2019 #**15**

CDE POLICY BRIEF

UNIVERSITÄT BERN

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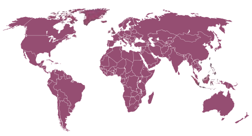
Making food systems safer: Time to curb use of highly hazardous pesticides

Use of synthetic chemical pesticides has expanded widely. These insecticides, herbicides, and fungicides have helped to boost crop production, but at a major cost – one whose full extent remains unknown. Many commonly used pesticides – especially in developing countries – are now considered "highly hazardous" by experts due to their proven or likely harms to nature and people.[1] Evidence from farms in the global South confirms heavy use of pesticides, including substances banned elsewhere. Farmers and nearby communities face the most direct health threats. This policy brief outlines key harms and research findings, highlights alternatives to pesticide-intensive agricultural practices, and calls for phasing out the riskiest substances – in line with human rights and proper application of the precautionary principle.



The research featured here is focused globally.

"Hey farmer, farmer, put away that DDT, now. Give me spots on my apples, but leave me the birds and the bees, please!" sang Joni Mitchell in 1970, two years before the US banned agricultural use of DDT. Yet half a century later, her plea still resonates, as numerous other hazardous pesticides remain in widespread use.

Today, pesticides are a 50-billion-dollar industry,[2] with the profits mainly flowing to rich northern countries (e.g. US, EU, Switzerland, Israel, Japan) and big emerging economies (e.g. China, India, Brazil) where major pesticide industries are based. Globally, over four million tonnes of pesticides are used in agriculture every year.[2] Poorer countries in the global South, especially those that rely on crop exports, face many pressures to use pesticides. These include the promotion of

KEY MESSAGES

- Promoted by companies largely based in the global North, synthetic pesticides are widely used in developing countries – especially those growing crops for export.
- Many commonly used synthetic pesticides are now considered "highly hazardous" by experts.
- Scientists and leading authorities such as the UN High Level Panel of Experts on Food Security and Nutrition recommend phasing out highly hazardous pesticides according to WHO and FAO criteria, beginning with WHO class I (extremely/highly hazardous) substances and neurotoxic *organophosphates*.
- Pesticide "double standards" – e.g. sale abroad of (domestically) banned substances, or outsourcing of pesticide-heavy crop production to countries with weak protections – should be addressed in line with human rights principles.
- Pesticide-free, agroecological farming and integrated pest management should be promoted through awareness raising, training and incentives, as well as targeted funding, research, and development.

Box 1. Pesticide use in Bolivia and Kenya

Between 2015 and 2018, the CDE-led Swiss *r4d* project "Towards Food Sustainability" studied the ecological performance of different farming systems in Kenya and Bolivia, including pesticide use. Together with the Universidad Mayor de San Simón, CDE researchers examined use of agrochemicals in Boliva's San Pedro municipality, where large-scale export-oriented production of soybeans dominates (Bascopé Zanabaria et al., in press).[38,54] On nine farms studied, a total of 64 pesticide products were found in use, sprayed in different mixtures up to 13 times per cultivation cycle. Of these, 4.7% had a nationally mandated red label for high toxicity and 35.9% had a yellow label for harmful substances. Two products ("Pilaron", red label, and "Hamidop 600", yellow) contained *methamidophos*, an organophosphate officially banned in Bolivia. The controversial herbicide *glyphosate* was found among the remaining products with "safer" blue or green labels. Altogether, 19 substances used in soybean production qualify as highly hazardous pesticides (HHPs) – such as *beta-cyfluthrin*, which persists in nature and harms bees and aquatic organisms.

