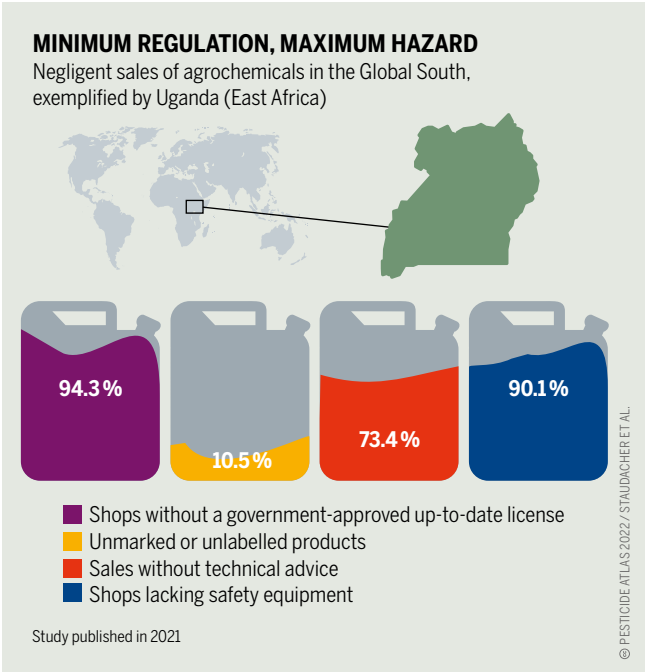
Civil society organizations are demanding stricter rules for pesticide market approval and authorisation informed by local data. They want governments to explore options to make regulatory risk data more transparent and accessible. Pesticide sales should be regulated and monitored accordingly, by independent authorities. Qualification criteria for agrovet sellers should be established and implemented.

Plant pathogens and pests are a major threat to the African farming sector, the incomes of producers and ultimately, achieving of the human right to food. Smart answers are needed to balance crop protection, which is necessary to ensure sufficient harvest, with human and environmental health: For example, investments in agroecological strategies and evidence-based knowledge sharing amongst farmers, experts, scientists, and policy makers. In some parts of the world this is already taking place. As a first step, organic farming has gained popularity for years.

NGOs criticize a lack of safety standards in low-income countries. In Uganda every fourth shop sells repackaged pesticides

Five in every six farms in the world consist of less than two hectares – which produce roughly 35 percent of the world's food. In most cases the farmers suffer from poverty

The organic acreage in the Middle East and in Africa is increasing as well. But these are only small steps on a long way. Even though scientists in the last years strongly point to the potentials of agroecological and organic farming methods these are still hardy supported by African governments. ●



IMPORTS AND EXPORTS

BANNED BUT SOLD ANYWAY

Many pesticides are banned in the European Union. It is illegal to use them in EU Member States, yet it is allowed to produce and export them to third countries – where they pose great risks to people and their environment.

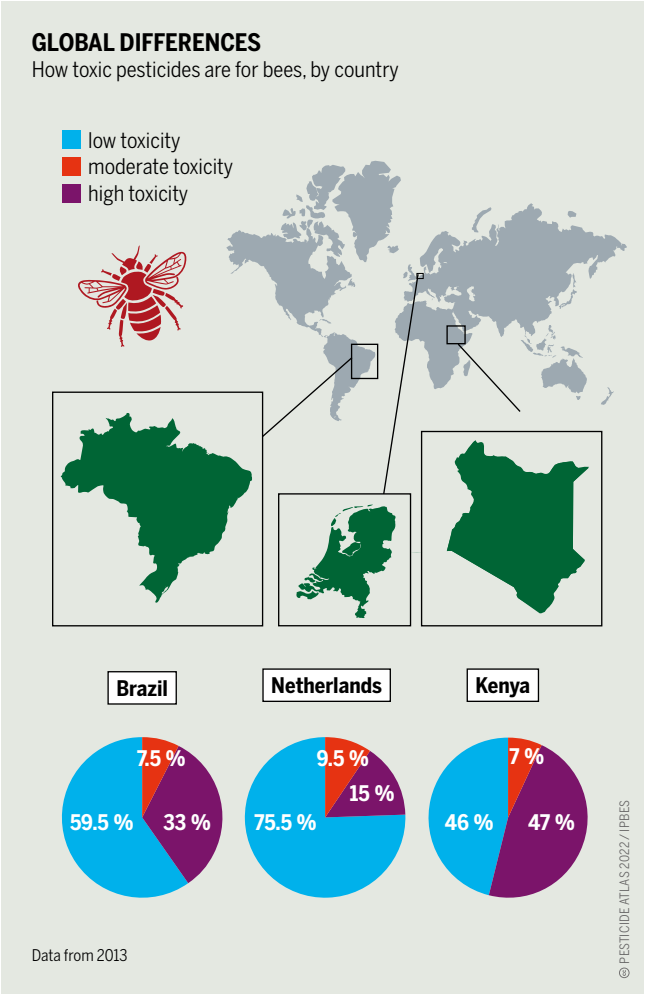
According to market forecasts, the number of pesticide exports to countries in the Southern Hemisphere will continue to grow. The five largest pesticide companies –including Bayer, BASF, and Syngenta – already generate more than one-third of their pesticide sales from active ingredients classified by the Pesticide Action Network (PAN) as highly hazardous. According to the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), Highly Hazardous Pesticides (HHPs) present particularly high levels of acute or chronic hazards to humans and the environment. For this reason, many of these pesticides are no longer authorized in the European Union.

However, European companies are still allowed to sell these pesticides – namely to countries outside the EU. This practice creates double standards. In 2018 and 2019, EU countries and the United Kingdom approved the export of a total of 140,908 tonnes of pesticides that are banned from being applied in European fields because of unacceptable health and environmental risks. Furthermore, European corporations like the German companies Bayer and BASF sell pesticide products locally in third countries with active ingredients banned in the EU. In South Africa and Brazil, they sold products containing at least 28 such active ingredients, according to a 2020 study. Some of the hazardous pesticides exported from Europe find their way back as residues in imported food. Residues of 74 pesticides banned in the EU were found in food tested on the European market in 2018 – 22 of which were exported from Europe that same year.

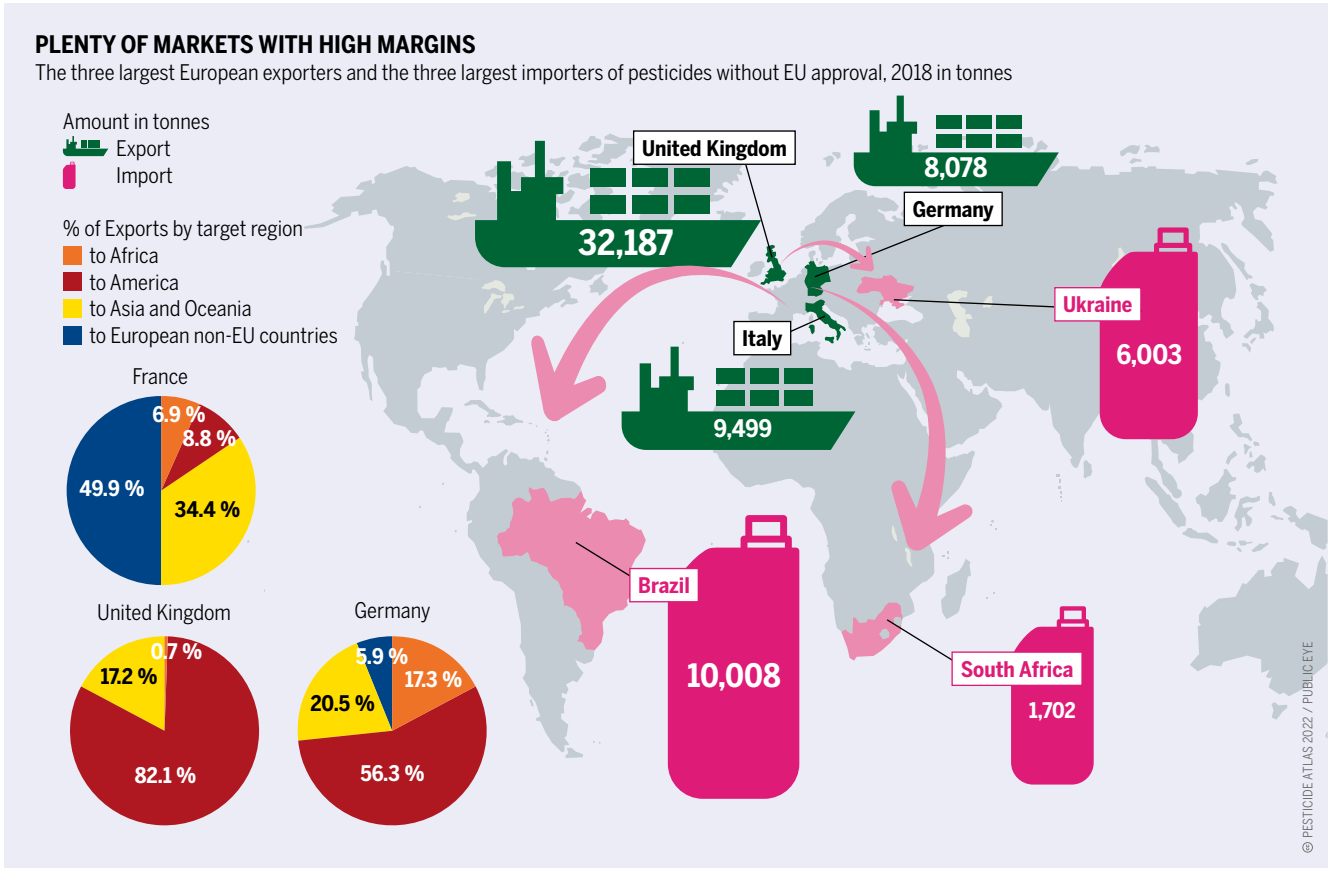
Brazil today is one of the largest consumers of pesticides in the world and imports most of the pesticide active ingredients from abroad, including from EU countries. In 2019 these included at least 14 highly hazardous active ingredients no longer approved in the EU. Among them were BASF's fipronil, which is highly toxic to bees, nerve damaging chlorpyrifos from Portugal's Ascenza Agro SA, as well as Germany's Alzchem AG's highly toxic cyanamide and Bayer's propineb, which damage sexual function and fertility.

A total of 230 active ingredients are registered in Kenya, including 51 that are no longer permitted in the EU, such as atrazine (Syngenta), trichlorfon (Bayer) and fipronil (BASF). 70 percent of the rural economy works in the agricultural sector. NGOs warn that farmers are increasingly using dangerous substances to grow food. Despite being banned in the EU, Kenyan imports in 2018 and 2019 included iprodiones and acetochlorines from Belgium and 1,3-dichloropropene from Spain. South Africa imported active substances such as imidacloprid, which is hazardous to bees, from Germany and France in 2021 and 2022.

The pesticide companies claim their products are safe and do not endanger humans, insects, or water bodies when handled properly. Proper handling often includes wearing personal protective equipment and adhering to specific application times, spraying distances, and guidelines for co-application with other substances. In reality, the prescribed application often cannot be guaranteed in the Global South, because applicants are inadequately trained or not trained at all, and insufficiently informed about health hazards and distance requirements when applying pesticides. Personal protective equipment is often difficult to obtain, too expensive, or it is simply not reasonable to wear due to high temperatures. Different studies also show that many users aren't able to read the instructions, either because they have a low level of school education or because the instructions are not written in the common languages of the



In the last quarter of 2020, Bayer and Syngenta announced exports of more than 3,800 tonnes of highly hazardous insecticides in third countries like Kenya and Brazil

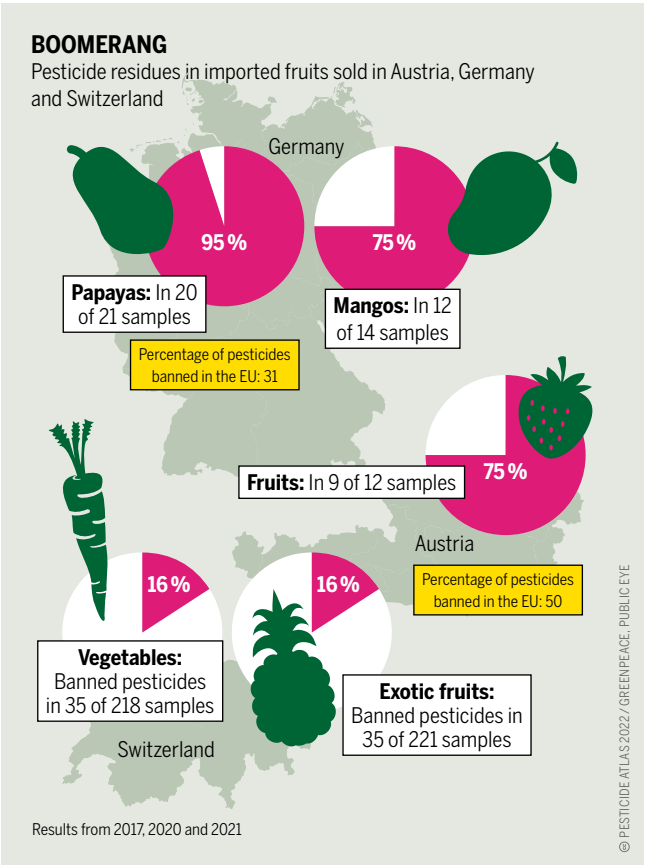


country. International organizations such as the FAO and WHO have been pointing out this problem for years.

Human rights experts criticize the practice by EU Member States of exporting EU banned pesticides to the Global South, because it externalizes the health and environmental impacts of these hazardous substances on the most vulnerable. Civil society organizations therefore demand a legal ban of such practices. Pesticides not approved in the EU due to their unacceptable health or environmental effects should no longer be allowed to be sold to countries outside the EU. In 2020 the European Commission's draft chemicals strategy included for the first time a commitment to prevent the export of hazardous chemicals banned in the EU. A first legal draft is to be expected in 2023.

Some European states have already taken national action. In France, a law forbidding the manufacture, storage, and export of EU banned pesticides came into force in January 2022. These substances can no longer be used to maintain green spaces, pathways or forests. Switzerland has banned the export of five particularly toxic pesticides since 2021, with other active ingredients to follow. In Germany, an announcement of putting a legal stop to such exports in the future was confirmed and concretised in September 2022. Importing countries have also taken steps against double standards in pesticide trade: Tunisia, Mexico and the Palestinian National Authority have imposed a ban on imports of pesticides that are forbidden in the exporting or producing country itself. ●

If ratified, the EU-Mercosur agreement would reduce over 90 percent of existing tariffs on pesticides and could increase exports of hazardous pesticides from the EU to South America



Random samples reveal: As long as it is allowed to export banned pesticides, they will return to Europe – in our fruit and vegetable

GLYPHOSATE

A MANUFACTURED CONTROVERSY

Bayer and other companies are fighting for the re-approval of glyphosate in the EU. To do so, they must prove that their pesticide active substance is not carcinogenic. But the studies presented are old – and point to the opposite.

In December 2019, the German pharmaceutical and biotechnoloigcal company Bayer submitted an application for re-approval of glyphosate for the European Union (EU) in conjunction with other companies under the name Glyphosate Renewal Group (GRG). Glyphosate is a chemical compound that works as a weed killer. It's the most commonly used herbicide chemical in the world. The approval process is accompanied by a yet unresolved controversy between EU authorities and the World Health Organization's International Agency for Research on Cancer (IARC), which centers on glyphosate's toxicity. In 2015, the IARC had classified the chemical as "probably carcinogenic to humans". The German Federal Institute for Risk Assessment (BfR) and the European Food Safety Authority (EFSA) – both in charge in the EU approval process at the time – came to a different conclusion. As a result of this heated debate, the EU renewed the license for the weed killer for five years, ten years less than the usual authorisation for crop protection chemicals. Glyphosate is currently approved for use as an active ingredient in pesticide products in the EU until the end of 2022.

Bayer's application calling for re-approval is substantiated with hundreds of manufacturer studies and studies from scientific literature but does not contain any new studies refuting the classification of glyphosate as "probably carcinogenic" by IARC. Instead, the Glyphosate Renewal Group relies on twelve cancer studies with mice and rats commissioned by manufacturers, which the agrochemical company Monsanto – acquired by Bayer in 2018 – had already submitted in the previous approval process.

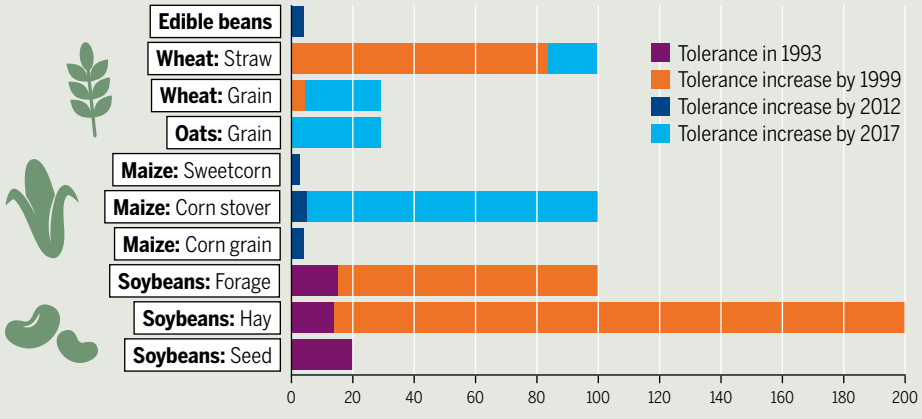
The IARC evaluated the weight of the evidence and examined four of these twelve cancer studies used by the authorities at the time as evidence of the safety of glyphosate. Basing their judgement exactly on these studies which manufacturers are trying to prove the harmlessness of glyphosate, the WHO cancer researchers concluded "sufficient evidence of carcinogenicity in animal studies". As it later turned out, the BfR had ignored statistically significant increases in tumours in all cancer studies commissioned by manufacturers – according to current rules, two independent studies with positive cancer findings are sufficient to classify a substance as carcinogenic. The BfR justified this failure in an addendum to its assessment report and state that it relied on the statistical evaluations of the manufacturers' study reports. This means that the German authorities did not evaluate the studies' results itself, although its legal mandate is predicated on scientific independence.

Even after being alerted to this fact, the authorities maintained their original conclusion. However, their explanation for considering glyphosate not carcinogenic has changed. The pesticide active ingredient was not responsible for numerous significant tumour findings, they claim, but deficiencies in the conduct of the studies: high dosages, sick laboratory animals, or mere coincidence. It remains questionable how authorities could make an objective assessment of cancer risk based on flawed studies. And secondly, why the manufacturers did not submit new and less flawed cancer studies for the current renewal process.

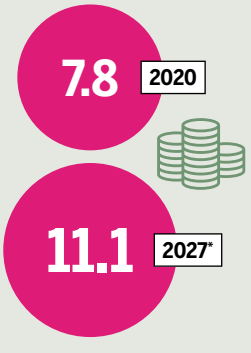
In the last decade, the U.S. Environmental Protection Agency (EPA) has drastically raised glyphosate tolerances. Civil society organizations state that the EPA is missing key pieces of information including an ecological risk assessment

RISING RISKS FOR RISING PROFITS

Change of glyphosate tolerance levels (allowable residues) for food crops in the USA, in parts per million



Global market value of glyphosate, in billion US dollars



*estimated

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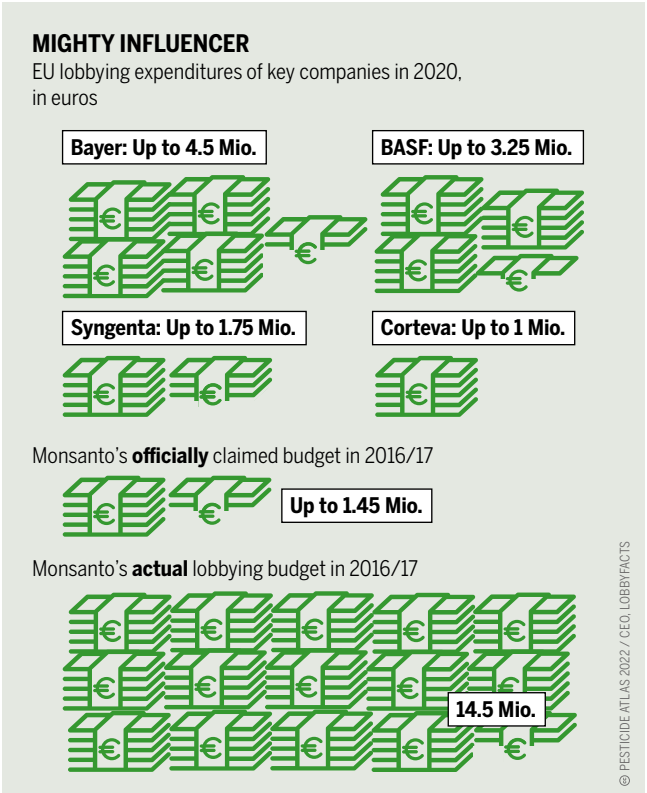
But not just the manufacturers' cancer studies have come under criticism. The authorities and IARC also reached different conclusions on the genotoxicity of glyphosate. Based on 53 studies commissioned by manufacturers, the EU authorities in 2015 denied that the herbicide can cause DNA or chromosomal damage. However, similar independent studies from scientific literature – which in their majority support a conclusion of "strong evidence of genotoxicity" according to IARC – had been classified by the EU authorities as "not reliable" and were excluded from the assessment. In September 2017, a plagiarism report revealed that the BfR's declaration in which the regulator had justified the exclusion of these studies was a copy of Monsanto's application for approval. Experts also criticize that national authorities like the BfR just focused on certain aspects like dietary exposures and risks to the general population – leaving risks of occupational exposure out of the picture.

