



TRANSFORMATIVE CHANGE: INFORMED BY SCIENCE AND POLICY

By Jay Feldman

The hazards of petrochemical pesticides and fertilizers to health and the environment are extraordinary and scientifically documented, creating a clarion call for urgent change. We know now what the necessary changes look like, as we seek to respect the gifts of nature—on which all life depends. The purpose of this issue of *Pesticides and You* (PAY) is to capture in the period of one year, 2022, the justification for the urgency that we must bring to our practices and policies. We look at what the science is telling us now, dramatic findings on public health diseases—from cancer, neurological and immunological illness, respiratory disease, learning disabilities, Diabetes, Parkinson's and Alzheimer's—associated with toxic chemical uses that are not needed, but widely applied, to produce our food and manage our landscapes.

Science Calls for Transformative Change

This issue contains a cross section of current science that documents the depth and breath of the problem and the destructive path we are on. This issue adds to a similar accounting in this journal last year, *Retrospective 2021: A Call to Urgent*

Action. Together, these issues serve as a compendium of the shocking scientific findings that compel us to act in our communities, states, and as a nation and world community. We publish this issue as a tool for education and the basis for action—to shift to organic practices clearly defined by the elimination of the toxic chemicals we track. As readers will see, this is not about banning or restricting a couple, or even several dozen, petrochemical pesticides and fertilizers, but is about a transformation to land and building management systems that align with nature and, at the same time, are more

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Science, Policy, and Action

The science that has accumulated in 2022 adds to an alarming and even higher degree of urgency than captured in the 2021 issue. With this edition, we organize the body of information into three categories—science, policy, and action. This body of science is organized into three major sections to address the clearly defined and escalating threats: a public health crisis, biodiversity collapse, and the climate emergency. The discussion and science call for transformative change that is no longer held back by those with a vested economic or political interest in continued pollution, small fixes to the status quo, or a reduction in problems that continue to be unsustainable. The time horizon for the health, biodiversity, and climate crises that now plague us does not give us the luxury to tweak broken policies or tinker with half-measures.

Beyond Pesticides is focused on public health and environmental protection—and advancing alternatives that prevent harm. This issue asks readers unfamiliar with the need for urgent action to think holistically when considering status quo dependency on petrochemical pesticide and fertilizer use in their community and on their property. We look at the use of toxic chemicals and evaluate them through their life cycle—from manufacture, transportation, storage, use, and disposal—and consider pesticides in the context of alternative practices and materials that can eliminate their use. In this context, our personal and community decisions have adverse impact, as articles in this issue show, on low-income people, people of color, fenceline communities near production facilities, communities experiencing chemical drift and poisons in the air, and those with preexisting health conditions—showing that adverse effects are not limited to individual users of toxic

products or consumers of pesticide-treated food. Our community and personal decisions determine the future well beyond the boundaries of our home and community.

Chemical Pollution Exceeds Safe Limits for Humanity

At this point, it is clear that we have answers to the problem of petrochemical pesticide and fertilizer dependency and this issue of *PAY* reinforces, with greater urgency than even one year ago, that we delay with incrementalism at our peril. So, we begin this issue with yet another wake-up call published in *Environmental Science and Technology*, “[Outside the Safe Operating Space of the Planetary Boundary for Novel Entities](#),” in which scientists are telling us that global chemical pollution has now exceeded a safe limit for humanity—exceeding the planetary boundary. The authors conclude that we are passing “the point at which human-made changes to the Earth push it outside the stable environment of the last 10,000 years.”

From pesticides, to plastics, to energy, the complexity of factors is broad, but in the arena of land management, both in the production of food and the caretaking of parks, playing fields, and public spaces, we can and must lead the way in embracing organic as the elimination of petrochemical pesticides and fertilizers.

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We cannot any longer justify the use of petrochemical pesticides and fertilizers, nor can we accept strategies that “reduce” use and adopt risk mitigation measures. Instead, we must embrace a dramatic change in land management that eliminates toxic chemicals. We must demand more of our policies, policymakers, and those with the discretionary power to implement the necessary changes.

This issue of *PAY* is intended to add to the body of information that informs advocacy for transformative change—in communities, school districts, park districts, public lands, private property, and state and federal government. The science tells us that we can no longer—and we do not need to—compromise with our lives and the lives of the next generation.