In Kenya's north-west Mount Kenya region, CDE researchers analysed three agro-industrial farms that produce vegetables for European supermarkets (Ottiger 2018).[37,55] Each farm was a member of the Global G.A.P. certification scheme, for "good agricultural practices". Still, CDE researchers found evidence of extensive pesticide use, including HHPs. Crops like broccoli and beans were sprayed up to 15 times per cultivation cycle. Of 53 products identified on the agro-industrial farms, only 17 are permitted in Switzerland; 36 products contained HHPs. Examples include the products "Match" (containing *lufenuron*: bioaccumulative and harmful to aquatic organisms) and "Pentagon" (containing *lambda-cyhalothrin*: a suspected endocrine disruptor, and harmful to bees).

large-scale, monoculture-style farming and chemical inputs by corporations and allied agencies, degraded soils rendering plants more prone to pests and diseases, and the demands of consumers for farm products that appear uniformly perfect.[3,4,5]

Rising use, rising concerns

Pesticides go hand in hand with industrial farming of commodity crops. For example, patent-protected pesticides are marketed to farmers as part of a package deal along with herbicide-tolerant seeds, such as genetically modified soya, which are engineered for large-scale cultivation. Global expansion of monocultures has been accompanied by major increases in pesticide application, particularly in developing countries.[2,6] CDE research in Bolivia and Kenya (see Box 1) illustrates the trend of growing use on the ground. Bolivian pesticide imports increased 290% (by quantity) between 2010 and 2017,[7] while Kenyan imports increased 270% (by value) between 2007 and 2017.[2]

As pesticides have proliferated, so too have concerns about their safety. In 2015, the WHO classified the omnipresent herbicide *glyphosate* as "probably carcinogenic to humans".[8] There is no consensus, but recent lawsuits by exposed workers in the US have lent credence to the WHO assessment, as has the German government's decision to ban domestic use of the weedkiller after 2023.[9,10] The Pesticide Action Network, a group of over 600 organizations compiling scientific studies, has added *glyphosate* to its database of highly hazardous pesticides (HHPs).[11]

HHPs contain substances that are either acutely toxic, have long-term toxic effects, pose a threat to the environment, or are known to cause severe or irreversible adverse effects in people or nature. For over a decade, the Pesticide Action Network has identified HHPs based on FAO and WHO criteria.[1,12] *Glyphosate* is just one of over 300 substances identified to date.

Ecological risks. When sprayed, HHPs pose dangers to many non-targeted organisms including plants, insects, birds, and reptiles.[13-15] Up to 75% of pesticides miss their target.[16] They can wash into water systems, harming fish, amphibians, and other aquatic life. Their toxicity to birds and crucial pollinators like bees (e.g. in the case of *imidacloprid*[17]) can cause cascading effects that threaten overall biodiversity, ecosystems, and eventually food systems.[18,19] Broader impacts can also result from the persistence and bioaccumulation of pesticides in nature.[20-22] The pesticide *methyl bromide* even depletes the ozone layer.[23]

Human health risks. Pesticides can affect farmworkers, nearby communities, and food consumers – via eye or skin contact, inhalation, or ingestion.[24] Documented harms range from skin irritation to cancer, reduced fertility, and developmental disorders.[25] Acute toxicity (e.g. from *paraquat*) can cause instant death, as seen in the case of pesticide-induced suicides – one in every five suicides globally[26,27] – and in cases of accidental ingestion, for example by schoolchildren.[28] Some pesticides exhibit long-term health harms. *Organophosphates* have been linked to brain impairment in workers and prenatally exposed children.[29,30] Other substances (e.g. *atrazine* or *mancozeb*) can disrupt hormone systems, and are particularly dangerous for children and pregnant women.[31,32,33,34] Combined ("cocktail") effects of different substances are also cause for concern.[35]

Socio-economic risks. Adoption of synthetic pesticides – and genetically modified seeds – can trap farmers in cycles of dependence on costly, patent-protected foreign inputs. This "pesticide treadmill" can erode the socioecological knowledge they have built over generations, especially on how to control plant pests and diseases without chemicals.[36] And the overall harms of hazardous substances like pesticides take a major (often hidden) economic toll: Adverse impacts, such as health burdens, are estimated to cost governments tens of billions of dollars annually.[4]

Evidence from farms in the global South

Major pesticide use on large farms. CDE research in Kenya and Bolivia confirms extensive use of pesticides, including HHPs, in intensive export-oriented agriculture. In Kenya, three agro-industrial farms producing vegetables for European supermarkets were found to apply an average of 40.8 kilograms (kg) of pesticides per hectare (ha) and cultivation cycle.[37] In Bolivia, nine large-scale farms growing soybeans for international markets were found to use an average of 35 kg of pesticides per hectare and cultivation cycle.[38] These amounts dwarf the global average of 2.75 kg of pesticides applied per hectare – as well as the Swiss average of 5.07 kg/ha.[2]