A 2019 ruling by the European Court of Justice requires EU regulators to disclose all manufacturer commissioned studies which had previously been confidential upon request. Two renowned researchers from the Institute of Cancer Research at the Medical University of Vienna in Austria examined the 53 manufacturer commissioned studies mentioned above and evaluated their scientific quality: 34 studies showed substantial deviations from applicable OECD test guidelines and were classified by the two researchers as "not reliable". As for the rest of the 53 studies, 17 were classified as "partly reliable" and only 2 studies as "reliable". However, the applicants resubmitted these studies in the current approval process again as evidence of the lack of genotoxicity of glyphosate.

Notwithstanding all this, in its first draft report of June 2021 the Assessment Group on Glyphosate was proposing to classify glyphosate in the EU as non-carcinogenic and non-toxic again. The group – consisting of EU Member States France, Hungary, the Netherlands and Sweden – is appointed by the European Commission and mandated to ensure that the application meets the formal requirements of the EU legal provision. The EU licence for glyphosate was due to expire in December 2022, but a decision on its future has been pushed back to mid-2023 following an "unprecedented" number of responses to public consultations. ●

Ctrl+C: The German Federal Institute for Risk Assessment has copied entire paragraphs and pages of running text from industry dossiers. A plagiarism report has concluded that the institute even copied the evaluations of independent studies by Monsanto

According to Transparency International, the ratio of member of European Parliament to lobbyists is one to fifty. Many of them are sent by agrochemical companies



GENDER

AT THE FOREFRONT OF EXPOSURE

Women working in agriculture often have lower levels of income and lack decision-making power. There is urgent need for gender equality to achieve food security and protection from pesticide exposure.

Women make up 43 percent of the global agricultural labour force, with almost 70 percent of employed women in South Asia and more than 60 percent of employed women in Sub-Saharan Africa working in agriculture. However, women's participation in agriculture is likely underestimated. Subsistence agriculture, unpaid family work, and seasonal labour, which frequently involve women and girls, often go unaccounted for.

Be it in subsistence farming, informal or formal employment, women are routinely exposed to toxic pesticides. Women carry out a significant part of pesticide application in certain countries and sectors, for example on coffee and fruit farms in South Africa, banana plantations in Costa Rica, or in Malaysia, where there are an estimated 300,000 women sprayers in the plantation sector. A study found that women plantation workers in Indonesia, Malaysia, and the Philippines are frequently exposed to Highly Hazardous Pesticides (HHPs) through mixing, loading, and spraying pesticides. Employers often do not provide Personal Protective Equipment (PPE), so women improvise by wrapping scarves around their faces or using bra cups as masks or respirators.

Women can also be unknowingly exposed to pesticides through activities like weeding and harvesting which does not require PPE. Women in flower farms in Kenya are more involved in weeding, flower cutting and packaging and showed a higher frequency of poisoning symptoms than men that do the actual spraying.

Recent figures on unintentional acute pesticide poisoning estimate that 385 million or roughly half of the world's farmers and farmworkers are poisoned each year. However, there is insufficient data to estimate the incidence of poisoning for women because there is a lack of gender-disaggregated data and gender perspective in occupational health research.

Due to traditional gender roles, women are more exposed to pesticides through household chores such as washing spraying equipment or their husbands' pesticide-soaked clothes, storing pesticides, or disposing pesticide containers. In Vietnam, a study found that more girls reported exposure to pesticides from washing spraying tanks compared to boys.

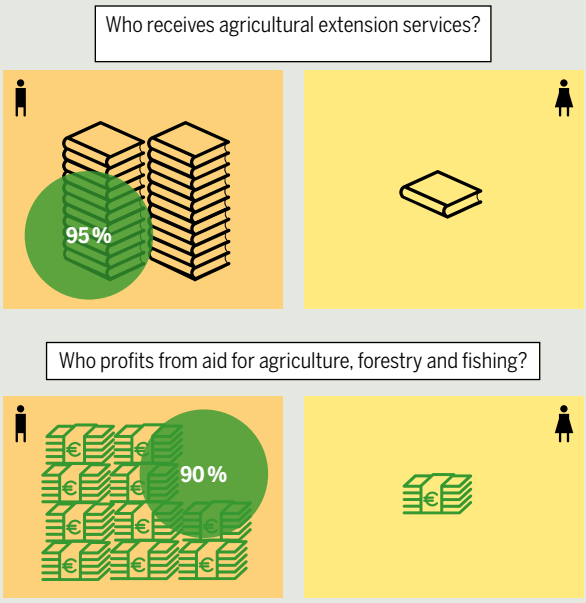
Pesticides are supposed to prevent crop losses. But a large proportion of losses occur because of inadequate extension, financial support and lack of equipment, especially for women

A MATTER OF SOCIAL JUSTICE

Yield gap between men and women farmers in Uganda

Due to differences in resource use, the worldwide yield gap between men and women farmers averages around 20 to 30 percent. Given equal access to resources, women could achieve the same yield levels. This could reduce the number of undernourished people in the world by 12 to 17 percent and boosting agricultural output in poor countries by 2.5 to 4 percent, according to a NGO study from 2016

Resources for high-yield agriculture: Who benefits?



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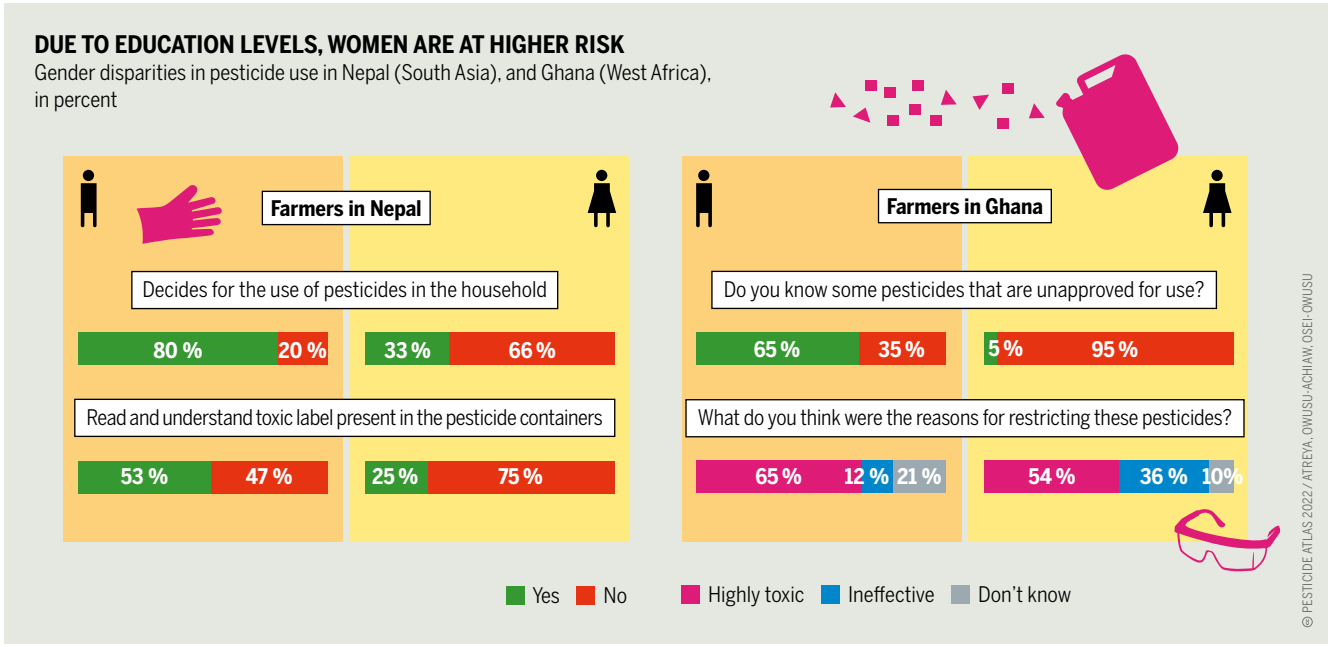
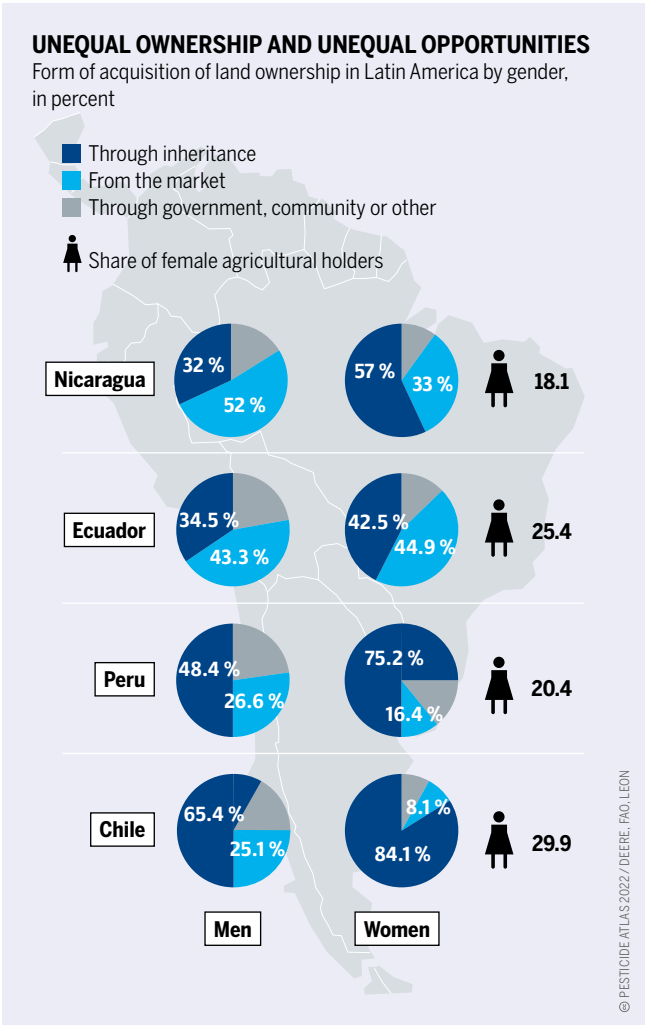


Studies in Bolivia, South Africa, and Tanzania also reveal that lower literacy rates and limited access to training increase women's vulnerability to pesticides. Women were unable to identify the names of the pesticides they were using, and unable to read or understand safety information on labels.

The impact of pesticides on women and girls differ from the impact on men and boys. Women generally have a higher proportion of body fat, and are thus more likely to store pollutants that can bioaccumulate in fat tissue. Women have a higher level of hormonally sensitive tissues that make them more vulnerable to pesticides, especially those that are hormonally active or known to disrupt the endocrine system. There is an established link between breast cancer and certain pesticides, which act as mammary carcinogens and tumour promoters. Residues of organochlorine pesticides, which degrade slowly and bioaccumulate in the food chain, including banned pesticides such as DDT, have been found in women breast cancer patients. Pesticides are also linked to endometriosis, a painful condition that may cause infertility and can pose a significant risk to women's reproductive health and their unborn child. Passed on from mother to child through the womb and breastfeeding, pesticides are linked to neonatal deaths, birth defects, and impaired mental development or pervasive developmental problems in children. Studies in the emerging field of epigenetics also show that pesticides exposure may affect gene activity and affect inherited physiological traits.

Women are recognized as playing a key role in transitioning to agroecology – and rural women in the Global South have taken the lead in eliminating pesticides use. Such movements are of benefit not only to farmers, but future generations whose welfare rests upon the health and well-being of women.

More than 80 percent of male cocoa farmers in Ghana posses at least a primary school education certificate, while almost half of female workers at cocoa farms in Ghana have no formal education at all. Studies show how education levels correspond with hazard awareness



Access to land is often denied to women. For many in Latin America, inheritance is the only way to acquire land

YOUTH SURVEY

CHANGE WANTED

Young people in Germany are worried about pesticide use in agriculture and call on politicians to take action. They demand more emphasis on ecological management of fields and plead for stronger support for farmers.

Pesticides are a perennial issue in the environmental debate: For years, many consumers have cited agrochemicals in EU-wide surveys as one of the biggest challenges in food safety. Concerns about pesticides are a well-researched motivation to buy organic food. And growing awareness of the problem of insect protection also suggests that environmental risks are becoming a more important topic.

Recent youth studies and the Fridays for Future movement show a high level of climate protection awareness among teenagers and young adults. However, the extent to which pesticides are seen as a problem for this age group has been largely unclear due to a lack of studies. How do the majority of young people in Germany view agriculture and its impact on environmental protection and species conservation? Is pesticide use even an issue for younger generations? As an attempt to find answers to these questions, 1,131 young adults in Germany were polled in October 2021 for the Pesticide Atlas. The online survey for the 16 to 29 years age group is representative in terms of gender, educational attainment, and regional distribution of respondents.

The results sketch a picture of a generation aware of planetary limitations that is demanding more commitment from policymakers so that agriculture can produce food in an environmentally and sustainable way. There is widespread interest in the ways production is carried out – only very few of the young respondents (7.2 percent) said they did not care about the issue. Awareness of risks associated with pesticide use in agriculture is high.

About two-thirds consider pesticide usage to be dangerous. The main concerns relate to water and groundwater protection. Then, respondents are concerned about impacts on air and soil. The impact on their own health only comes in fourth place in the list of concerns.

The adverse effects on biodiversity are also worrying to a clear majority: The decline in pollinating insects and bird species is somewhat more in the focus than the loss of wild herbs and grasses. The problems caused by pesticides are seen as numerous. There is clear support for biological crop protection, for example the use of beneficial insects as biologically sustainable pest controllers. New farming management technologies from the field of precision farming – such as self-propelled robots for weed control or precise pesticide application – are greeted with scepticism.

The reputation of pesticides and the crop protection industry is rather bad. In contrast, organic farming is seen as sustainable and modern. Many of those surveyed believe that organic farming has advantages in terms of insect protection and is a promising approach to achieving respectful treatment of nature. Overall, organic farming is associated with clear benefits for the environment and wildlife conservation – about 60 percent say they buy organic food for these reasons. Looking at the situation of farmers, young adults see major challenges: 70 percent assume that it is difficult to do business under the current conditions. The commitment of farmworkers is held in high esteem – as evidenced by the high importance attached to the issue of fair pay. However, trust in the industry's problem-solving ability is low. From the respondents' perspective, agriculture is constrained by circumstances. Less than a quarter of respondents believe responsible pesticide use is feasible. Almost three quarters call on policymakers to reduce pesticide usage. The policy instruments surveyed are consistently well supported. Respondents were also asked to indicate how they assess frequent arguments in the public debate. Confronted with three arguments each from the environmental perspective and industries' point of view, the environmental positions meet with greater approval. 74 percent of respondents consider the link between pesticide use and biodiversity loss plausible. On the other hand, only 35 percent are convinced that "the world's food supply is at risk without pesticides". There are four groups among the respondents: The largest group is the 'Uncertain' (42 percent), who do not take a clear position on all the arguments presented. For two groups, the environmental arguments are decisive – the core group of 'pesticide opponents' (10 percent) and the 'pesticide sceptics' (29 percent), who are not quite so clear in their rejection. The 'weighers' (18 percent) can understand arguments of both sides.

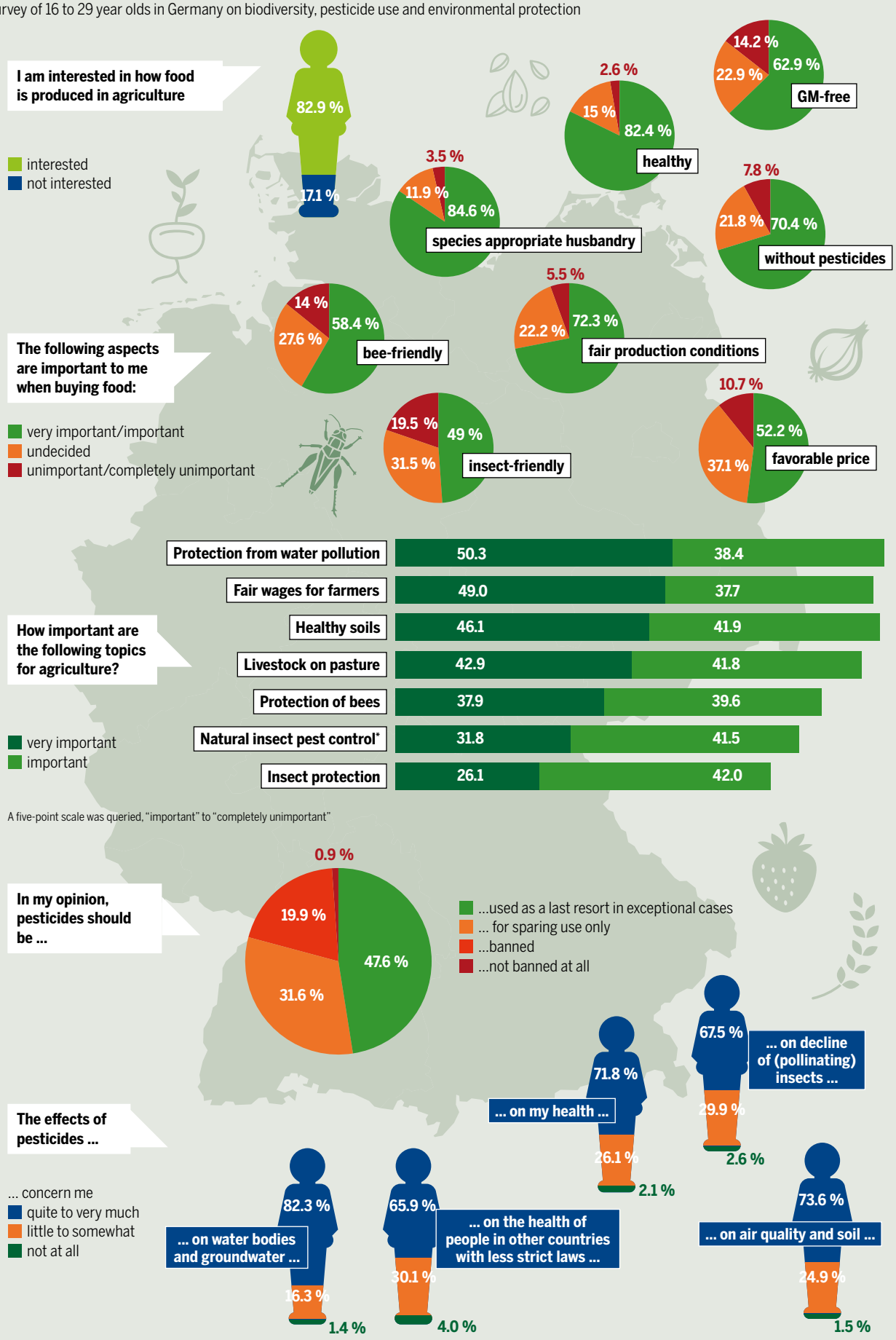
The survey ended with a question about perspectives on handling of chemical crop protection: Should pesticides still be used in the future? Given the choice between unrestricted use, sparing use, use only in exceptional cases and a ban, 48 percent of respondents opted for "use as a last resort in exceptional cases". Another 32 percent are in favor of sparing use. 20 percent would recommend a ban. Only just under 1 percent are in favor of unrestricted use. These are ambitious reduction targets that go far beyond what policymakers have been aiming for so far. 80 percent of respondents express willingness to support a signature campaign calling for gradual elimination of pesticides and aid for farmers converting their businesses.