SCIENCE DEFINES THE THREAT | JANUARY 21, 2022

Global Chemical Pollution Exceeds Safe Limits for Humanity

The bottom-line conclusion of a recent study is that global chemical pollution has now exceeded a safe limit for humanity. As reported by *The Guardian*, “The cocktail of chemical pollution that pervades the planet now threatens the stability of global ecosystems upon which humanity depends.” Published in *Environmental Science & Technology*, the research paper asserts that the creation and deployment (into the materials stream and environment) of so many “novel entities” (synthetic chemicals) is happening at a pace that eclipses human ability to assess and monitor them. The study team calls this exceedance of the “planetary boundary” of such chemical pollution “the point at which human-made changes to the Earth push it [outside the stable environment](#) of the last 10,000 years.” According to Beyond Pesticides, which covers pesticide (and other kinds of) chemical pollution, these results underscore a grim twin reality to the human-caused [climate emergency](#), and should be a dire warning on the

state of our shared environment and a time for systemic movement to eliminate fossil fuel-based pesticides and fertilizers.

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team define “[novel entities](#)” as those compounds and materials introduced by humans that “are novel in a geological sense and that could have large-scale impacts that threaten the integrity of Earth system processes.” The novel entities that have so suffused Earth’s [air, water, ecosystems and biodiversity, wildlife, and human bodies](#) comprise 350,000 synthetic chemicals—including persistent organic pollutants (POPs) and volatile organic compounds (VOCs)—found in plastics, synthetic pesticides and fertilizers, industrial and manufacturing compounds, antibiotics, degreasers, cleaning agents, and many other commodities. Only a tiny fraction of those 350,000 compounds has been assessed for safety, yet many are now found in human tissues. (See the Beyond Pesticides web page on “[body burden](#)” of synthetic chemicals and the relationship to disease development.)

Although there is no consensual metric attached to the category of “novel entities,” [the researchers assert](#) that the human introduction of them is

globally concerning because “these entities exhibit persistence, mobility across scales with consequent widespread distribution and accumulation in organisms and the environment, and potential negative impacts on vital Earth System processes or subsystems.”

The introduction of [synthetic chemicals](#) into the materials stream began in 1869 with the creation of chloral hydrate (a sedative) and the first nearly synthetic polymer, celluloid, which was developed as a substitute for ivory. Such innovations, which began in the 19th century as a trickle of [new compounds](#) and materials, yielded in the first half of the 20th century materials such as nylon, Bakelite (the first fully synthetic plastic), and the first synthetic fluorocarbon. But it was the advent of World War II and the decades to follow that opened a firehose of new materials, as military—industrial research spawned a universe of new chemicals and materials.

Many of those were plastics; during the war, U.S. plastic production increased by 300%. The plastic surge continued throughout the rest of the 20th century, and is unabated today. Indeed, 2020 estimates clocked the amount of plastic in the world at roughly 8.3 billion tons—with 6.3 billion of those tons being “trashed” plastic. As [UNEP](#) (United Nations Environment Programme) invites us to consider: “Imagine 55 million jumbo jets and that’s how much plastic exists.”

Beyond plastics, the 20th century spawned a new world of chemical compounds that were engineered into nuclear and chemical weapons, pesticides, and the universe of nearly 5,000 PFAS (per- and polyfluoroalkyl) substances, among others. [Patricia Villarrubia-Gómez](#), a PhD candidate and member of the research team, commented, “There has been a fiftyfold increase in the production of chemicals since 1950 and this is projected to triple again by 2050. The pace [at which] societies are producing and releasing new chemicals into the environment is not consistent with staying within a safe operating space for humanity.”



Were all these synthetic compounds chemically inert, the implications for human and environmental health might be quite different. However, [biological organisms](#) do interact with many of them, causing largely unknown, unpredictable (except as they are studied retrospectively), and frequently, harmful impacts to all manner of organisms, from archaea to armadillos to humans (never mind the [ecosystem impacts](#)).

The extensive chemical pollution this study documents is a threat to the functioning of Earth's systems because, [the biological and physical processes that underpin all life](#). For example, pesticides wipe out many nontarget insects, which are fundamental to all ecosystems and, therefore, to the provision of clean air, water and food." Rebecca Altman, PhD, member of the Board of Directors of Science and Environmental Health Network, has written in the article, "[Time-bombing the future](#)," this pithy sentence: "Synthetics created in the 20th century have become an evolutionary force, altering human biology and the web of life."

The study paper notes that toxic plastic pollution—which is now found,

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as [The Guardian](#) puts it, "from the [summit](#) of Mount Everest to the deepest oceans"—is of especial concern. One of the researchers, [Professor Bethanie Carney Almroth](#), commented, "There's evidence that things are pointing in the wrong direction every step of the way. For example, the total mass of plastics now exceeds the total mass of all living mammals. That to me is a pretty clear indication that we've crossed a boundary. We're in trouble, but there are things we can do to reverse some of this." The

research paper asserts that the high social (health, environmental, economic, et al.) costs of the impacts of these "novel entities" are a potent argument for strong and urgent action.