Acute exposure risks among small farmers and families. Small-scale and family farmers in Kenya and Bolivia used less pesticides.[37] But they faced higher exposure risks: First, they often did not wear protective gear when applying HHPs.[39] Second, the winds can carry sprayed pesticides long distances.[40] Third, poor households often use empty pesticide containers for other purposes – even storage of food and drinking water.[41] Metabolites of *chlorpyrifos* were recently found to be up to 50 times higher in the urine samples of Bolivian agricultural communities than in control populations.[42] A separate Swiss study in Uganda even found pesticide residues in the urine of organic farmers, with river water, polluted well water, and pesticide drift representing possible exposure pathways. Similar to CDE studies, the researchers concluded that information and training on ecological farming practices and integrated pest management were not sufficiently available to farmers.[43,44]

Use of substances banned elsewhere. In both study areas, CDE researchers observed use of substances now banned in the EU and/or Switzerland (but sometimes made by companies based here). Most of the identified substances used on the Kenyan vegetable farms are not allowed in Switzerland.[37] Other studies show similar results: In Uganda, small-scale farmers were found to use *profenofos*, a neurotoxic substance prohibited in the EU and Switzerland.[43]

Example of organophosphates. The study areas also showed use of *organophosphates*, neurotoxic pesticides originally derived from nerve agents used in wars. Scientists and the UN have recommended that they be banned.[29] One of the most widely used is *chlorpyrifos*. It has been linked to reduced IQs,[29,30] autism,[29,30,45,46] and other development deficits in children.[30,47,34] The organophosphates *monocrotophos* and *methamidophos* were banned in Bolivia in 2015, but remain in use.[42]

Call for alternatives

A recent major report by the UN Special Rapporteur for the Human Right to Food (Elver 2017) holds pesticides to account for approximately 200,000 acute poisoning deaths annually – mostly in developing countries.[5] Presenting evidence of pesticide harms from 31 countries, the report challenges narrowly conceived "food security" justifications for pesticide use. It highlights the potential to grow enough healthy, sustainable food without using HHPs, and calls for the international community to develop a comprehensive, binding global treaty to regulate HHPs based on principles of human rights.

Overcoming the 'pesticide treadmill'

Controlling plant diseases and insect outbreaks remains fundamental to agriculture. But it is no longer clear that the benefits of hazardous pesticides outweigh their harms.

Systems approaches aimed at holistically redesigning processes and networks of food growing, distribution, consumption, etc. are needed to end reliance on HHPs in particular and pesticides more broadly. The Swiss Research Institute of Organic Agriculture, for instance, recently deemed herbicide-free agriculture a promising vision, highlighting the importance of more funding for research on alternatives.[48] Notably, the World Overview of Conservation Approaches and Technologies, a database with over 1,900 best practices, already documents many successful biological pest control examples from all over the world (www.wocat.net).[49]

Agroecology has emerged as a key systems approach.[50] Bringing together transdisciplinary science, core sets of principles and practices, and social movements, it seeks to establish alternatives to corporate-run agriculture, agrochemical treadmills, and centralized food systems. It emphasizes use of ecological processes over external inputs, empowering small farmers and building on their knowledge. One example is the "push–pull"[51] system of pest control used by many farmers in East Africa. To protect their maize crops from insects called stemborers, the farmers grow *Desmodium* plants whose smell repels the pests (*push*). At the same time, they cultivate fodder grasses around the maize fields that attract the unwanted insects (*pull*). *Desmodium* has the added benefit of improving soil fertility, while the fodder grasses can be fed to livestock.