Altogether, the study shows that young people between 16 and 29 years are in favor of agriculture that either does without chemical-synthetic crop protection or at least reduces the amount applied significantly. Farmers are seen as being driven by an agricultural system that imposes unfair conditions and restrictions. ●

The youth survey shows no significant differences between urban, rural and educational levels: Sustainability is an important matter for all young people

AWARENESS FOR PROBLEMS – AND FOR SOLUTIONS

Survey of 16 to 29 year olds in Germany on biodiversity, pesticide use and environmental protection



* For example ladybugs against aphids

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BRAZIL

MORE CULTIVATION, MORE PESTICIDES, MORE EXPORTS

As one of the world's largest importers of agrochemicals and exporters of agriculture goods, Brazil sets record for pesticide consumption. A significant part of the pesticides used there is produced in the European Union – and highly hazardous.

Around 14 percent of the total volume of pesticides exported by the European Union to the Mercosur countries – the South American trade bloc with the full members Argentina, Brazil, Uruguay, and Paraguay – consists of substances banned or never authorized in the European Union itself. Although they are produced and sold by companies headquartered in these countries. Amongst the top ten most commonly used pesticides in Brazil, four lost their authorisation in the European Union: atrazine, acephate, chlorothalonil, and chlorpyrifos. In 2020, 33,300 tonnes of atrazine, 29,900 tonnes of acephate, 24,100 tonnes of chlorothalonil, and 8,800 tonnes of chlorpyrifos were sold in Brazil, also via EU based companies.

The European Union is an important trading partner of Mercosur. The two trade blocs reached an agreement on a free trade deal in 2019. Before it can enter into force, it requires the approval of the European Parliament and the national parliaments of the 27 EU Member States, and the Mercosur Countries. The deal would largely lift tariffs and increase import quotas. Concerns about environmental and social impacts were among the contentious issues that have led to more than 20 years of trade negotiations between both parties.

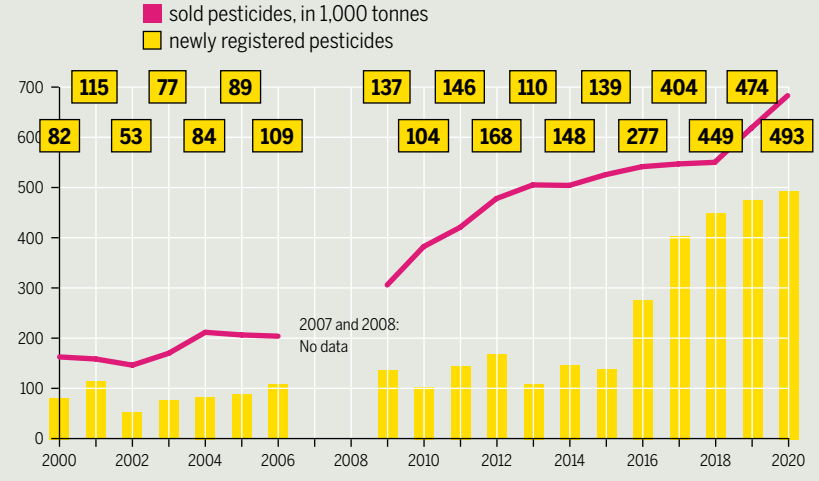
If the EU-Mercosur trade agreement is ratified, tariffs on agrochemicals will be reduced by up to 90 percent, likely leading to an increase in the export of dangerous pesticides from the EU to Mercosur countries. The deal is also expected to boost exports of crops and crop-based products, including soy, sugarcane, and sugarcane-derived ethanol – that depend heavily on pesticides. The deal is also expected to increase exports of meat products such as poultry, which depend on soy-based animal feed, driving even more pesticide use. Brazil is the biggest exporter of soybeans, beef, chicken and sugarcane worldwide, besides being the second largest exporter of grains in the world. This role in the global market as exporter of commodities and biofuels also led to deforestation, biodiversity destruction, violation of Indigenous rights – and also an increase in pesticide use. The total amount of pesticides consumed by Brazil in 2010 was 384,501 tonnes and the volume has risen year after year, until it reached 685,745 tonnes in 2020, with a value up to 28 billion euros.

About half of this total volume of pesticides sold in Brazil is destined for soybeans; together with sugar cane, maize, and cotton these crops constitute 82 percent of commercial pesticide use in the country. Past increases in pesticide use are mainly due to the increase of the cultivated areas used to produce animal feed and to the production of ethanol – also driven by EU demand.

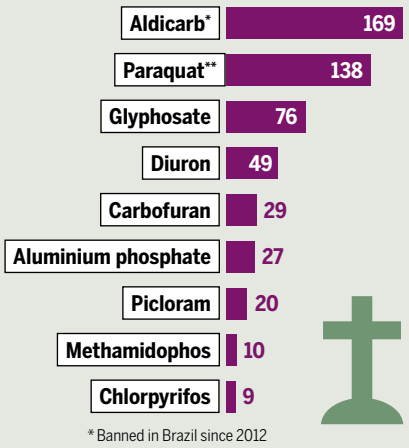
Data from the Ministry of Health of Brazil shows high numbers of poisonings. The industry-friendly government and its land use change policies is considered as one reason for increased pesticide use

FATEFUL DEVELOPMENT?

Pesticides sold and pesticides newly registered in Brazil between 2000 and 2020



Number of reported fatalities, per active ingredient, 2010 to 2019



* Banned in Brazil since 2012
** Banned in Brazil since 2021

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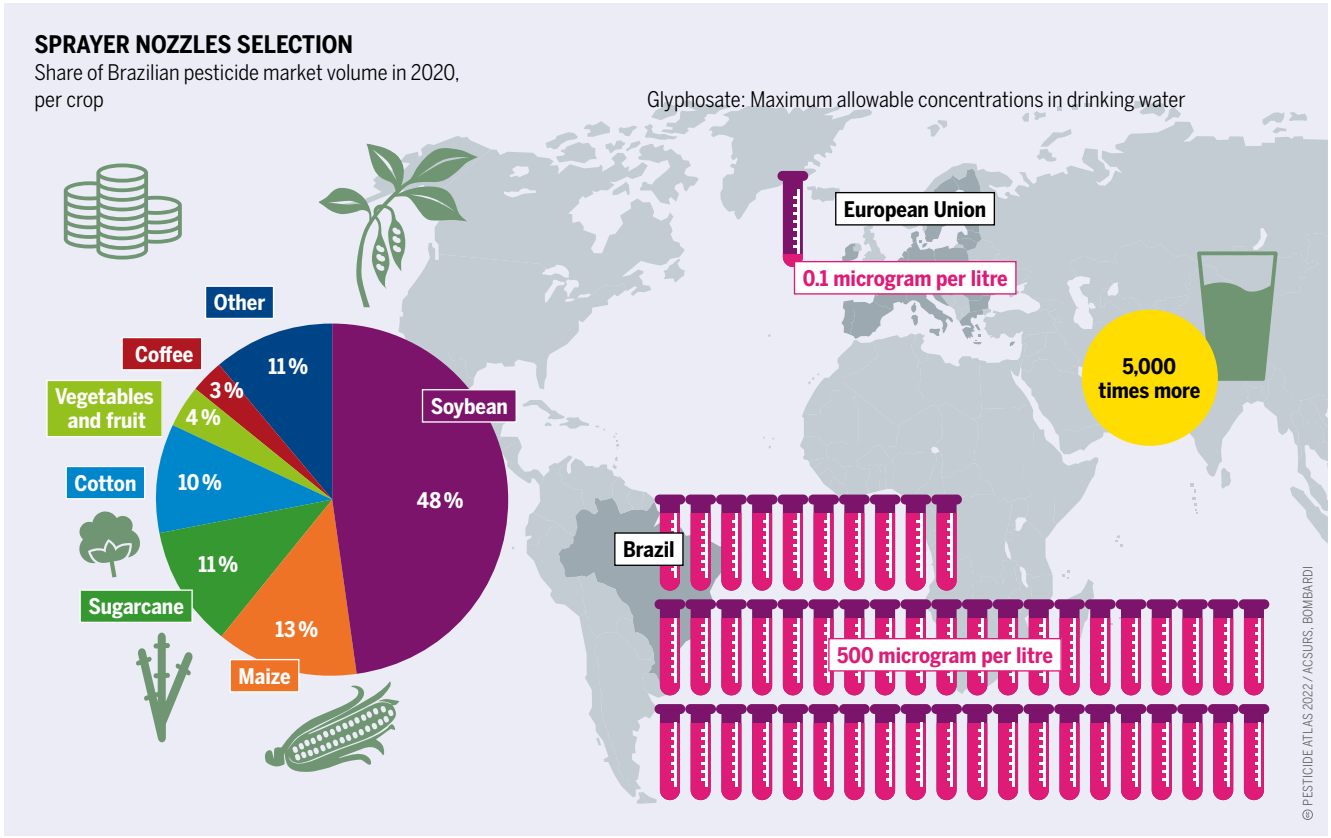


Glyphosate is classified by the WHO as probably carcinogenic. It is one of the best-selling pesticides in Brazil – almost 200,000 tonnes were sold in 2018

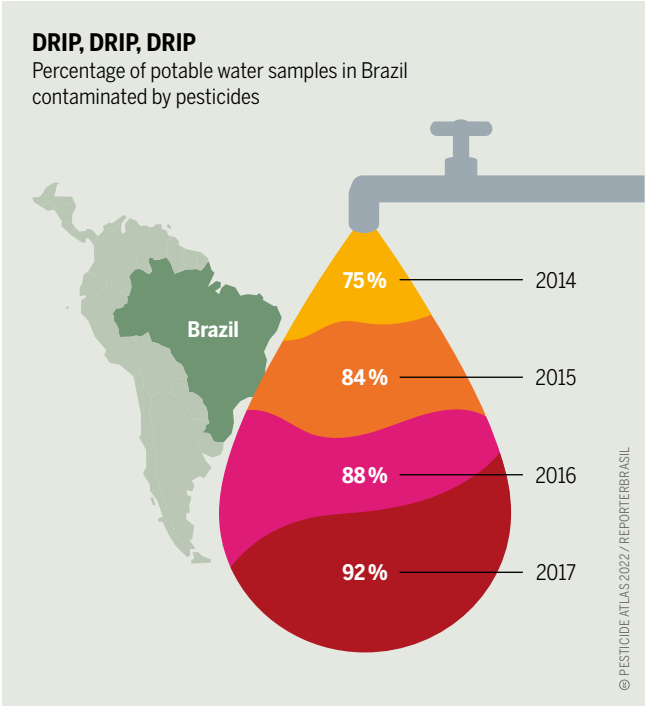
The area cultivated with sugar cane increased between 2010 and 2019, from 9 million hectares to 10 million hectares. The cultivated area with maize increased 38 percent between 2010 and 2019, from 13 to 18 million hectares – and the cultivated area with soybeans increased 56 percent in the same period. For soybeans, the cultivated area now covers an area that equals the territory of Germany.

The increase in the use of pesticides in Brazil goes hand in hand with the increase in areas cultivated with genetically modified organisms. Currently 92 percent of soy, 87 percent of maize, and 94 percent of cotton cultivated in Brazil are genetically modified crops. The use of these substances has severe impacts on the health of the Brazilian population: Between 2010 and 2019, 56,870 people were poisoned by pesticides in Brazil, which represents an average of 5,687 cases per year, or 15 people daily. However, the Ministry of Health in Brazil itself admits that the number of unreported cases is high and that, consequently, the real total number of poisoned people is even higher.

The health of children and women is of particular concern. Approximately 15 percent of the population poisoned by pesticides in the country are children and young adults aged 0 to 19 years old. Even babies have been poisoned by pesticides. Pesticide residues have been found regularly in breast milk.

But there are also important movements of resistance to this model of agricultural production in the country. For example, the Landless Rural Workers' Movement (MST) has played an important role in agroecological production, developing this strategy in around 700 settlements. During the pandemic, the Landless Rural Workers Movement donated more than 2,300 tonnes of food from ecological farming to poor populations in the cities. ●

Over ninety percent of tests detected pesticide presence. NGOs fear: In the next few years it could become a struggle to find any drinking water free of agrochemicals in Brazilian taps



DIGITAL TRANSFORMATION

WHO REALLY BENEFITS FROM DIGITALIZATION?

Agricultural robotics, drones, and algorithm-driven technologies for a new way of farming are becoming big business. They are supposed to help farms cut pesticide use, but there are serious doubts whether this will work.

Agriculture faces major challenges. For one thing, it still has to cope with plant diseases, insect pests, and weeds. And secondly, high consumption of pesticides leads to entirely new risks for both humans and nature. Agricultural technology companies are promising to solve these problems with digital technologies known as smart farming or precision farming. According to a survey, 82 percent of farms in Germany already use digital technologies. 45 percent of the farmers surveyed work with GPS-controlled agricultural machinery and 40 percent use agricultural apps for their smartphones or tablets. 32 percent use IT solutions to apply crop protection products or fertilizers to their fields. The networked agriculture market is expected to grow from $1.8 billion in 2018 to $4.3 billion by 2023, at an annual growth rate of 19.3 percent during the forecast period. Expectations are high: Progressive digitalization is hoped to enable the world's farms to produce food for nine billion people. Some experts predict digital transformation will raise incomes and protect climate and biodiversity by enabling more precision in pesticide and fertilizer usage – which could lead to lower doses. Digital technologies can also save time which could be used for more labour-intensive methods of pesticide-free cultivation.

One example of the digitalization of agriculture is GPS camera technology. It identifies field areas with weed infestations, so the connected field sprayer opens its nozzles in this section only. Selfpropelled spraying robots use this technology to detect, target, and remove weeds. Drones can be programmed to spot weed nests from the sky. Algorithms can identify and locate diseased or pest infested plants. According to the manufacturers, all this will soon be part of daily farming business.

In a joint trial project, German companies Südzucker AG and the agricultural technology company Amazone in cooperation with the Danish field robot manufacturer FarmDroid are testing how the use of herbicides and insecticides in sugar beet fields can be reduced. The field robot first sows sugar beet seeds in a precise grid using its GPS system. The robot knows the exact position of the beets and hoes next to and between the rows to remove weeds. In the immediate vicinity of the plant, it is difficult to remove all weeds mechanically without damaging the beet, so the robot sprays agrochemicals right next to the beet, which destroys even the last weeds.

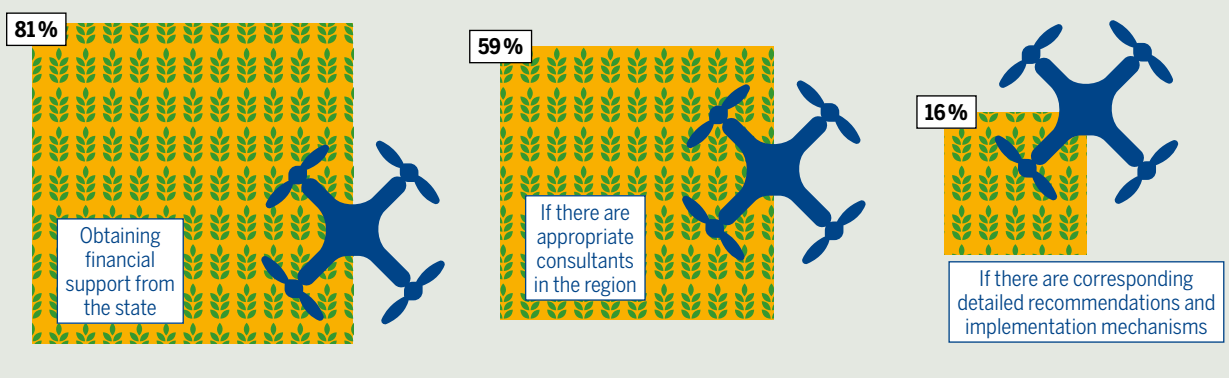
Already today, agricultural machinery can identify how well soils are supplied with nutrients. This information can be fed into cropping plan databases to calculate the necessary amount of fertilizer and pesticides to be applied. Big data corporations are playing a significant role in the development and dissemination of the technology, the processing and the use of the data collected. Google for example works with agencies such as the U.S. National Oceanic and Atmospheric Administration (NOAA). The company wants to use its artificial intelligence programs and the weather agency's vast amounts of data to enable extremely accurate weather forecasts in the future.

Whether the ecological effects of digitalization will be

The survey in the Russian Astrakhan region shows: Farmers in poorer countries fear being left behind by digital technology – if there is no support

NO AUTOMATISM

Conditions of implementation of data-driven approaches in digital agriculture, survey of smallholder farmers in 2019



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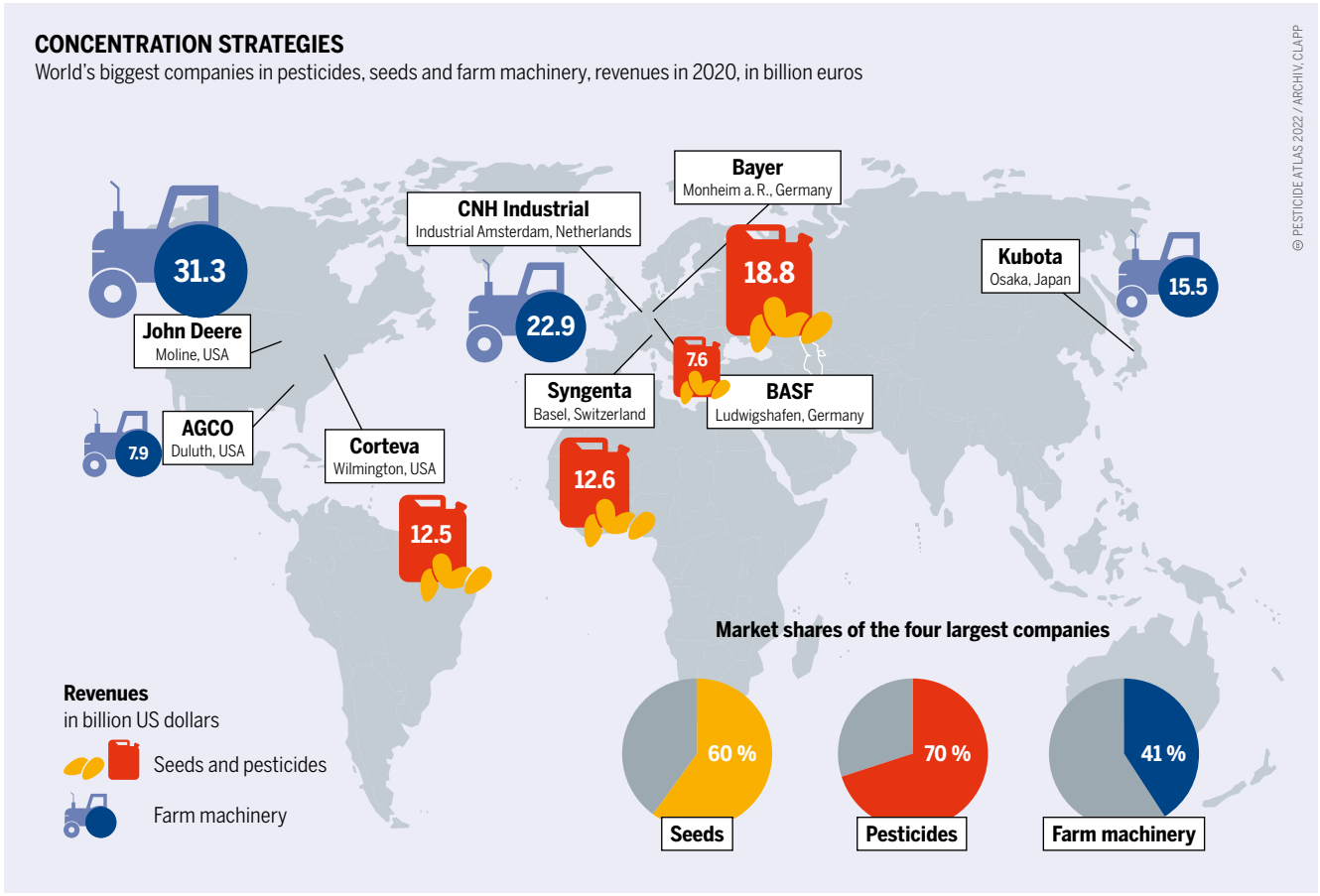


positive or negative depends on many factors. Researchers see potential to reduce pesticide use. On the other hand, there are also so-called rebound effects, for example increased energy consumption due to new technologies or the expansion of intensive production on land previously used only extensively or not at all, or that is ecologically valuable. There is also a risk that smallholder farmers in lower income countries are excluded from this transformation. They may lack access and knowledge to new technologies. Furthermore, many digital tools are only economical when used at large scale.