According to [The Guardian](#), [Professor Sir Ian Boyd](#) of the University of St. Andrews notes: "The rise of the chemical burden in the environment is diffuse and insidious. Even if the toxic effects of individual chemicals can be hard to detect, this does not mean that the aggregate effect is likely to be insignificant. Regulation is not designed to detect or understand these effects. We are relatively blind to what is going on as a result. In this situation, where we have a low level of scientific certainty about effects, there is a need for a much more precautionary approach to new chemicals and to the amount being emitted to the environment."

The researchers say that stronger regulation and a fixed cap on chemical production and release are needed—initiatives analogous to the maximum carbon targets that have been established (if not necessarily honored) in some locations to reduce greenhouse



gas emissions. Increasingly, members of the global science and health communities are calling for action on reining in the flow of synthetic chemicals and [plastics](#), into the environment—including the establishment of a [global scientific body](#) for chemical pollution akin to the Intergovernmental Panel on Climate Change (IPCC).

A 2009 study, “Planetary Boundaries: Exploring the Safe Operating Space for Humanity,” asserts that there are nine “planetary boundaries” within which humans should operate in order to avoid disastrous consequence. These boundaries relate to climate change, biodiversity loss, the nitrogen cycle, the phosphorous cycle, stratospheric ozone depletion, ocean acidification, global freshwater use, changes/intensification of land use, atmospheric aerosol loading, and chemical pollution. The study authors note that in 2009, *three of those nine interlinked planetary boundaries* had already been transgressed.

In late March 2021, [Mongabay](#) published an article, “The nine boundaries humanity must respect to keep the planet habitable,” which set out a very slightly revised system of boundaries and a sober warning. “All life on Earth, and human civilization, are sustained by vital biogeochemical systems, which are in delicate balance. However, our species—due largely to rapid population growth and explosive consumption—is destabilizing these Earth processes, endangering the stability of the ‘safe operating space for humanity.’ Scientists note nine planetary boundaries beyond which we can’t push Earth Systems without putting our societies at risk.... Humanity is already existing outside the safe operating space for *at least four of the nine boundaries* [emphasis by Beyond Pesticides]: climate change, biodiversity, land-system change, and biogeochemical flows (nitrogen and phosphorus imbalance).”

The subject study confirms that humankind has now pushed past the *fifth of the nine boundaries* in its planet-wide synthetic chemical pollution that is damaging the biological and physical processes that underpin all life. Beyond



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Pesticides has long taken to task the [regulatory bodies](#) in the U.S., particularly the Environmental Protection Agency (EPA) for its multitude of failures in regulating pesticides. But EPA also regulates non-pesticide synthetic chemicals and materials, as do other federal agencies, including the Occupational Safety and Health Administration (OSHA), Department of Transportation (DOT), and Nuclear Regulatory Commission (NRC).

Comporting with Professor Boyd’s points, Beyond Pesticides has repeatedly asserted that a “whack-a-mole” approach to regulation of pesticides, and toxic synthetic chemicals broadly, is decidedly not a precautionary way forward. What is needed urgently is a holistic, precautionary approach to the deployment of *all* synthetic chemicals, domestically and around the world,

given the apparent lack of urgency among policymakers to take action, and the piecemeal chemical regulations that abound in the U.S. and abroad. As noted previously, the researchers are recommending an [international body](#) to address these issues.

[Beyond Pesticides](#) wrote in its *Pesticides and You* journal two winters ago (see p. ii): “When we advance reform, we do not want to just tinker with a failed risk assessment-based regulatory system.... We want to eliminate the use of these toxic materials, starting from the ground up. This means that we, as a part of our decision-making process—whether in a community or [in] federal law—must look at whole ecological and biological systems, the range of interactions that are possible, and reject any harm. With alternatives available, there is no reason to accept anything less.”

SOURCES: Linn Persson, Bethanie M. Carney Almroth, Christopher D. Collins, Sarah Cornell, Cynthia A. de Wit, Miriam L. Diamond, Peter Fantke, Martin Hassellöv, Matthew MacLeod, Morten W. Ryberg, Peter Søggaard Jørgensen, Patricia Villarrubia-Gómez, Zhanyun Wang, and Michael Zwicky Hauschild *Environmental Science & Technology* 2022 56 (3), 1510-1521, <https://pubs.acs.org/doi/10.1021/acs.est.1c04158>; [The Guardian](#)