Labour- and knowledge-intensive, but dignified and transformative is one way of describing pesticide-free agroecological farming. It takes time and human engagement to implement push–pull, crop rotation, and other pesticide-free ways of controlling unwanted insects, weeds, or plant diseases. But this is an opportunity, not a weakness. Added labour demand can create more sustainable, dignified jobs and broader networks of meaningful, self-determined livelihoods.[52] True to the systems approach, practitioners of pesticide-free agroecological farming often strive to build wider solidarity-based food systems. They link up with like-minded farmers, small-scale food-processing enterprises, and sensitized consumers to form mutually beneficial value chains under names like "Community Supported Agriculture" or *Solidarische Landwirtschaft* ("solidarity agriculture").[53]

Box 2. Key international agreements and guidelines relevant to pesticides

Several existing treaties or codes can be used to leverage action on pesticides, to inform new national policies, and/or to inform a new binding global agreement on highly hazardous pesticides (HHPs). Binding treaties include:

- *Basel Convention on Transboundary Movements of Hazardous Wastes and Their Disposal:* www.basel.int
- *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade:* www.pic.int
- *Stockholm Convention on Persistent Organic Pollutants:* www.pops.int
- *International Labour Organization's Safety and Health in Agriculture Convention:* https://bit.ly/32UwRLS

Non-binding codes and instruments include:

- *FAO International Code of Conduct on the Distribution and Use of Pesticides:* https://bit.ly/2JvtSC0
- *FAO Codex on Maximum Residue Limits:* https://bit.ly/2Wm0PWG
- *Intergovernmental Forum on Chemical Safety advice on Acutely Toxic Pesticides:* https://bit.ly/2BOLjJs

Chemical pesticides for sale in a popular market in El Alto, Bolivia, March 2019. The products "Stermin", "Caporal", and "Tamaron", for example, contain *methamidophos*, a neurotoxic organophosphate officially banned in Bolivia since 2015.
Photo: Johanna Jacobi

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Policy implications of research

Ending use of highly hazardous pesticides (HHPs) requires concerted global and local efforts. These should emphasize phaseouts[56] of HHPs based on WHO and FAO criteria, beginning with WHO class I (extremely/highly hazardous) substances and neurotoxic *organophosphates*. Preventive use of pesticides, treatment of seeds, and spraying in protected areas should be banned.[57] Other keys include:

Leverage pesticide action based on existing international agreements
Most countries are already signatories of international agreements obligating them to protect people from substances like HHPs. The *Rotterdam Convention* requires that pesticide-exporting countries (e.g. industries headquartered in Europe, US, China) inform importing countries (e.g. Kenya, Bolivia) about the risks of substances and protective measures taken elsewhere. The *Stockholm Convention* mandates that countries reduce or eliminate production, import/export, and use of "persistent organic pollutants" – a term covering many pesticides. And existing International Human Rights Covenants – including rights to health/adequate food – imply that states have an obligation to eliminate pesticide-related health and nutrition risks.

Enforce protection of farmers, communities, and nature
Our food should not come at significant cost to the health of farmworkers or ecosystems anywhere. This means strengthening labour protections everywhere, ending double standards on pollution safety, and judiciously applying the *precautionary principle* – not only to humans, but also to all of nature. Laws to hold pesticide companies responsible for harms should also be precisely defined and expanded, in line with the *polluter pays principle* – including mechanisms for legal recourse in the home countries of pesticide makers. And testing and approval of new pest-control products should consider long-term, accumulative impacts, chronic or "hidden" health burdens (e.g. endocrine disruption), harms to non-targeted organisms, possible "cocktail" effects of mixed substances, etc.[34]

Foster alternatives in a food system approach
Overall, support should be greatly increased for transformations to food production and landscape stewardship without pesticides. Cultivation and pest-control methods, market structures, and the wider cycles and functions of the natural world must be considered together when designing transitions to pesticide-free social-ecological systems. Decades of organic farming and age-old agroecological knowledge show these transformations are possible.[56]

Suggested further reading

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This issue
Series editor: Anu Lannen
Editor: Anu Lannen
Expert legal consultant: Elisabeth Bürgi Bonanomi
Summary of treaties and codes: Jimena Maria Solar Alvarez
Design: Simone Kummer
Printed by Varicolor AG, Bern
FSC MIX FSC® C020328

ISSN 2296-8687

Citation: Jacobi J, Ottiger F, Kiteme BP, Delgado Burgoa JMF, Winkler MS, Lannen A. 2019. *Making Food Systems Safer: Time to Curb Use of Highly Hazardous Pesticides.* CDE Policy Brief, No. 15. Bern, Switzerland: CDE.

Keywords: Highly hazardous pesticides, food systems, agroecology, sustainability, transformation

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