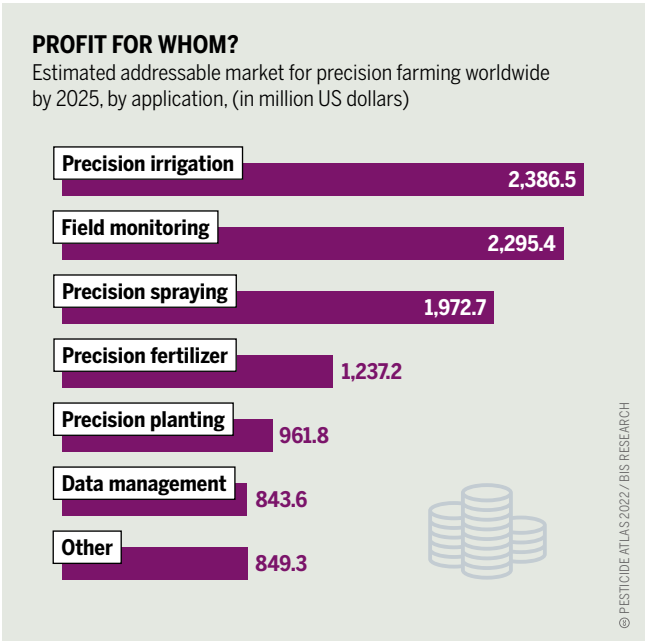
This could reinforce monopolization and concentration. One example is the market for agricultural machinery. In 1994, the four largest companies controlled less than one-third of the market – after twenty years of consolidation, they already controlled more than half. Players like John Deere are now staking out their territory through collaborations with agrochemical companies. In the past, the company has already cooperated with pesticide manufacturers such as Syngenta, Dow Agrosciences, BASF and Bayer. Other companies such as CNH Industrial and AGCo have also entered into joint ventures. Venture capital interest in software agricultural technologies is rising as well: From 223 billion US dollars in 2015 to more than 700 billion US dollars in 2017.

Civil society organizations warn of a loss of food sovereignty. New tools and techniques are turning land that is currently managed by smallholder families into agro-industries' profits.

Regulation is needed so that not only corporations benefit from digital farming, but also people and the environment

The market for digital agricultural technology is promising – especially for large corporations that are based in the Global North already dominating other sectors of agriculture

One of the future challenges for policymakers is therefore to prevent the commercialization of climate, nutrition, and crop data and to reinstate farmers sovereignty over their data. Otherwise, there is a risk that digital transformation will contribute to further dependence on unsustainable agriculture. ●



OBJECTIVES ARE NOT ENOUGH

Even though the EU's pesticide legislation is the most sophisticated, it has failed to achieve a reduction in use. The EU's Farm to Fork Strategy seeks to change that. Many questions remain.

Pesticides are high on the agenda at the European level. In its Farm to Fork Strategy from May 2020, the European Commission committed to the objective of reducing the use and risks of synthetic pesticides by 50 percent until 2030, the use of the most hazardous substances by 50 percent, and to introduce a new regulation to reach that goal. The "Save Bees and Farmers" European Citizens' Initiative, which gathered over 1.2 million signatures, demands an even higher reduction of 80 percent by 2030, a complete phase-out by 2035, and strong support to be given to farmers in their transition towards agroecology.

The current policy to bring down pesticide use, the "Sustainable Use of Pesticides Directive", was introduced in 2009. The legislation aimed to limit the use of pesticides by promoting alternative practices like Integrated Pest Management (IPM). IPM principles give priority to preventative measures and biocontrol. Biopesticides and as a last step synthetic pesticides are only an option, when all other measures have failed.

However, more than a decade after the adoption of the directive, the EU Court of Auditors (ECA), the Union's external auditor to assess among other things the effectiveness of EU action, found that only limited progress has been achieved in measuring and reducing the use and risk of pesticides in the EU. Over the period 2011 to 2018, the sales of pesticides remained stable at around 360 thousand tonnes per year in the EU. The ECA outlined several flaws in the EU framework. For example, there is the missing alignment between the Common Agricultural Policy (CAP) and reduction policy. The CAP determining the funding and priorities of EU agriculture. Another key issue is the lack of appropriate indicators on European level to measure the potential decrease in pesticides. Indicators are mainly based on sales data of pesticides and therefore do not take into account the agriculture area, the volume or the way these substances are used.

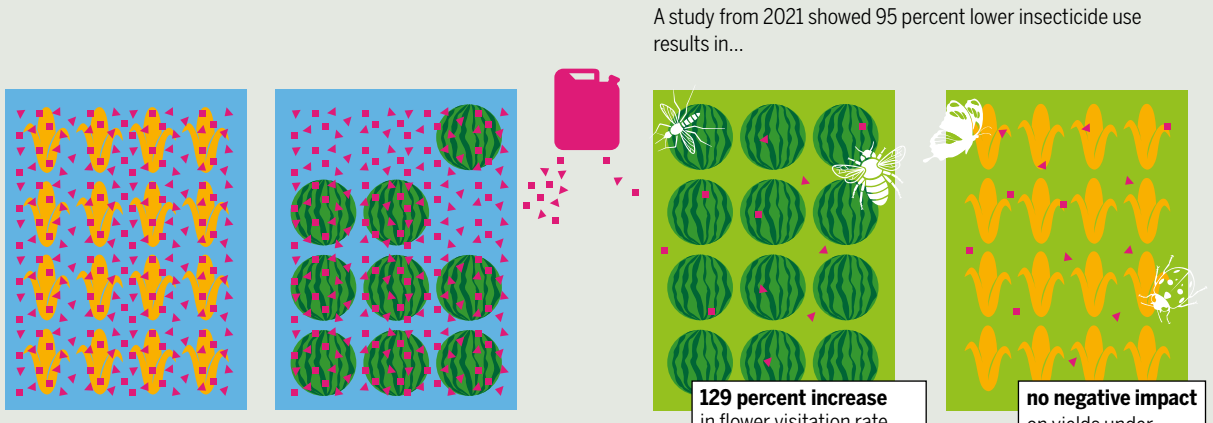
From the EU budget, farmers receive financial support based, for the most part, on the number of hectares of the farm. Currently, the EU does not tie the receipt of this EU funding to the respect of IPM principles and other rules laid out in the pesticide directive. This is unlikely to change substantially with the latest attempt to reform the CAP, entering into force in 2023.

Finally, the way Member States handled the implementation of the EU framework into national rules, is another reason for its limited success. Several Member States delayed the transposition into national law and were slow to develop national action plans to implement concrete measures. Civil

At least officially, the EU encouraging with its strategies like "Farm to Fork" natural pest control mechanisms. Integrated pest management is one sort of a sustainable non-chemical methods in agriculture

LOWER PESTICIDE USE, HIGHER HARVEST YIELDS

Consequences of integrated pest management (IPM) as ecological alternative to conventional pesticide practices



The UN's Food and Agriculture Organization (FAO) defines **Integrated pest management (IPM)** as an approach that emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms as for example beneficial insects in order to reduce pesticide use

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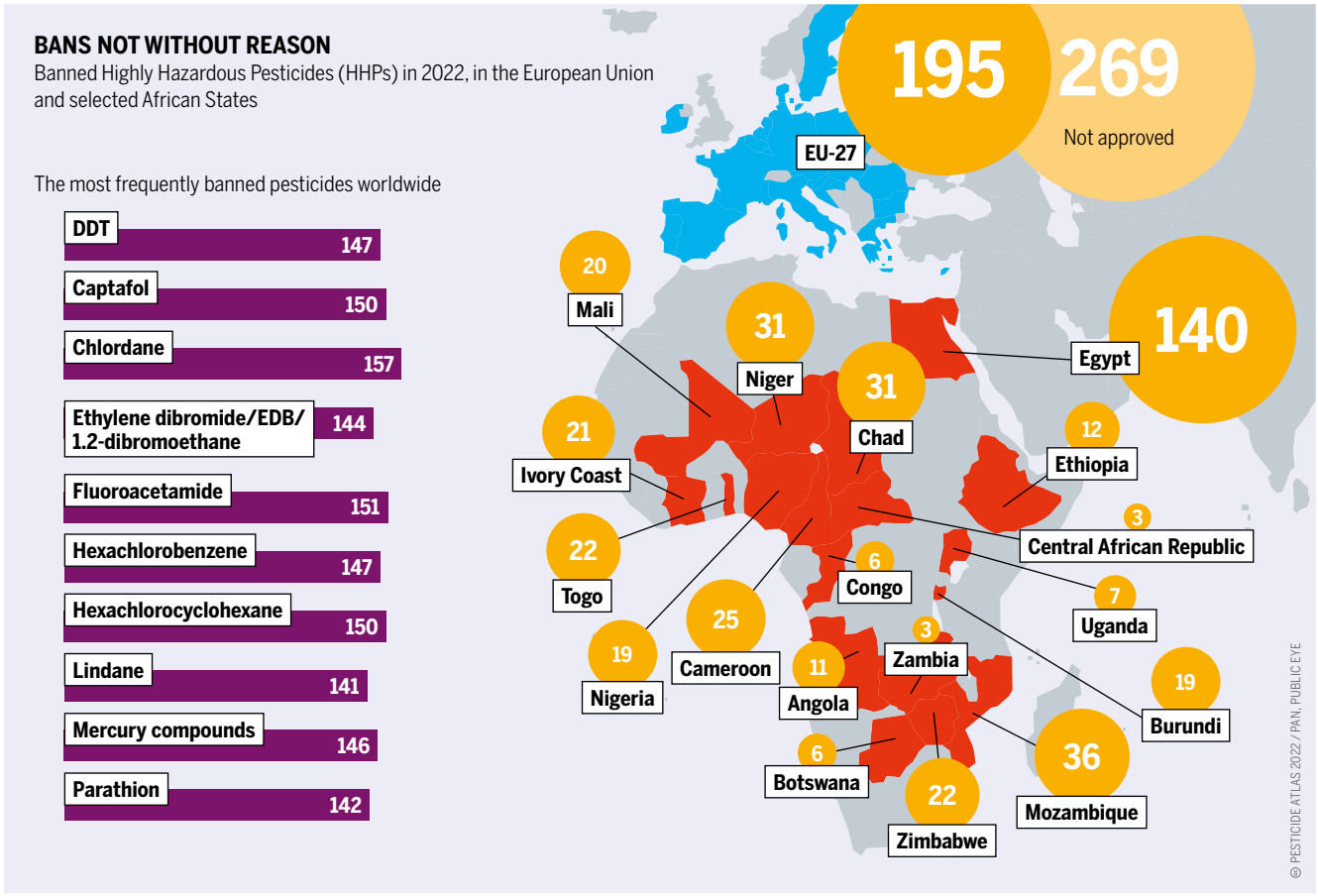


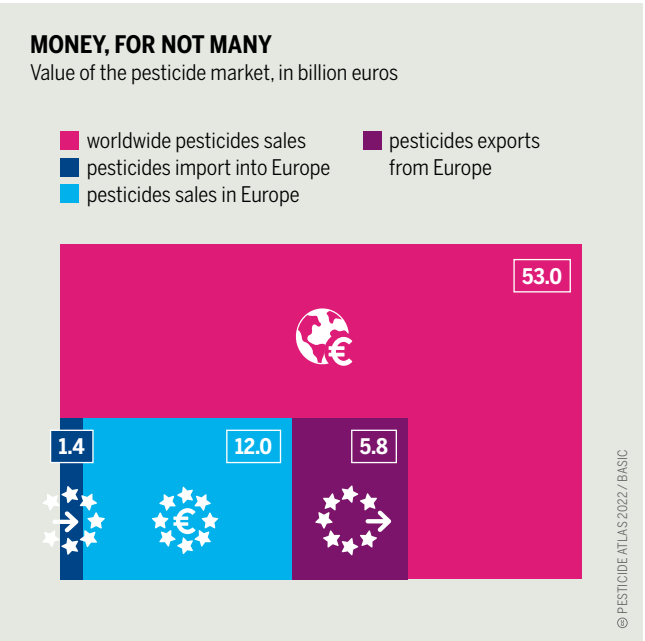
The global comparison shows: The European Union leads the way in banning very harmful pesticides. But toxic substances are still used in Europe

society organizations furthermore criticised Member States for not using the legroom they have within the CAP to make the use of IPM more attractive. Member States can use funding from the CAP to offer voluntary schemes that incentivize techniques which lead to a lower use of synthetic pesticides. However, these schemes fail to take a systematic approach needed to reduce pesticides.

According to a joint statement of over 70 civil society organizations, the new EU legislation needs to address all of these concerns to be effective in transforming the food and agriculture system to protect citizens' health, biodiversity and the climate. They also demand that the regulation entails ambitious and legally binding reduction targets at both EU and national levels, a complete phase-out of the most hazardous pesticides and the use of damaging practices, like aerial spraying or seed coating, as well as a strengthened definition of IPM. Such practices are part of the transformation towards agroecology.

There are also discussions about the role of the EU when it comes to the use of pesticides in other countries. In its Chemicals Strategy for Sustainability from October 2020, the European Commission commits to put an end to pesticides banned in the EU being exported by EU companies to other parts of the world. But this has yet to be translated into actual policies.

The timeline for the reform on the pesticide directive was originally expected at the beginning of 2022 – but was delayed to summer 2022 due to Russia's war of aggression against Ukraine. The co-decision between the European Parliament and the Council are expected to go well into 2023 with the new rules likely only being made applicable starting 2024. ●



The pesticide market has almost doubled in the last 20 years worldwide, with the European Union as one of the biggest consumer and exporting markets

PESTICIDE-FREE REGIONS

GOOD EXAMPLES

All over the world, projects are proving that an ecological future is possible: more and more cities, states, and regions are trying to slash pesticide use; or even ban chemical agents completely from their fields and land.

More than 550 German cities and municipalities have so far decided to manage their urban greenery partially or completely without pesticides. Some municipalities are phasing out a specific group of active ingredients or a specific active ingredient, such as glyphosate. Other municipalities have already completely cut the use of pesticides. One example is Saarbrücken, capital of the German state Saarland: The city has not used pesticides for 25 years. Many cities and regions in the European Union (EU) have also established pesticide-free zones – in Italy, Belgium, the Netherlands, and Luxembourg. However, so far this only affects municipal areas. Many farms in those regions continue to use pesticides. In 2007, Denmark implemented a nationwide ban on the use of pesticides in public areas. Additionally, Danish politicians have been working to reduce the usage of pesticides all over the country. Denmark has slashed nationwide pesticide use by more than 40 percent since 2011. It currently applies an average of 40 percent fewer pesticides than its EU neighbors. Despite these efforts, the country is still far from being completely pesticide-free.

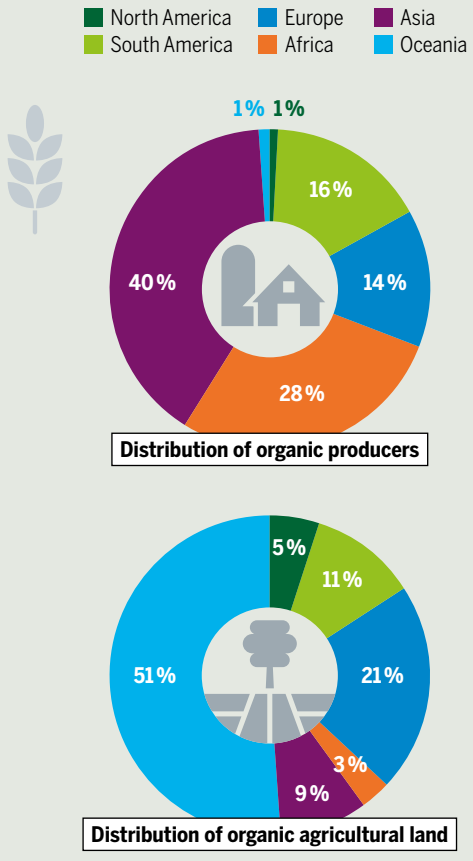
One of the European pioneers in banning pesticides is Luxembourg, where a complete pesticide ban on public land came into force in 2016. Since 2021, the government has also forbidden the use of glyphosate on agricultural land – even though the herbicide is still approved throughout the EU until 2022. The Italian commune of Mals in South Tyrol – the largest apple growing region in Europe – is also particularly committed to living and doing business without harmful pesticides. In a referendum in 2014, the majority of residents decided that their community areas and agricultural land should be pesticide-free. Apart from broad support, the resolution faced a lot of opposition from business, such as large local apple orchards fighting in court to prevent the pesticide ban from being implemented. The administrative court finally overturned the referendum with the argument that the municipality was not the competent authority for this environmental protection issue.

Nevertheless, the civil society effort has received widespread recognition: In 2020, the community was honored with the EuroNatur award for its perseverance in taking action against pesticides.

Not only in Europe, but all over the world a change is taking place. In 2018, Mexico was admonished by the National Human Rights Commission for violating its due diligence obligations by failing to ban Highly Hazardous Pesticides (HHPs). Only two years later, the Mexican agriculture department has proposed rules for phasing out the use of glyphosate by 2024, following pressure from civil society organizations. Until then, a transition period will be established to achieve the total substitution of the herbicide. The competent authorities were urged to develop non-chemical alternatives to current pesticides. Kyrgyzstan even plans to completely phase out pesticide use. Kyrgyzstan's parliament decided in 2018 that all agriculture should transition to organic production within the next ten years, eliminating the use of synthetic chemical insecticides, herbicides, fungicides, other agricultural chemicals as well as growth regulators. Only biological substances are excluded from the decision. In India, several states have begun to convert their agriculture to organic farming and ban pesticide use: The small state of Sikkim will be the first region in

Organic farms in Asia, Africa, and Latin America mostly manage small areas. Australia has the largest organically farmed land – more than 35 million hectares

ALTERNATIVE REALITIES
Organic farming, by continent



2017. Based on estimates

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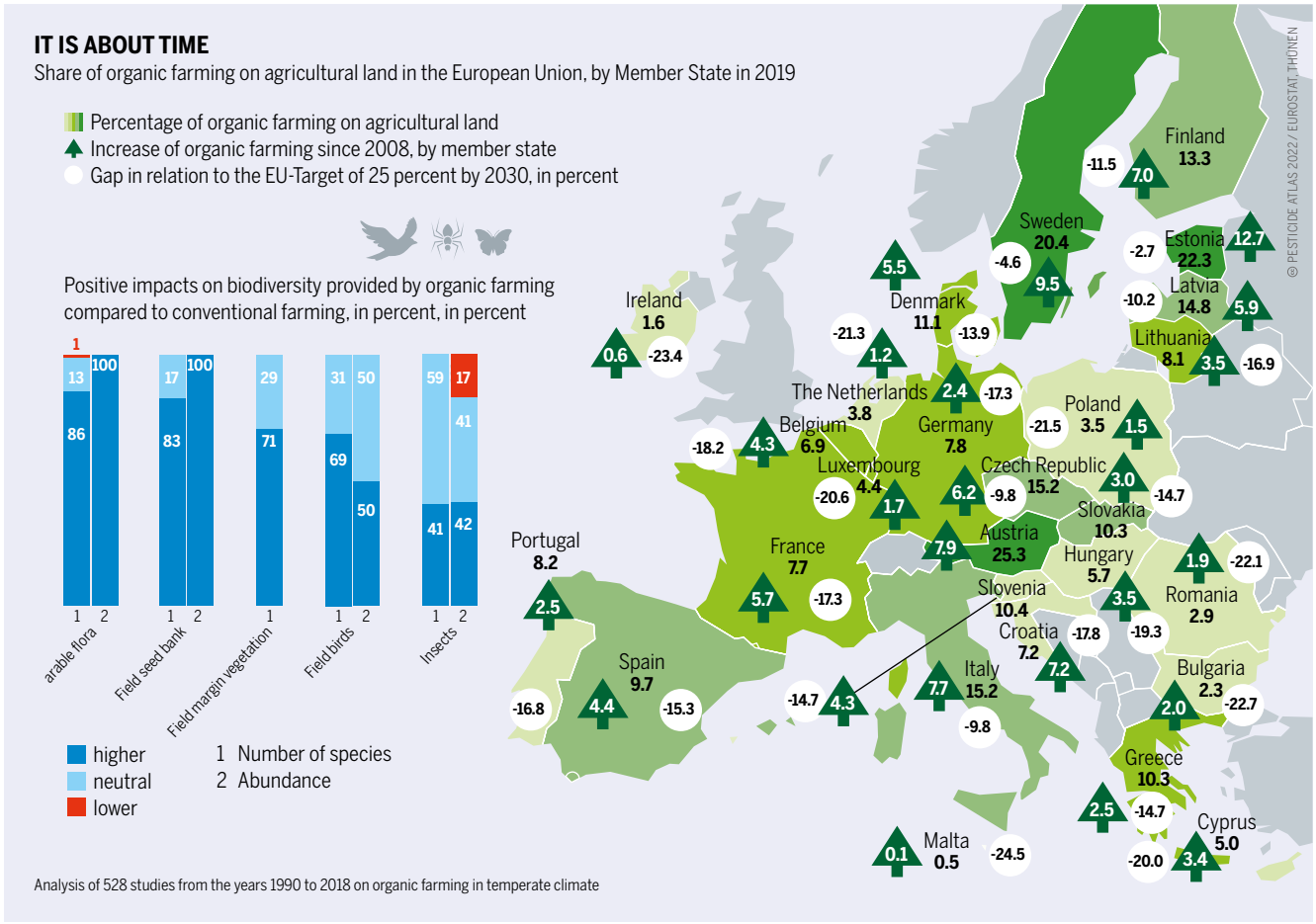


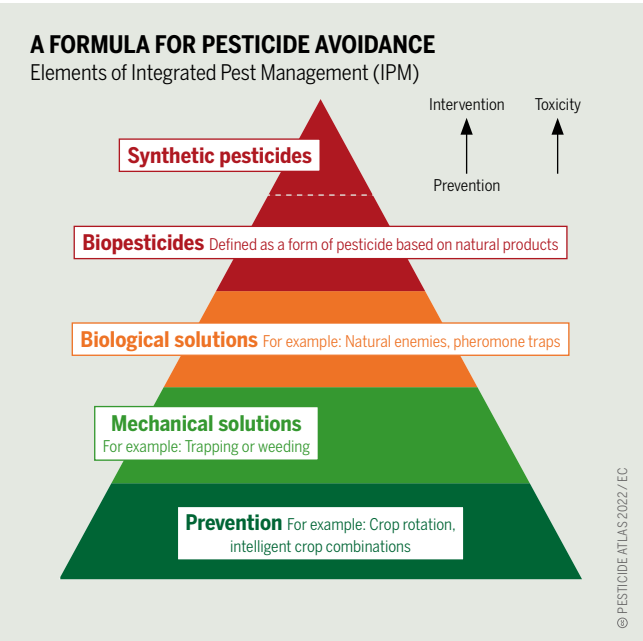
the world to have a 100 percent organic agriculture. This is a huge paradigm shift in a country that for decades had relied on the heavy use of synthetic fertilizers and pesticides.

Key to the decision in Sikkim were rising cancer rates, polluted rivers, and infertile soils due to pesticide usage. The Sikkim government also attributed its move to the fact that pesticide residues – including many that are banned in other countries – have contaminated staple foods such as rice, vegetables, and fish. The Indian state of Andhra Pradesh – about the size of Austria, Denmark and the Netherlands combined – announced in 2018 that the state's approximately six million farmers will work without synthetic chemical pesticides by 2024 at the latest. Sri Lanka is following this lead: To achieve the goal of 100 percent organic agriculture, the government had temporarily banned the import of chemical fertilizers and pesticides in April 2021. A few months later after an economic crisis, the government reversed the decision and allowed imports again.

However, the country is sticking to the fight against toxic substances: For years now, the government has been tightening restrictions with the pesticide control law, banning a total of 36 Highly Hazardous Pesticides.

Member States still have until 2030 to increase organically farmed land to a quarter of total agricultural land, as stipulated in the EU's Farm to Fork Strategy

For this effort, the country received the Special Future Policy Award in 2021, dedicated to the most effective policy solutions that protect people and the environment from hazardous chemicals. ●



IPM is an approach to suppress pest populations. It uses biological and ecological knowledge to avoid pesticides – their use is a last resort

PALESTINE

BANNED IN EUROPE, TRADED LOCALLY

Press and investigative reports have revealed the excessive use of banned pesticides has taken on a new dimension: those banned in Europe find their way into the hands of Palestinian farmers. Isn't the rule of thumb: what is dangerous in one place is dangerous everywhere?

If your path ever leads you to the northern Jordan Valley – Palestine's vegetable basket – you will witness firsthand the uncontrolled use of agricultural pesticides. It's a situation characterized by chaos and randomness, with a clear absence of the most basic precautionary measures and safety standards. One of the most prominent issues is excessive spraying of various kinds of pesticides. Farmers often use large quantities of a single pesticide or combine multiple pesticides at the same time, mistakenly believing that such practices will provide better crop protection. This extends to the use pesticides that are banned but smuggled from the illegal Israeli settlements in the West Bank.

After Israel occupied the West Bank and the Gaza Strip in 1967, Palestinian agriculture was greatly affected. The introduction of external agricultural sciences caused the loss of much of its originality and inherited agricultural knowledge. Many locally produced (baladi) crops were lost due to the disappearance of heirloom seeds. Palestinian agriculture became entirely subject to the influence of foreign monoculture and chemical agriculture, with all that entails in terms of the use of hybrid, and later genetically modified seeds. This has also been accompanied by the intensive use of agricultural chemicals such as fertilizers and pesticides.

For decades, funding from international financial institutions and various agricultural programs in Palestine has pushed Palestinian farmers towards agricultural practices, which have proven globally unsuccessful, such as monoculture. After this was experienced, Europe and North America began to shift towards developing sustainable and ecological agriculture. There has also been a growing trend towards agricultural diversification as a necessity for livelihood and economic stability, and as an alternative to monoculture farming, which requires great dependence on external production inputs, such as pesticides, chemical fertilizers, hybrid seeds, water, financial loans, etc. In addition, industrial monoculture has caused environmental pollution, disrupted the natural ecological balance, destroyed soil fertility, and consumed scarce water.

Banned in Europe... Allowed elsewhere!

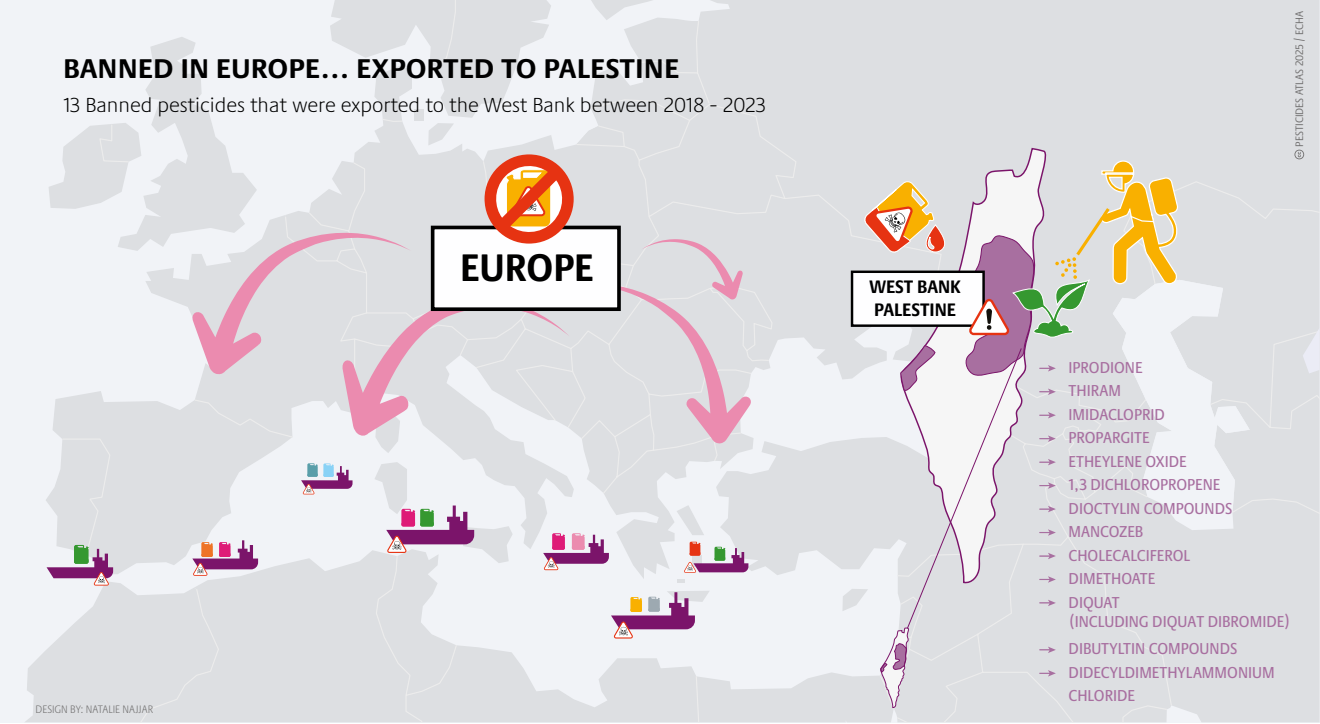
More than 500 pesticides are not banned for use in the West Bank, although some are prohibited in the European Union due to their health impacts and environmental hazards. An investigative report, "Poison: Banned European Pesticides Exported to Arab Countries," revealed that between 2018 and 2023, 13 pesticides banned or restricted in the European Union were exported to the Palestinian territories. The Director of the Pesticides Department in the Palestinian Ministry of Agriculture and member of the Scientific Committee, Salama Shabib, however, stated that it is conducting a study and reevaluating pesticides to decide whether to allow or ban their use.

It is acknowledged by the scientific committee specialized in pesticides section that decisions to allow or ban pesticides prioritize the economic importance of maintaining agricultural production over health and environmental risks. Other considerations include allowing the import of these pesticides by citing differences between Europe and Palestine, the farmers' need for these pesticides, and the fact that "prohibition in one country does not mean local prohibition." As a result, pesticides banned internationally due to harmful substances are likely to remain in circulation.

The report of the State Audit and Administrative Control Bureau (October 2021) indicated the weak performance of the Scientific Committee due to the absence of an operational procedures manual and the lack of updates to the pesticide guideline in line with global studies and research. This has allowed the circulation of internationally banned pesticides containing harmful substances.

For example, the pesticide Mancozeb was banned in the West Bank in 2012, but the Palestinian Scientific Committee reauthorized its use in 2017 and it remains permitted until the publication of this article. According to the report of the European Food Safety Authority (EFSA), this pesticide causes endocrine disruption in humans because it alters hormonal balance. However, this was not enough for the Ministry of Agriculture and the Palestinian Scientific Committee to reinstate the ban of the pesticide. This example clearly illustrates the arbitrary working mechanism of these bodies.

An interview with Ministry of Agriculture and a State Audit and Administrative Control Bureau report, reveals a of lack sufficient regulatory monitors and inspectors. Furthermore, the limited number of agricultural extension workers are unable to fulfill their roles in monitoring and providing guidance. Alongside the possibility that some importers may circumvent the official procedures for pesticide licensing. Field observations and feedback from farmers reveal that many do not follow strict preventive measures when spraying pesticides. Instead, they rely on what they describe as 'experience,' without adhering to the instructions provided on the pesticide packaging during spraying operations.



Billions of financial gains

In 2018 alone, European companies exported more than 81,000 tonnes of highly hazardous pesticides banned in the EU due to "unacceptable risks they pose to human health and the environment," according to the non-governmental organizations Greenpeace and Public Eye. The United Kingdom, Italy, the Netherlands, Germany, France, Belgium, and Spain accounted for over 90 percent of these exports. Moreover, three-quarters of the 85 importing countries (including Palestine) are low- or middle-income countries, where the use of these substances is allowed despite their known risks.

An analysis of a large database of best-selling "crop protection products" for 2018 revealed that the world's leading agrochemical companies generated over 35 percent of their sales from pesticides classified as "highly hazardous" to humans, animals, or ecosystems. According to Statista, a leading statistics portal, the total sales of pesticides for the top 20 companies globally in 2022 amounted to $85.7 billion, representing an 18 percent year-on-year increase, from $72.5 billion in 2021. Four companies (Syngenta, Bayer, BASF and Corteva) accounted for 55 percent of the list's total sales. With the exception of Nanjing Red Sun, all companies had revenues exceeding $1 billion. In 2023, Syngenta was ranked as the leading global crop protection company by revenue, with pesticide sales totaling approximately $15.43 billion. Bayer CropScience, a division of Bayer AG, ranked second with pesticide sales of $11.4 billion. Bayer CropScience's total revenue for the year, which includes both seed and pesticide sales, exceeded €23 billion.

Despite their obvious dangers, many types of pesticides banned in Europe continue to find their way to many Arab countries, including Palestine, through a European legal and legislation system that turns a blind eye to the export of these toxins. These double standards of the European Union pose real challenges to environmental, health, and social safety standards. With the failure to pass amendments to the law on the export of hazardous pesticides abroad, pesticide lobbies continue to reap billions of dollars at the expense of the health and lives of humans and organisms that are of great agricultural importance. This occurs at a time when accurate statistics on the impact of these pesticides in impoverished importing countries are lacking. The effects of these toxic substances often remain hidden, emerging only after years of exposure and the consumption of crops treated with numerous types of pesticides.

In the Palestinian territories, the journey to achieving effective control that limits the excessive use of agricultural poisons appears long and arduous. It's a journey that requires strict control from the Scientific Committee, the Ministry of Agriculture, the Ministry of Health, and the Environmental Quality Authority and bold decisions to ban pesticides that have been banned in other countries as a precautionary measure. Until the first step in the thousand-mile journey is taken, people's health and our biodiversity-rich environment remain at risk, waiting for the bell to be tolled. ●

JORDAN

BANNED PESTICIDES IN DISGUISE

Due to high competitiveness in regional and global vegetable and fruit markets, farmers resort to using banned pesticides, such as paraquat and methomyl, to quickly eliminate crop pests and achieve financial profits, disregarding human health and the environment.

Banned pesticides, which are prohibited from trade and use internationally, find their way into Jordanian markets, invading agricultural supply stores, particularly those located in areas such as South, North, and Central Shouneh. The sale of these pesticides is not limited to stores in South Shouneh, Central Shouneh, and Deir Alla in Balqa Governorate, North Shouneh in Irbid Governorate, and Rama in the capital city of Amman. It extends to numerous other stores specializing in agricultural pesticides across the kingdom.

Anyone working in the agricultural sector, or even those who own private farms, can easily purchase them from these stores. Even though these pesticides pose significant risks to human health and the environment – causing diseases like cancer, genetic mutations, and birth defects.

At the top of these banned substances is the pesticide paraquat, which is sold under fake trade names and is illegally imported from a neighboring Gulf country and China. Since 2013, Jordan's lists of banned pesticides have contained paraquat due to its serious delayed effects upon absorption, which can be fatal to humans. According to warnings from the World Health Organization (WHO), it can lead to acute poisoning, respiratory difficulties, and damage to the nervous system and kidneys. Due to its high effectiveness in killing weeds quickly and upon contact, farmers prefer to buy the non-selective herbicide paraquat. Paraquat ranges in price from 25 JODs ($35.27) to 40 JODs ($56.43) for a five-liter container.

It is not just paraquat that is available on store shelves; there are also other pesticides, such as methomyl, that have not been approved for sale by the Ministry of Agriculture. Methomyl is marketed under various trade names, including Lannate.

The primary reason for the spread of these pesticides, which enter the Hashemite Kingdom of Jordan illegally through land border crossings, is the inadequate regulation by relevant authorities over agricultural supply stores throughout the kingdom's governorates.

Perhaps farmers' preference for using these pesticides primarily stems from their desire to achieve financial profits and to ripen their diverse crops within a very short period, given the intense competition in the vegetable and fruit market in the kingdom.

There is a paradox here. Albeit being internationally banned, international reports, including one published by Public Eye organization in November 2023, have pointed out the 'double standards' in dealing with banned pesticides and active substances in terms of their trade, use, and distribution. The report revealed that in 2018, European Union countries approved the export of more than 81,000 tonnes of pesticides containing 41 hazardous chemicals, which are banned for use by their own farmers, to low- and middle-income countries such as Brazil, Ukraine, Morocco, and Mexico.

This double standard is not limited to exports alone; the lists of the European Union, the U.S. Environmental Protection Agency (EPA), and the Rotterdam Convention ban several active substances and agricultural pesticides, none of which are included on Jordan's list. This is because the Ministry of Agriculture relies solely on official communications directed to it from those entities with the names of the banned active substances.

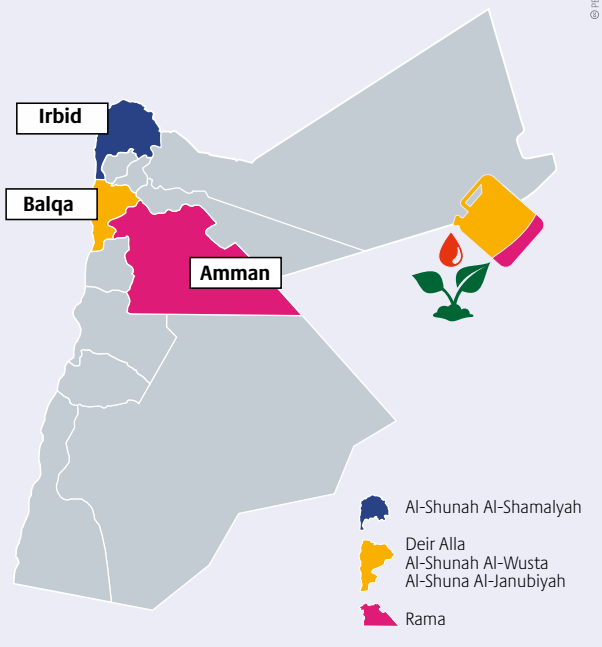
According to data from the Ministry of Agriculture, Jordan has banned about 71 active substances. While the Rotterdam Convention lists 55 banned chemicals, including paraquat, the National Pesticide Information Center (NPIC) – which partners with the U.S. Environmental Protection Agency (EPA) – only includes 28 banned active substances in its list, such as methomyl.

Between the double standards and the lack of awareness among farmers about the harmful effects of pesticides, the responsibility among official entities remains unclear. For instance, the Ministry of Environment places full responsibility for the permission or prohibition of the trade and use of agricultural pesticides on the Ministry of Agriculture, considering it is "the competent authority" in this field.

Through their membership in the Pesticide Registration Committee, which was previously formed by the Ministry of Agriculture and in accordance with its law, the role of each entity is framed. This committee includes representatives from the Ministries of Health (MOH) and Environment (MOE), the Jordan Food and Drug Administration (JFDA), the Royal Scientific Society (RSS), public Jordanian universities, the Association of Agricultural Materials Traders and Producers (AMATPA), the Jordan

EXAMPLES OF AREAS WHERE PROHIBITED PESTICIDES SPREAD IN JORDAN

Paraquat and Methomyl are prohibited in Jordan, yet are sold in some agricultural stores in governorates of Irbid, Balqa, and Amman (not limited to these areas)



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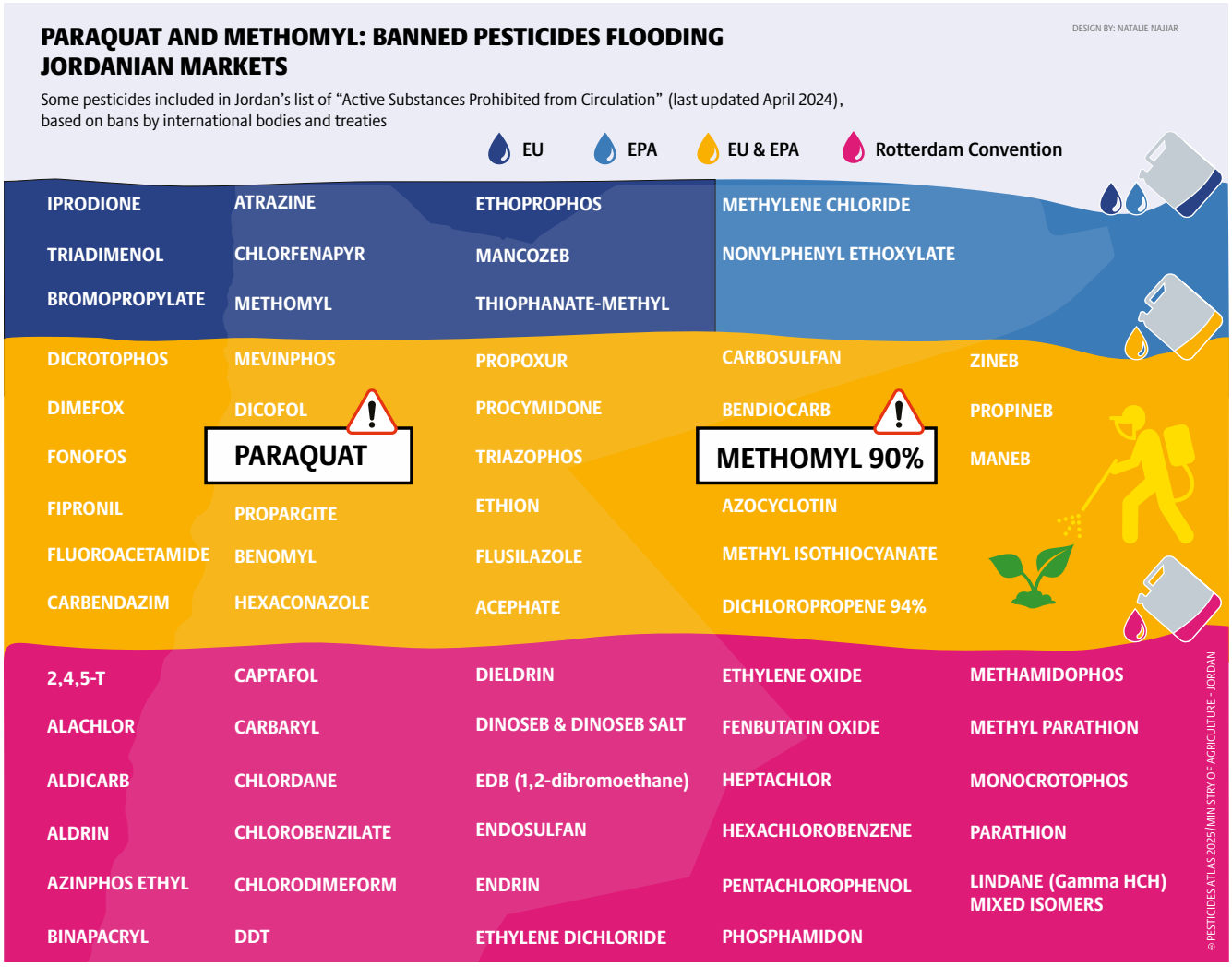
DESIGN BY: NATALIE NAJJAR



Chamber of Industry (JCI), the National Center for Agricultural Research (NARC), the Agricultural Engineers Association (AEA), the Plant Wealth Laboratories, the Head of the Pesticide Registration and Manufacturing and Import Control Division, and the Head of the Pesticides Department.

No complaints, violations, or seizures of internationally banned active substances and agricultural pesticides being traded in local markets have been reported or recorded by the Ministries of Agriculture and Environment, despite the presence of this committee, specifically since 2018. There are 167 licensed stores across the kingdom that sell agricultural pesticides. These stores are subject to periodic inspections by the Ministry of Agriculture's inspection teams to ensure that the products offered for sale meet the required standards

According to its laws and in cooperation with all border centers, the Ministry of Agriculture prohibits the entry of any active substances except through licensed companies. However, there have been instances where five-liter or ten-liter containers of pesticides were seized with travelers coming from outside the kingdom. There is a procedure in place for the disposal of seized pesticides, which are transported to the Swaqa hazardous waste landfill in cooperation with the Ministry of Environment.

Regarding the substances imported by companies, the procedures before allowing their entry into Jordan include sampling by the Ministry of Agriculture's teams to verify their compliance with the requirements. The registration of pesticides in Jordan relies on international references that employ advanced registration systems, such as those used by the European Union and the U.S. Environmental Protection Agency (EPA). These pesticides must meet specific global standards and be subject to toxicity studies to prove their safety. This means that the cancellation or approval of any active substance for trade and use is directly linked to what is issued by these advanced, internationally recognized systems.

The number of active pesticides registered with the Ministry of Agriculture (both prohibited and non-prohibited) is about 243 substances, categorized under 2205 trade names. Across the kingdom, there are 23 factories registered and licensed by the Ministry of Agriculture to produce pesticides, and 147 companies are authorized to import these substances from outside Jordan, according to ministry statistics. However, some local factories continue to produce pesticides under various trade names that contain active substances with toxicity and danger levels similar to those that are internationally banned and prohibited. Yet, they are sold regularly by agricultural supply stores without any governmental prohibition.

To ensure that the active substances used by local factories comply with international standards and those adopted by the Ministry of Agriculture, a device is used to test these substances. This is a new step that has been incorporated into the monitoring process carried out by their teams. The licensing process for factories is subject to the instructions for registering pesticides and their manufacturing, preparation, import, trade, and distribution for the year 2023. One of its clauses requires that the factory meets 21 good manufacturing requirements, according to data from the Ministry of Agriculture.

TUNISIA: PESTICIDES GOVERNANCE

WHAT SHOULD BE KNOWN ABOUT PESTICIDES IN TUNISIA

In 2022, Tunisia imported 4,161.2 tonnes of pesticides, reflecting a significant 33 percent decrease from the previous year. This decline is largely due to reduced cultivated areas resulting from drought and water scarcity, alongside a general lack of awareness regarding the severity of the situation and the dangers associated with pesticide use.

Tunisia's adhesion to international agreements on pesticides

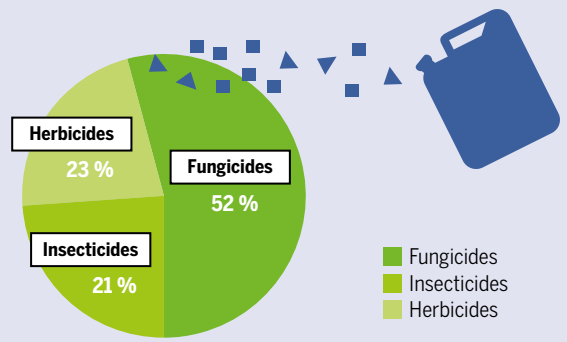
Tunisia has joined multiple international conventions aimed at regulating pesticides and protecting the environment. Table 1 lists the most important ones that are both signed and ratified by Tunisia. Despite Tunisia being a member of the International Labour Organization (ILO), it has not yet ratified ILO convention on Safety and Health in Agriculture (C184).

National Regulations on Pesticides Use

Since the 1960s, Tunisia has adopted a range of laws aimed at regulating pesticide use. The starting point was with Law No. 61-39 of 7 July 1961; along with its implementing decree No. 61-300 of 28 August 1961. These regulations govern the trade and use of agricultural pesticides and established an homologation process of pesticide products through a technical commission, which was officially formalized in 1977. Additionally, Law No. 92-72 of 3 August 1992, and its implementing decree No. 92-2246 of 28 December 1992, set standards for the manufacturing, importing, formulation, packaging, and marketing of pesticides. Pesticide control is mandated in this decree and is enforced by authorized inspectors who monitor the facilities for the manufacturing, formulation, packaging, and distribution of agricultural pesticides and issue reports accordingly. All agricultural pesticides are automatically inspected upon importation (decree No. 94-1744 of 22 August 1994) by laboratories accredited by the Ministry of Agriculture.

The evolution of pesticide imports in Tunisia from 2016 to 2022 shows that in 2022, imports totaled 4,161.2 tonnes, marking a 33 percent decrease compared to the previous year due to the reduction in cultivated areas caused by drought and water scarcity.

FIGURE 2- DISTRIBUTION OF PESTICIDES BY TYPE



Imported pesticides in Tunisia for the year 2022 were as follows: 52 percent fungicides, 23 percent herbicides and 21 percent insecticides

FIGURE 1: QUANTITY OF PESTICIDES IMPORTED ANNUALLY INTO TUNISIA

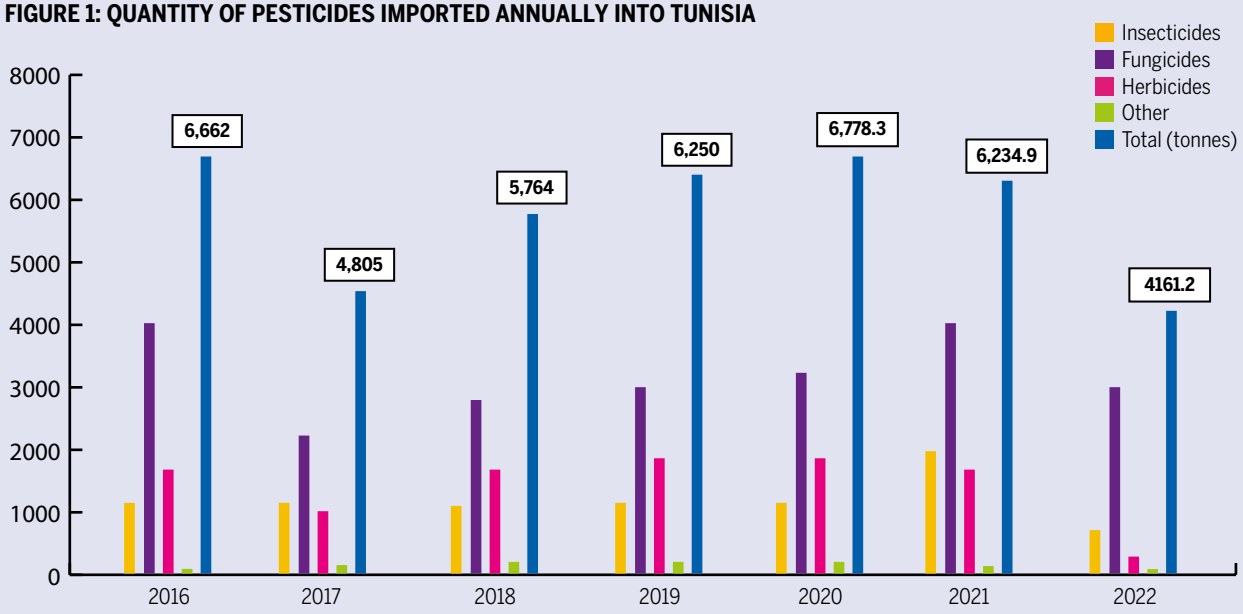


TABLE 1: LIST OF MAIN CONVENTIONS AND PROTOCOLS SIGNED AND RATIFIED BY TUNISIA

CONVENTION/PROTOCOL	OBJECTIVES	LEGAL REFERENCES
VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER	Protecting human health and environment from the harmful effects resulting from the deterioration of the ozone layer.	- Law No. 54 of 1989 dated 14 March 1989 relating to an authorization for the Republic of Tunisia to join the Vienna Convention for the Protection of the Ozone Layer (issued in Official Gazette No. 20 dated 21 March 1989).
MONTREAL PROTOCOL	Halving of substances that deplete the ozone layer and its restoration.	- Law No. 55 of 1989 dated 19 March 1989, authorizing the accession of the Republic of Tunisia to the Montreal Protocol on Substances that Deplete the Ozone Layer. (Published in the Official Gazette No. 20 dated 21 March 1989). - Law No. 44 of 1993 dated 3 May 1993, authorizing the accession of the Republic of Tunisia to the Amended Montreal Protocol on Substances that Deplete the Ozone Layer (issued in Official Gazette No. 35 dated 11 May 1993). - Law No. 72 of 1994 dated 27 June 1994 authorizing the accession of the Republic of Tunisia to the amendments relating to the amended Montreal Protocol on Substances that Deplete the Ozone Layer, adopted at the Fourth Meeting of the Parties (issued in Official Gazette No. 51 dated 1 July 1994). - Law No. 77 of 1999 dated 2 August 1999 ratifying the amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer adopted at the Ninth Meeting of the Parties (issued in Official Gazette No. 63 dated 6 August 1999). - Law No. 79 of 2004 dated 6 December 2004 approving the Republic of Tunisia's accession to the amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (issued in Official Gazette No. 98 dated 7 December 2004).
BAMAKO CONVENTION	Banning the import of hazardous waste into Africa, controlling of movement across borders, and managing hazardous waste produced within Africa.	- Law No. 11 of 1992 3 dated February1992 relating to the ratification of the Bamako Convention (published in the Official Gazette No. 9 dated 7 February 1992).
BASEL CONVENTION	Controlling the cross-border transport and disposal of hazardous waste.	- Law No. 63 of 1995 dated 10 July 1995 authorizing the accession of the Republic of Tunisia to the "Basel" Convention (published in the Official Gazette No. 56 dated 14 July 1995). - Order No. 2680 of 1995 dated 25 December 1995 relating to the publication of the Basel Convention adopted in Basel on 22 March 1989 (issued in the Official Gazette No. 4 dated 12 January 1996).
ROTTERDAM CONVENTION	Controlling the cross-border transport and disposal of hazardous waste.	- Organic Law No. 43 of 2015 dated 3 November 2015 approving the Rotterdam Convention. - Order No. 241 of 2015 dated 13 November 2015.
STOCKHOLM CONVENTION	Protecting human health and the environment from persistent organic pollutants.	-Law No. 18 of 2004 dated 15 March 2004 approving the Stockholm Convention on Persistent Organic Pollutants (published in the Official Gazette No. 22 dated 16 March 2004). -Order No. 918 of 2004 dated 13 April 2004, ratifying the Stockholm Convention on Persistent Organic Pollutants (published in the Official Gazette No. 32 dated 20 April 2004).

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Tunisian legislation also addressed issues related to Pesticides control, packaging, repackaging, hygiene, and workers' health and safety, through Law No. 2002-3469 of 30 December 2002. Other measures have been introduced, such as decree No. 2010-2973 of 15 November 2010, which revises and improves the previous decree No. 92-2246 by specifying the processes for obtaining administrative approval as well as the conditions for importing, packaging, and storing pesticides. In 2011, the government issued decree No. 2011-686 of 4 June 2011 to establish the amount and procedures for collecting contributions related to phytosanitary monitoring, analysis, certification, and temporary licenses for commerce in pesticides. Although Tunisia's regulations largely comply with international standards, there are still delays in implementing provisions that protect vulnerable groups and limit the availability of hazardous pesticides or regulate their use conditions.

Main international conventions on pesticides signed/ratified by Tunisia, with the exception of the International Labour Organization Convention C184 on Safety and Health in Agriculture.

Pesticides Usage and Areas with High Phytosanitary Pressure

There is no policy in place for systematic collection of information and the updating of statistics on pesticide usage by crop, nor their harmful effects on human health or environmental contamination. According to the study conducted by the National Agency for Waste Management (ANGeD) in 2013, the average pesticide usage in Tunisia is estimated to be 0.714 kg/ha.

Banned Pesticides Still in Circulation

Many dangerous pesticides that are banned in Europe are still available on the Tunisian market and are used by local farmers. In 2018, a national report from the Center for Innovation in Agriculture and Industry (IAAA), and which was conducted by CABI, identified 44 extremely hazardous active substances that were approved and shipped to Tunisia,

including chlorpyrifos. According to a 2018 study conducted in Sousse Governorate, residues of this pesticide were found in tomatoes at levels as high as 80 percent and 312 percent of the acute reference dose (ARfD) for adults and children respectively. A field survey conducted in 2019, among 27 vineyard farmers over three agricultural seasons (from 2015 to 2017) across six governorates (Ben Arous, Nabeul, Bizerte, Zaghouan, Jendouba, and Béja) revealed that 24 percent of the pesticides used were not approved for grape cultivation or had been withdrawn from the market.

Several government agencies are involved in pesticide management in Tunisia, key actors listed in Table 2.

However, it is noted that there is no policy aimed at producing and disseminating adequate and accurate educational materials on the use and management of pesticides.

Although several laws and decrees have been issued in Tunisia regarding pesticide management and the protection of human health and the environment, there is still a long way to go to align our regulations with constantly evolving international standards.

Regulations Regarding the Protection of Human Health and the Environment

Unfortunately, there are no policies in place to educate users about the importance of protecting health and the environment, or to conduct health-monitoring programs for those who use pesticides in their jobs. The legislation does not contain provisions prohibiting the use of pesticides by children and pregnant or breastfeeding women, nor does it require employers to take the necessary measures to prevent pesticide use by this vulnerable group. However, the legislation does require employers to take the necessary measures to protect workers' health and the environment. Therefore, they must ensure that all workers, including those in agriculture, are protected by the legal framework.

In this context, a study was conducted by the Food and Agriculture Organization (FAO) in 2019 on the effects of pesticides in Tunisia on human health and the environment. The study covered three agricultural regions: Ben Arous, Nabeul, and Monastir, involving 1174 farmers. The study found that only 33 percent of the farmers surveyed 'used personal protective equipment (PPE)', while the majority (42 percent) had 'never worn it'. The remaining farmers surveyed (25 percent) 'wear only a few pieces of equipment' that they deemed essential for protecting their health (gloves, shoes, masks). Although they are aware of their importance, various reasons were cited for not using PPE, such as high costs (no subsidy scheme), unavailability on the market, bulkiness, or unsuitability due to high temperatures.

On the other hand, the survey revealed that surveyed farmers showed negligence regarding the health and environmental risks of pesticides. This is evident from practices such as 'burning empty packaging outdoors' (63 percent), 'abandoning waste in nature' (30 percent), 'storing pesticide at homes' (22 percent), and frequently disregarding the recommended dosages and pre-harvest intervals.

The study ultimately highlighted that a large percentage of the farmers surveyed (81 percent) had a low level of education (primary and secondary), and that 91 percent had not received training on best practices for pesticides use. This certainly has serious repercussions on the effectiveness of treatment processes, both for the user's health, and for environmental pollution.

Several medical studies conducted in Tunisia confirm that exposure to pesticides significantly increases the risk of developing several serious diseases. In a 2020 study, Parkinson's disease was linked to pesticide exposure. Another study published in 2018 found an association between breast cancer and pesticide exposure. Lastly, a 2016 study highlighted the link between pesticides and primary bronchopulmonary cancers (PBPC).

Agroecology vs. Pesticides

The intensification of agricultural production is partly achieved through increased use of pesticides and fertilizers. To preserve our environment and human health, it has become necessary to shift towards healthy methods such as Integrated Pest Management (IPM), which FAO defines as "designing crop protection operations so that their application requires a set of methods that meet environmental, economic and toxicological requirements." Agroecological crop protection depends on the principles of agroecology to create resilient agroecosystems that can withstand pests and diseases while ensuring the sustainability of cropping systems and environmental preservation. This approach involves adopting various techniques aimed at (i) improving soil fertility, such as crop rotation, using manure as natural fertilizer, intercropping, no-tillage, and applying beneficial microorganisms; (ii) developing biodiversity within cultivated fields and surrounding areas; (iii) reducing the use of pesticides, thus minimizing reliance on chemical pesticides. Several studies on Integrated Pest Management (IPM) have been conducted in Tunisia.

Combating the carob worm (Ectomyelois ceratoniae), which attacks a wide range of host plants, using the mass trapping technique, has proven effective in reducing infection rates in citrus orchards, and palm orchards. Natural predators such as Trichogramma cacoeciae are used to control tomato leaf tunnelers (Tuta absoluta), while entomopathogenic nematodes (EPN) work in cooperation with bacteria to control on the wax moth Galleria mellonella.

A list of main Tunisian government institutions involved in pesticides governance

TABLE 2: LIST OF MAIN GOVERNMENT STRUCTURES INVOLVED IN PESTICIDES MANAGEMENT AND ENVIRONMENTAL PROTECTION

GOVERNMENT STRUCTURES	ROLE	MANDATE
DGSVCIA (General Department of Phytosanitary and Agricultural Input Control)	Approval of pesticides intended for agricultural use	- Examination of applications for registration - Verification of the effectiveness of pesticides - Environmental impact assessment - Publication of the list of registered products
- DGSVCIA **- ANCSEP** (National Agency for Sanitary and Environmental Control of Products) - CRDA (Regional Commissariats for Agricultural Development)	Application of pesticide legislation	- Control of pesticides marketing **(DGSVCIA)** - Coordination with national and international institutions specialised in health control **(DGSVCIA)** - Participation in the preparation of draft legislation and regulations relating to health control **(DGSVCIA)** - Proposals and contributions to the drafting of regulations and standards **(ANCSEP)** - Implementing laws related to animal and plant health **(CRDA)**
- ANCSEP **- DGSVCIA**	Food safety and health problems linked to pesticides	- Coordination and consolidation of health and environmental control activities for products carried out by the various relevant control structures reporting to the various ministries **(ANCSEP)** - Analysis of pesticides residues in agricultural products **(DGSVCIA)**
- ANPE (National Environmental Protection Agency) **- ANCSEP** **- ANGeD** (National Agency for Waste Management) **- CRDA**	Impact on the environment	- Drawing up government policy on pollution control and environmental protection and its implementation **(ANPE)** -Promoting training, education, study and research activities in the field of pollution control and environmental protection **(ANPE)** - controlling and monitoring the discharge of pollutants and the facilities for treating these pollutants **(ANPE)** -Pollution prevention, control and elimination **(ANCSEP)** -Conducting prospective studies on the environment to ensure appropriate conditions for sustainable development **(ANCSEP)** -Integrated and sustainable waste management **(ANGeD)** -Improving the institutional, legal and economic and financial management of waste **(ANGeD)**
-Research institutions affiliated with **IRESA** (Institution of Agricultural Research and Higher Education), the most important of which are: **- CTAB** (Technical Center for Biological Agriculture) **- INRAT** (National Institute for Agricultural Research in Tunisia) **- INAT** (National Institute of Agronomic Sciences in Tunisia)	Agricultural research	- Encourage and promote alternative solutions to existing pesticides -Developing research programs and experiments - Transfer of technology, training, and coaching
- AVFA (Agricultural Extension and Training Agency) **- CRDA** **- CTAB** **- INPFCA** (National Institute of Pedagogy and Continuing Agricultural Training)	Popularisation, training and support for producers	- Contribution to the design and implementation of national policies for guidance and vocational training in the agricultural and fisheries sectors **(AVFA)** - Developing, monitoring and evaluating vocational guidance and training programs **(AVFA)** - Support for field extension programs developed by the CRDAs **(AVFA)** - Developing farmers' skills - Networking between various stakeholders to enhance the transfer of knowledge in research and innovation **(AVFA)** - Ensuring the research results are adapted to the real conditions on farms **(CTAB)** - Ensuring guidance and technical support for farmers and training agricultural advisors in the field **(CTAB)** - Technical support and encouragement **(CRDA)** - Technical and pedagogical training for mentors **(INPFCA)**

TUNISIA: HIGHLY HAZARDOUS PESTICIDES

A CHALLENGE FOR HEALTH AND THE ENVIRONMENT

As in many countries, pesticides are widely used in Tunisia, which poses potential risks to human health and the environment. Despite their known risks, research on pesticides use and their effects is still lacking. It is challenging to assess the extent of pesticide-related problems in Tunisia and develop a reliable strategy to safeguard both the population and the environment.

The Main Problem

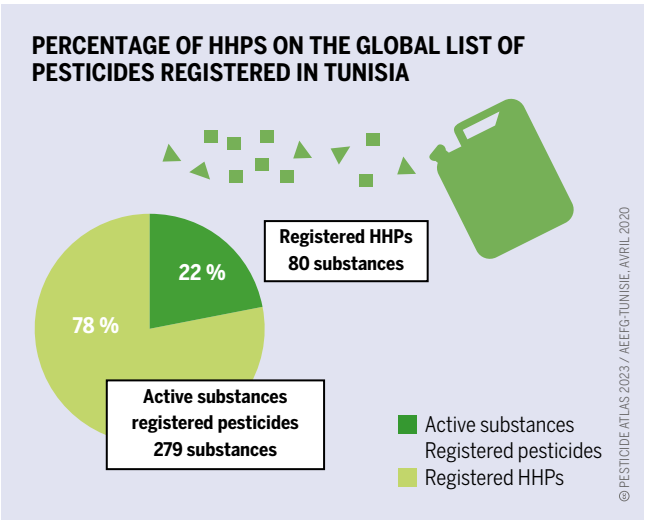
Tunisia does not produce pesticides and is totally dependent on importing them.

The use of pesticides creates significant problems and amplifies the associated risks. The report on irrigated agriculture in Tunis allows to highlight the shortcomings in pesticide control, which are mainly:

- Non-compliance with legislative texts at several levels (marketing, storage, application, residues, protection, and management of empty containers).
- Lack of adequate post-homologation control procedures.
- Insufficient efforts to raise awareness and provide guidance for small and medium-sized agricultural producers and agricultural users on the risks related to pesticides and crop protection.
- The existence of parallel market.

Definition of Highly Hazardous Pesticides (HHPs)

High Hazardous Pesticides refer to pesticides that are known to have particularly high levels of acute or chronic health and environmental risks. In addition, HHPs also concern pesticides that may have serious or irreversible adverse effects on health or the environment under certain conditions of use in a given country, can be considered and treated as extremely dangerous pesticides.



Percentage of HHPs among the total pesticides registered in Tunisia. Concerns about potential risks of exposure and risks to people and the environment.

Effects of HHPs on Health

The health risks associated with HHPs pose a direct threat to those involved in their handling, such as farmers and vendors, as well as consumers, due to the residues that remain in agricultural products and can impact people during consumption. Lethal doses (LD^{50}) have been determined for most pesticides based on the specificities and contexts of major industrialized countries. Despite the existence of legislation, there is a difference in practices and controls in developing countries.

Thus, the term HHPs has been expanded and is now used to describe not only highly toxic pesticides but also pesticides that cause serious chronic health effects. Proving chronic health effects is usually much more difficult than demonstrating the acute toxicological effects. Chronic health effects linked to pesticides include cancers, tumors, nervous system disorders, reproductive problems, impacts on the immune system, and endocrine disorders. Moreover, children and women represent the most vulnerable population in rural areas given that the number of female farmers working in the fields is very high.

According to experts from the World Health Organization (WHO) and public health experts, the use of HHPS may partly explain the increase in cancer cases observed in Tunisia.

Some research on pesticide residues on table grapes mentioned that "sixty-four samples of table grapes from different regions of Tunisia were collected over three consecutive years (2015-2017). The presence of 96 pesticides, including dithiocarbamates, was assessed. All samples contained several residues (4 to 24 residues), with an average of 11.6 residues per sample. Individual pesticide concentrations in grapes ranged from 0.01 to 5.86 mg kg^{-1} .

Overview of HHPs for Agricultural Use in Tunisia

Approved HHPs in Tunisia

A recent report on HHPs in Tunisia shows the percentage of HHPs among the national list. Despite the lack of data on risk assessment and the dangers of exposure to the population and users, as well as the impact on the environment in Tunisia, it can be considered that the presence and use of this significant percentage of HHPs on Tunisian territory pose exposure risks and potential dangers associated with their attributed criteria.

Let's take tomato production as an example. Tunisia has the highest production of tomato paste in the world. As a result, tomatoes are likely to be subjected to 29 types of actives substances classified as HHPs. Similarly, the number of HHPs authorized for use on potatoes is also very high Given that the Tunisian population is a major consumer of tomatoes and potatoes, there is a high risk of exposure to pesticide residues. This risk is due to both the potential daily intake of pesticide residues, and their potential bioaccumulation in the body. Additionally, the possible interaction between various substances could lead to the formation of new, more harmful molecules.

The presence of pesticide residues further underscores the danger posed by these pesticides. One research conducted in Tunisia on grapes (which undergo numerous treatments with HHPs over three consecutive years (2015-2017) involved collecting 64 samples from various regions. It showed that these samples contained residues from 4 to 24 types of pesticides, including dithiocarbamates, with an average of 11.6 residues per sample. The individual concentrations of each pesticide ranged from 0.01 to 5.86 mg/kg^{-1}.

Double Standards

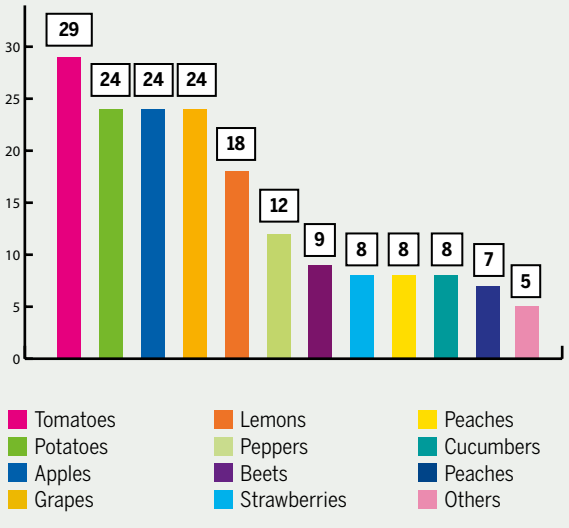
Many developed countries, including those in Europe, have acknowledged the threats posed by HHPs and a number of pesticides. In response, the European Union has implemented several measures to safeguard its population and environment by banning the production and use of these substances on European territory. However, this ban does not apply to developing countries, including Tunisia, whose imports continue to come from Europe. These are double standards, which raises the question: Isn't the value of human health equal throughout the world?

In 2018 and 2019, 240.5 tonnes of banned or restricted pesticides intended for agricultural use were exported from the European Union to Tunisia. Despite the European Union's ban, 33 active substances were still be imported into Tunisia until 2021.

Tunisian Civil Society Wins the Battle Against Pesticides

Tunisian civil society has been dedicated in its efforts to advocate for toxic-free and environmentally friendly agriculture. It has worked tirelessly to bring to light the dangers of pesticides, especially HHPs, and has strongly opposed their use due to the associated health risks. At each meeting, NGOs serving on the National Pesticide Certification Committee present and explain the health effects of listed pesticides, water contamination, damage to biodiversity, ecotoxicology, and other relevant factors associated with the active ingredients being considered for approval.

THE NUMBER OF ACTIVE INGREDIENTS USED VARIES ACCORDING TO THE TYPE OF CROP



The illustration shows the various ways HHPs are used on different crops in Tunisia. These practices entail health risks and threats to the population, particularly because of the high pesticide residues found in common foods like tomatoes and potatoes.

Some Tunisian journalists have also been trained in the topic of pesticides, and they in turn joined the efforts, posing questions and writing extensively about the pesticides banned in the European Union and brought into Tunisian territory. The issue of pesticides has garnered the attention of the international civil society for decades, leading to various platforms that denounce the dangers posed.

On 24 July 2023, the pressure exerted by civil society actors on the government, represented by the Ministry of Agriculture, paid off, and the use of HHPs was banned due to the danger they pose to the health of citizens.

For their part, the Ministry of Environment and the Ministry of Health acknowledged the danger of HHPs, which has led to banning 33 pesticides, of which 20 are classified as HHPs, 10 are pending, and 6 are of restricted use, which only gives the ministry the right to use them upon request.

TUNISIA: RETHINKING AGRICULTURE

A HOLISTIC AGRICULTURAL VISION FOR A PARADIGM SHIFT

Agriculture in Tunisia is facing critical challenges now with the recent findings on the use of phytosanitary products, which are banned in several countries, including Europe and the United States. This raises concerns about soil health, biodiversity, and food security in the country. Nonetheless, promising alternatives such as agroecology and permaculture are becoming more prominent, offering a holistic perspective for a sustainable transformation of the Tunisian agricultural sector.

Despite repeated revelations regarding the sale of some phytosanitary products in Tunisia that are banned in Europe and the United States are multiplying, no Tunisian official seems to be alarmed.

In April 2022, the Swiss NGO "Unearthed" stated that Tunisia is among the countries that imported chlorpyrifos. Tunisia represents the second-largest market for exports of this product from Belgium. The product was banned in the European Union, the United States, and Canada since 2020 due to its harmful effects on children's neurological development. Studies indicate that it significantly increases the risk of autism, lowers IQ, and causes attention disorders, as well as harming bee pollen, which is in danger of extinction worldwide. In addition, in March 2023, chlorpyrifos was detected on Maltese oranges exported to France. These oranges were immediately withdrawn from the market to 'protect the citizens.'

Although chlorpyrifos poses threat to our health, it was found in analysis results of on citrus fruits – an analysis requested by the Tunisian Permaculture Association to certify the production of a young sustainable farmer from the city of Menzel Bouzelfa, which is located in an area known for citrus cultivation. This young farmer has been regenerating his soil and applying permaculture principles for two years – thus the serious alarm. His certified "citizen food" citrus production was the victim of areo-spraying of chlorpyrifos. Consequently, he was unable to protect his produce, and was obliged to market his high-quality citrus through conventional channels, losing months of work that respected the land and living systems. Although it is also banned in Egypt, Palestine, Morocco, Turkey, among others, this insecticide remains on the list of approved products in Tunisia.

Seed: A Sovereignty Matter

Vegetable seeds included in the official list are largely hybrid seeds, purchased by farmers every year and require the use of phytosanitary products. These seeds have proven limitations, as they are not adaptable to the current drought and are not resistant to diseases, yet those kinds are the only ones legally allowed on the seed market. Moreover, their prices continue to rise, pushing farmers into irreparable debt, alongside the anxiety over the availability of seeds, which diminishes more each year. Reconsidering reproducible seeds that adapt to climate change and are resistant to diseases is also a solution strongly supported by civil society and Tunisia's gene bank. Furthermore, Peasant Seed Systems (SSP) are being revived to enhance community practices and knowledge and to preserve reproducible viable peasant seeds. These systems have existed since agriculture began but have been dethroned by seed marketing companies that have no interest in making room for established agricultural seed systems. These systems place the farmer at the center of the processes of seed multiplication, selection, and distribution, without claiming any intellectual property rights over them. Although these unrecognized systems guarantee sovereignty for the country, they are closely linked to traditional practices and orally transmitted knowledge that are sustainable, non-polluting, and adaptable to drought and climate change.

How to regenerate soil? How to develop and disseminate the principles of permaculture and agroecology in the current regulatory context in Tunisia? How to combat climate change sustainably when agriculture is dependent on climate?

There are several adaptation measures, such as conservation agriculture, integrated pest management, and optimized water management, but their implementation takes longer. It is still difficult to convince farmers not to practice tillage to ensure soil coverage and to limit water evaporation, or use organic fertilizer, for example. Such practices go a long way in conserving the few centimeters of rainwater and combating soil erosion and salinization.

For several years now, researchers at the Institution of Agricultural Research and Higher Education (IRESA) have been considering solutions for Tunisian agriculture that uses as few inputs as possible. The Higher School of Agriculture of Kef (ESAK) and the National Institute of Agricultural Sciences in Tunisia (INAT) have also established master's programs in environmental sciences/agricultural ecology, a subject that is still emerging in Tunisia. Confusion between practices and concepts still exists, even among the educators themselves. The notion of organic agriculture is more empowered because it is linked to a certification that meets a clear set of requirements, while agroecology (permaculture) are more ambiguous and often misused. The concept of permaculture is not just a mode of production but rather a way of life and a quest for autonomy (food, energy, etc.) which respects the 12 design principles and the 3 ethical principles, aiming to create a resilient ecosystem integrating humans, animals, and plants in a curated space that is not fixed but constantly evolving. Agroecology seeks to design production systems that rely on the functions provided by ecosystems. It focuses more on production techniques while respecting living or-

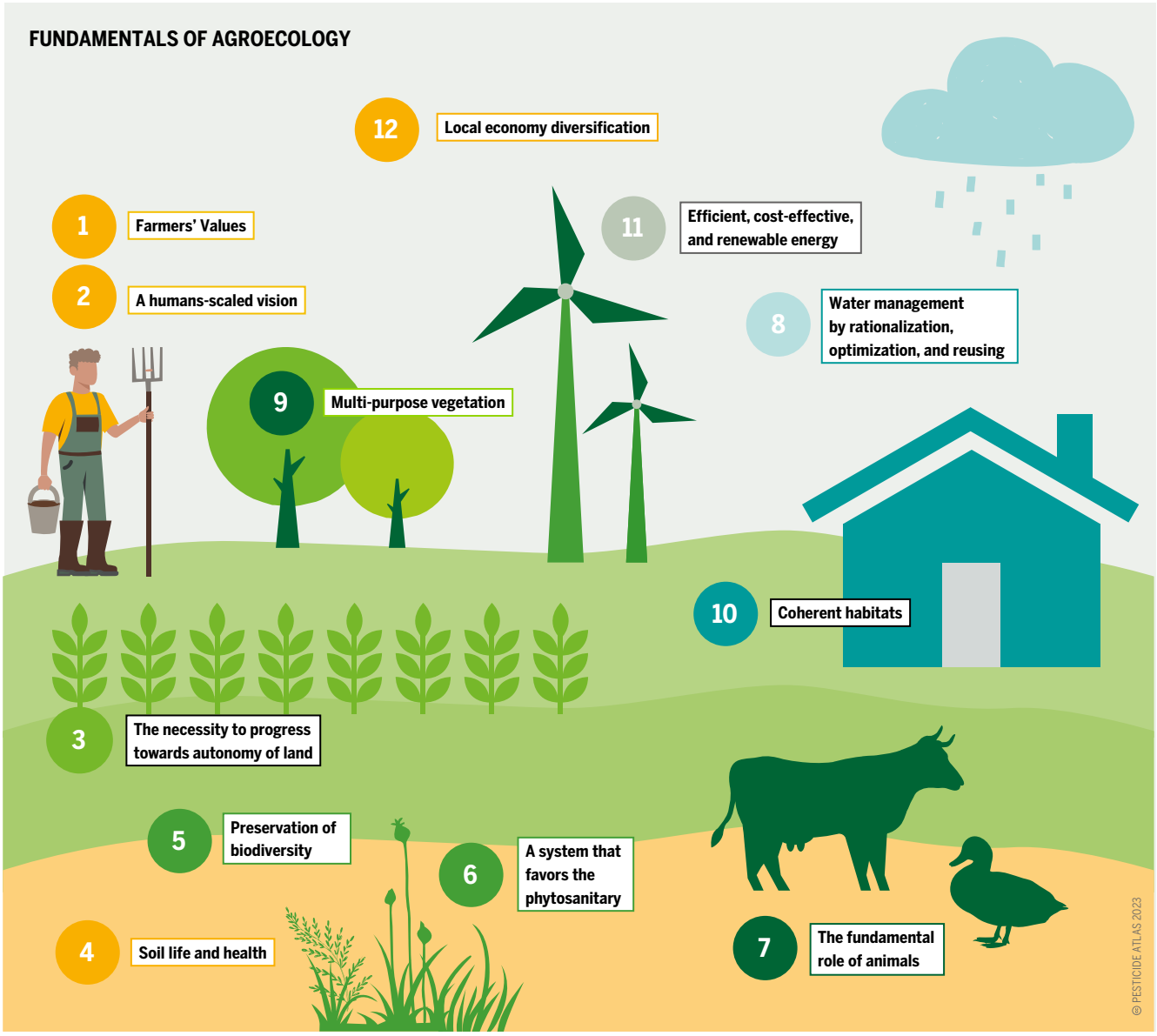


Illustration inspired by the work of Terre et Humanisme (Land and Humanity)

ganisms, working on soil regeneration, and limiting the use of phytosanitary products. Unfortunately, these concepts are not fully mastered by farmers, gardeners, or even within ministries.

What about the Solutions?

Agroecology and permaculture, which aim at creating a "forest-garden" and a resilient ecosystem, are undoubtedly practices that can mitigate the consequences of climate change and can accelerate soil regeneration in the medium and long term, provided a change happens in regulations and pesticide control is imposed, towards protecting consumers' health. Some Tunisian associations, such as the Tunisian Permaculture Association (ATP) the Tunisian Association of Environmental Agriculture (ATAE), and the Association for the Protection of the Chenini Oasis (ASOC) are guiding young farmers towards these practices, and are achieving promising results, although they have not yet been documented by researchers in Tunisia and are still adequately appreciated.

In the face of the accelerating pace of climate change, water scarcity, and lack of seeds, projects focusing on agroecology have recently multiplied, even if most of them remain tied to practices far from a rounded vision of agriculture. The paradigm shift that the country needs cannot happen without an agricultural revolution that respects living systems, soil, health, and the general wellbeing by means of a new vision or production and consumption. The notion of the authentic peasant seed system must also be recognized so that the seed cycles can freely thrive and ensure sovereignty. The farmer who provides the food for the country ought to be at the center of negotiations and discussions. It is also possible to develop a strategic agricultural vision by including orderly training and support for agriculture with high environmental value; one that includes all systems from production to distribution, not overlooking waste recovery. ●

MOROCCO

THE BITTER COST OF ABUNDANCE

Behind the alarming statistics on pesticide use, lies a rarely acknowledged reality: agricultural female workers and small-scale farmers are trapped in a system that sacrifices their health and dignity in the name of profit. Their testimonies reveal a daily struggle marked by grueling working conditions, exposure to chemicals without adequate protection, and the resulting tragic consequences. Exposing these realities aims to spark collective awareness and advocate for a fairer agricultural model – one that upholds human dignity and preserves the environment.

Pesticides: Invisible danger

In Moulay Bousselham, an agricultural region in Morocco renowned for its production of strawberries, raspberries, and other red fruits – and more recently for avocado farming – workers like Khadija reveal harsh realities: direct exposure to pesticides, lack of protective equipment, and limited awareness of the associated health risks. Crouching in the fields, they inhale toxic chemicals sprayed without any precautionary measures.

Intensive agriculture, a driving force of the local economy, relies heavily on pesticides and chemical inputs – a market valued at 2 billion dirhams (equivalent to 201 thousand US dollars), dominated by insecticides and fungicides. According to CropLife Maroc, a confederation of certified phytosanitary companies in Morocco, approximately 70 percent of the pesticide market is dedicated to agricultural use. Of the pesticides applied, 45 precent are insecticides, 40 precent fungicides, and 15 precent herbicides. Regarding crop types, nearly 44 percent are used in market gardens, 26 precent in plantations, and 21 precent in cereals.

To oversee this sector, Law 34.18, adopted in 2021, mandates the certification of products by The National Office of Food Safety (ONSSA), which monitors chemical residues to ensure food safety. However, on the ground, conditions remain alarming, exposing the limitations of this regulation.

Despite current regulations, the unchecked and excessive use of pesticides continues to be a significant issue in Morocco. Export market pressures, particularly from Europe, lead to risky practices, often resulting in products being rejected for non-compliance. In 2024, reports revealed the presence of banned substances like chlorpyrifos in peppers and hepatitis A in Moroccan strawberries. In 2023, 168 tonnes of non-compliant watermelons were destroyed, underscoring the scale of the problem.

According to Dr. Bouazza Kherrati, president of the Moroccan Federation for Consumer Rights, these pesticides are responsible for serious diseases, including cancer and neurological disorders. Between 2008 and 2016, Morocco recorded over 11,000 cases of acute induced pesticide poisoning. Agricultural workers, often untrained and without protection, are the most exposed, suffering from cumulative toxic effects that are overlooked by the sector.

The environment is equally affected: soil contamination, the collapse of biodiversity, and pollution of water resources. A study from 2023 lists over 600 threatened species and estimates that 24 percent of Morocco's flora could disappear – a heavy toll paid by intensive agriculture and its harmful practices.

Lives Ruined by Pesticides

Khadija, 55-year-old, from Douar Guenafda, has spent her entire life working in the fields around Moulay Bousselham to make a living and support her family. Moving from one harvest to the next - strawberries, mint, basil, etc. - she endured harsh working conditions in all kinds of weather, often without protection against pesticides. In 2018, she collapsed at work, suffering from respiratory issues caused by inhaling smoke and chemicals. The diagnosis: severe asthma and allergies, leaving her unable to work. However, her attempts to assert her rights were ignored. The 10,000 dirhams compensation offered by her employer was deemed insufficient, and Khadija faced the impunity of large agricultural employers.

Now deeply affected by the consequences of her work, she refuses to let her daughters suffer the same fate. Yet, her youngest daughter, only 16 years old, already bears the marks of indirect pesticide exposure, suffering from recurring asthma attacks since birth.

Women in Agriculture Facing Exploitation and Toxic Exposure

In Arbaoua, Yousra, 29, a mother of a 9-year-old child, represents the fate of many women in the region. After a divorce, she had to abandon her studies and work as an agricultural laborer to support her family. Every day, she wakes up at 4 a.m. to work on strawberry and raspberry farms intended for export. The days are long, the conditions harsh, and the pay meager (83 dirhams/day; equivalent to 8.3 US dollars/day). Women, selected for their docility, are exposed to pesticides without protection, suffering health problems with no information about the risks.

Malika, 35, has also been exposed to pesticides and chemicals without protection. Despite the health risks, she continues working to feed her family.

Small-scale farmers like Mustapha and Abdelkader are also poorly informed and use pesticides excessively, often without protection, despite warnings from suppliers. Inspections do occur, but they do not change much, as protective measures are only used when inspectors are expected.

Finally, pesticide waste management is a serious concern: some farmers continue to repurpose empty pesticide containers for packaging food. They store them improperly, bury them in the ground, burn them in open air, dispose them with household waste, abandon them in the fields, or discard them in nature, all of which contribute to soil pollution and environmental contamination.

Mobilizing the Public

Morocco's first consumer rights association has been active in fighting the overuse of pesticides since its founding in 1999 in Kenitra. A public awareness campaign was launched on television, highlighting the excessive use of these chemicals, particularly against the whitefly affecting tomatoes.

Agricultural workers and consumers were the primary victims. However, the association faced strong resistance from agricultural input producers.

In 2012, the National Federation for Consumer Rights was established, further increasing pressure on the authorities. Despite attempts at regulation, the agrochemical lobbies have hindered any meaningful progress, prioritizing economic interests over public health and environmental protection.

An awareness shift occurred in 2018, following the contamination of Moroccan mint by insecticides and rodenticides, leading to its ban due to health risks. That year, Moroccan exports were rejected by the European Union, sparking a public awareness campaign and stricter regulatory measures for export products. However, cases of non-compliance persist, damaging the country's reputation.

The Moroccan Local Market

While there has been some progress, the Moroccan pesticide market remains hindered by lax regulations and poor oversight. Pesticides banned in other nations are still in circulation, and smuggling and counterfeiting account respectively for 20 percent and 10 percent of the estimated 2 billion dirhams (almost 201 thousand US dollars) market, as reported by CropLife Morocco. Agricultural areas such as Loukkous, Gharb, Chaouia, Doukkala, Oriental, and Souss are the most affected by these illegal practices, posing significant risks to the economy, public health, and the environment.

Despite its responsibility for ensuring food safety, ONSSA faces difficulties in carrying out its duties due to limited human resources, centralized analysis in Casablanca, and a lack of regulation in weekly markets where pesticides are sold unchecked. A legal paradox worsens the situation: Law 13.83 excludes fresh produce from fraud enforcement, allowing 50 to 60 percent of citizens to purchase uncontrolled goods.

To address this issue, the National Federation for Consumer Rights is urging immediate reforms. It advocates for the use of environmentally friendly pesticides, improved training for farmers on adhering to harvest intervals, and heightened consumer awareness of best practices to minimize exposure to pesticide residues.

When Agroecology Challenges Pesticides

In response to the challenges posed by conventional agriculture and its overreliance on pesticides, agroecology is emerging as a promising and sustainable alternative. Since 2001, organizations like Terre et Humanisme (Land and Humanity) Morocco have been guiding both male and female farmers toward environmentally friendly practices, enhancing local ecosystems, and strengthening their autonomy. In 2013, the Agroecological Initiatives Network in Morocco (RIAM) became a key player in this transition, notably through the establishment of the Participatory Guarantee System (SPG), certified under the "Agroecology Morocco" label. This platform brings together more than 100 members, including farmers, cooperatives, associations, and consumers, with the aim of promoting an agricultural model that aligns with both nature and the economy.

RIAM aims to facilitate collaboration among agroecology stakeholders by encouraging the exchange of experiences and knowledge. It is also dedicated to supporting local initiatives by providing them with visibility, recognition, and access to the resources needed for their development. In addition, it strives to raise awareness among the public and decision-makers about the importance of agroecology, emphasizing its benefits for health, the environment, and the local economy.

Contrary to popular belief, agroecology is economically viable. Rachida Mehdioui, president of RIAM, stresses that this approach is not only profitable but also sustainable. She explains that while per-crop yields may be slightly lower, the diversity of crops leads to a more abundant overall harvest, while also preserving soil fertility – an essential resource for future generations. Additionally, the savings on chemical inputs like fertilizers and pesticides more than compensate for the increased labor required. Agroecological products, which tend to have more stable prices, are becoming increasingly competitive, especially in the face of inflation affecting conventional products.

The success of agroecology also depends on the development of suitable marketing channels. To this end, the RIAM has established eco-solidarity farmers' markets in several Moroccan cities, including Rabat, Mohammedia, Casablanca, and Marrakech. These markets provide new opportunities for producers while ensuring consumers have access to healthy, high-quality products. According to Rachida Mehdioui, consumers, who are increasingly concerned about their health and the environment, play a crucial role in encouraging farmers to adopt ecological practices.

Moroccan agriculture stands at a pivotal moment. For years, it has prioritized intensification and productivity, but it is now encountering its limits. The impact on both the environment and the health of small farmers and agricultural workers, particularly in the Gharb region where fields of red fruits and avocado trees stretch endlessly, is severe. Illness and suffering have become part of the daily reality for those who face constant exposure to harmful chemicals.

Amidst this urgent crisis, agroecology offers a viable path forward. By prioritizing ecosystem health and valuing local knowledge, it offers a way to produce healthy food while safeguarding biodiversity, soil fertility, and the well-being of farmers and agricultural workers. Initiatives like the RIAM show that this transition is not only possible but already underway. However, for this sustainable agricultural model to flourish, it will require genuine awareness and strong backing from policymakers and decision-makers. The future of our agriculture – and our society as a whole – depends on it.

LEBANON

MAINSTREAMING BIOPESTICIDES

In Lebanon, after years of intensive agriculture and the use of chemicals, there is a growing need and interest in safer and environmentally friendly alternatives. Emerging from years of academic research, biopesticides have been approved by Lebanese authorities, but are still not officially registered due to the lack of regulatory procedures.

Introduction

Pesticides have long been portrayed as an essential element in conventional agriculture to meet the growing demand for food. They produce higher yields, deter pests, and prevent diseases, allowing agricultural production at an industrial scale. Nevertheless, their short and long-term impacts remain significant on ecosystems and health.

After Rachel Carson's call to action in Silent Spring, efforts were put to shift from the extensive use of synthetic pesticides to natural alternatives. Global environmental movements against agrochemical industries followed. As such, biopesticides derived from animals, plants, minerals, or micro-organisms, gained success for being an eco-friendly product that brings equal benefits to chemical pesticides.

Demand for biopesticides has been growing since the late 20th century as farmers and consumers started prioritizing organic agriculture and nature-based solutions. However today, the global market share of biopesticides remains low.

While biopesticides have been used for a surprisingly long time, their extensive use is still restricted to specific areas as the governance of this sector depends on many geo-political factors. In the European Union, the "Regulation on the Sustainable Use of Plant Protection Products" targeted the reduced use and risk of chemical pesticides by 50 percent in 2030.

In Lebanon, after years of intensive farming and heavy use of agrochemicals, there is increasing interest in safer and environmentally friendly alternatives. Biopesticides, introduced around fifteen years ago through academic research, received approval from Lebanese authorities but remain unregistered due to lack of regulations.

Status in Lebanon

The biopesticides status in Lebanon remains unclear due to lack of documentation and accessible information. Lebanon's regulatory framework does not clearly differentiate between biopesticides and chemical pesticides, making it impossible to track any market dynamics. Moreover, even though Decree No. 1\307 regulates the registration and use of biopesticides, it still lacks an application decree. This complicates the licensing and marketing of locally produced biopesticides. On the other hand, before 2019,

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Table showing the differences between chemical pesticides and biopesticides

Chemical Pesticides	Biopesticides
Formulated from chemicals	Formulated from natural elements
Relatively cheaper in the market	Expensive to purchase in the market
Cannot be made at home	Some recipes can be prepared at home
Persists in the environment from 1 to 40 days	Degrades naturally after 48 to 72hrs of application
Long expiry date of product	Short expiry date of product
Does not allow production of organic products	Allows production of organic products
Small doses can be applied	Requires applying more quantities

Success Story

The Agricultural Movement in Lebanon (Agrimovement) promotes ecological farming practices. Farmers are encouraged to adopt sustainable agricultural practices and produce their own biopesticides, cutting costs by 50 percent. Agrimovement also raises awareness through practical examples, using pioneering projects as a baseline for other farmers to follow. The effectiveness of their projects relies on the regular follow-ups they do with the farmers.

Agrimovement also advocates for direct links between consumers and producers. They collaborate with municipalities to revive local farmer markets, aiming to boost demand for organic products, and motivating farmers to switch from chemicals to biopesticides.

Lastly, Agrimovement's "Seed in a box" initiative preserves heirloom seeds and facilitates their exchange among farmers. These seeds are valuable in organic farming for their local climate adaptation, lower water needs, and pest resistance.

the Ministry of Agriculture distributed free fungal and bacterial biopesticides to farmers as part of its Important Pest Management (IPM) strategy. But after the economic crisis that began in 2019 and its subsequent challenges, the strategy was was paused.

Today, one major stream that dominates Lebanon's biopesticides market is imports from international companies. These biopesticides are bought by the Consortium for the Control of Organic Products (CCPB) for certified organic farmers who export their crops. In the meantime, those biopesticides remain inaccessible to small scale farmers, due to their high cost.

Facing these challenges, many local success stories are living proof that alternative options always exist. Research on biopesticides in Lebanon started in early 2012 with "le biope," the first official biopesticide in the country pioneered by arcenciel, a Lebanese based non-profit, and the Faculty of Sciences at Saint Joseph University. Made from local strains of bacteria, this biopesticide succeeded in controlling pests a wide range of crops and forest trees.

Additionally, the Biopesticides Start-up at Deir Taanayel is by far the largest facility in Lebanon with its semi-industrial production capacity. The American University of Beirut is also working on entomopathogenic biopesticides from locally sourced fungi through the Pathology Lab at the Faculty of Agriculture and Food Science. Several smaller niche producers also exist.

On a smaller scale, many farmers and coalitions are championing the development of biopesticide recipes, using natural products such as whey, garlic, pepper, neem, horsetail, and nettle, and building on traditional knowledge. Exchange of materials, knowledge, and expertise is widely succeeding within the farming community.

Challenges

Farmers often lack awareness of biopesticide benefits, including cost-effectiveness, reduced harm to health, and their importance in organic agriculture. Therefore, they face difficulties in the transition from agrochemicals to biopesticides at the expense of public and environmental health. Most report this shift as a high-risk especially for large farmers dependent on their yields for livelihood. The risks include a decrease in yield, and hence also financial returns. The farms that shift may also lose entire crops if the soil is not treated properly before planting new seeds. Also, if these farms are located in close proximity to conventionally farmed land, these newly shifted organic lands may be harmed by the neighboring pests.

Additionally, biopesticides might result in less attractive yields, potentially limiting their sales in big markets. Furthermore, organically grown fruits and vegetables are losing much of their intangible value when being sold in the same markets as conventional products. When organic products are marketed in some conventional markets, the disparity between the price of the organic product and the conventional product makes the competition favor the conventional product. Although consumers do have demand for organic products, the demand for conventional products is higher due to the more affordable pricing.

Challenges are also faced in terms of doses and costs. Biopesticides require higher doses and more frequent applications to match the effectiveness of agrochemicals. Certified biopesticides are also more expensive than chemical ones. As such, farmers tend to prefer readily available and widely tested products rather than piloting new ones.

Opportunities

Facing these challenges, additional efforts are still needed to bridge the gap between farmers and consumers. Creating local markets can build trust between the two entities. Two examples of these markets are Souk El Tayeb, a social enterprise working to promote and preserve culinary traditions, rural heritage, and the natural environment, and Badaro Urban Farmers, a group that describes itself as individuals promoting environmentally-friendly and community-building actions.

Municipalities' role is major in adapting these markets to their local context, through cooperating with farmers in their areas and providing a space to build such a market with all logistical needs. Such initiatives raise consumer awareness about organic products, leading to their increased demand, promoting sustainable agriculture, and reducing the market for conventional agricultural products.

On another front, farmers can be reinforced when provided with extension services, technical coaching, and follow-up throughout several seasons. Equipping farmers with knowledge of holistic agricultural practices can help them make their farms organic. Financial support from livelihood grants is essential to secure their means of living and compensate for any losses arising from the transition. Also, tax exemptions on biopesticides can greatly lower costs, enhancing market competitiveness.

Most importantly, farmers have reported that experiencing tangible benefits of switching from the use of chemicals to biopesticides is a key driver for their own transition to biopesticides. A 50 percent cost reduction in biopesticide formulation encourages farmers to share recipes and techniques with their peers.

Conclusion and Recommendations

In summary, many challenges linked to awareness, cost, effectiveness, and marketing are in the way of mainstreaming biopesticides in Lebanon. However, existing financial, technical, and social opportunities are already being explored. Many imperative levers remain to facilitate further the shift towards responsible agriculture:

- Initiating regulatory reforms to activate decree 1\307 for the registration of biopesticides.
- Lobbying for a governance structure to locally formulate, use, and market biopesticides.
- Providing financial support to farmers and subsidizing costs of biopesticide production and import.
- Promoting organic products through marketing campaigns to raise public awareness among consumers.
- Supporting farmers in switching to biopesticides to optimize their farms by ensuring adequate training and follow-up.
- Conducting scientific research to enact evidence-based policies and design awareness raising tools.
- Integrating principles of agroecology and sustainable farming in the curriculum of universities and technical-vocational education programs.

AUTHORS AND SOURCES FOR DATA AND GRAPHICS

All online links were last checked in October 2025.
See page 2 for the websites where you can download a clickable PDF of this atlas. Lengthy global links have been shortened using the bitly web address conversion service.

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Affiliation	Name
Plant Resources Department at the Ministry of Agriculture	Mhammad Abouzeid
Buzuruna Juzuruna and Turba Farm	Erica Accari
Buzuruna Juzuruna	Salem Al Azwaq
Independent farmer	Hadi Awada
The Agricultural Movement in Lebanon	Bashar Abou Saifan
Lebanese University	Hassan Makhlouf
Jibal NGO	Georges Najem
SOILS Permaculture Association Lebanon	Wael Yammine
arcenciel	Fadi Moujaes
UNIFERT	Ziad Yazbeck
Unit of pesticide registration at the Ministry of Agriculture	Najwa Al Khansa
CCPB	Hiba Fawaz
Faculty of Agriculture and Food Sciences at the American University of Beirut	Yusuf Abou Jawdeh
Pathology Lab at the American University of Beirut	Nour Ezzedine
Independent farmer trained by Jibal NGO	Tony Khalil

The table summarizes the interviewees that NCC contacted over the phone during May 2024. The organizations represented work in regions across Lebanon.

HEINRICH-BÖLL-STIFTUNG

Our objectives: Fostering democracy and upholding human rights, taking action to prevent the destruction of the global ecosystem, advancing equality between women and men, securing peace through conflict prevention in crisis zones, and defending the freedom of individuals against excessive state and economic power. We are closely tied to the German Green Party (Alliance 90/The Greens), and maintain currently 32 international offices in approximately 60 countries.

Heinrich-Böll-Stiftung,
Schumannstr. 8, 10117 Berlin, Germany, https:/.boell.de

FRIENDS OF THE EARTH EUROPE

We are the largest grassroots environmental network in Europe and campaign on today's urgent environmental and social issues. We challenge the current model of economic and corporate globalization, and promote solutions that will help to create environmentally sustainable and socially just societies. We advocate for an ecological and fair
agriculture that protects natural resources, supports small scale family farms, and halts exploitation of developing countries.

Friends of the Earth Europe,
Rue d'Edimbourg 26, 1050 Brussels, Belgium, https://foeeurope.org

PESTICIDE ACTION NETWORK EUROPE

PAN Europe is a network of NGOs working to reduce the use of hazardous pesticides and have them replaced with ecologically sound alternatives. We work to safe sustainable pest control methods. Our network brings together over 45 consumer, public health and environmental organizations and women's groups from across Europe.

Pesticide Action Network Europe,
Rue de la Pacification 67, 1000 Brussels, https://pan-europe.info

BUND FÜR UMWELT UND NATURSCHUTZ DEUTSCHLAND

We view ourselves as a driving force for ecological renewal, social justice and sustainable development. With more than 660,000 members and supporters, BUND is one of the largest environmental organizations in Germany. We are a member of the Friends of the Earth International (FoEI) network with partner organizations in 72 countries.

Bund für Umwelt und Naturschutz Deutschland (BUND),
Kaiserin-Augusta-Allee 5, 10553 Berlin, Germany, https://bund.net

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SOIL ATLAS 2024
Facts and figures about a vital resource

boell.org/soil-atlas

INSECT ATLAS 2020
Facts and figures about friends and foes in farming

boell.de/insect-atlas

AGRICULTURE ATLAS 2019
Facts and Figures on EU Farming Policy

boell.de/agriculture-atlas

AGRIFOOD ATLAS 2017
Facts and figures about the corporations that control what we eat

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PEATLAND ATLAS 2023
Facts and figures about wet climate guardians

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EUROPEAN MOBILITY ATLAS 2021
Facts and Figures about Transport and Mobility in Europe

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MEAT ATLAS 2021
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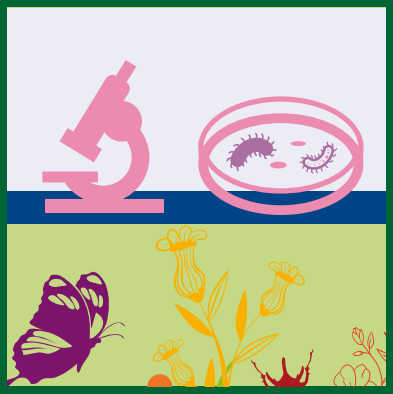

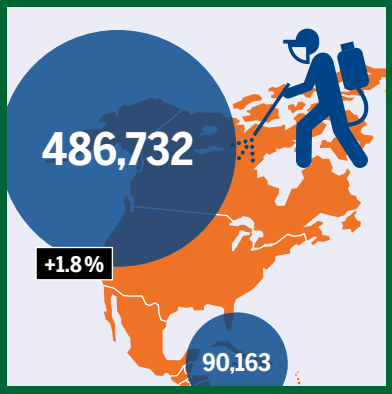

385 million people around the world suffer pesticide poisoning – each year.
from: SEVERE CONSEQUENCES, page 18

Biodiversity is shrinking worldwide. Pesticides are one reason for insect decline.
from: EXTINCTION IN FULL SWING, page 24

Many Highly Hazardous Pesticides (HHPs) do not have EU approval. Nevertheless, they are produced here and exported to poorer countries.
from: BANNED BUT SOLD ANYWAY, page 40

Gender roles also affect pesticides exposure. Women are recognized as playing a key role in transitioning to ecological farming.
from: AT THE FOREFRONT OF EXPOSURE, page 44

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