



Ecocycles, Vol. 8, No. 1, pp. 99-102. (2022)
DOI: [10.19040/ecocycles.v8i1.233](https://doi.org/10.19040/ecocycles.v8i1.233)

OPINION

Silent Spring: Landscape after sixty years

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Abstract – The *Silent Spring* is now the zero-kilometer stone of environmental movements related to plant protection, a fundamental piece of work that projects visions for us in literary English. Compared to Carson's era, the number of pesticides that can be used has increased by sixfold. It grew from 50 pesticide active ingredients in the 1960s to over 350 in 2001-2002 and stabilized at around 250 compounds in 2008 because of the EU's re-registration activities. Based on the findings of the Rapid Alert System of Food and Feed of the EU, more than 400 actions per year were required between 2012 and 2015 on the EU import food market due to pesticide residues. We live in the *Plastic Age*, and we made the planet so much lame. A catch-22 if all this is projected on overpopulation. The balance between resources and consumers is fatally damaged, pollution has caused global warming, as well as a shortage in energy and raw materials.

Keywords – Rachel Carson, *Silent Spring*, pesticide residue, environmental pollution, overpopulation

Received: July 16, 2022

Accepted: July 17, 2022

Twenty-five years ago, I wrote an afterword for the Hungarian edition of *Silent Spring*.¹ This sixty-year old book² made a deep impression back then on me, perhaps as the overture to environmental protection in the context of chlorinated hydrocarbons (especially DDT and similar insecticides).³ *Silent Spring* (1962) was first published on September 27, 1962, preceded by Carson's essays in *The New Yorker* in June 1962.⁴ John F. Kennedy read these articles, and later a Senate committee (recorded by history under the name of Senator Abraham Ribicoff)⁵ paid emphasized attention to her statement in 1963 (*Figure 1*).

At that time, according to her medical records, marine biologist Rachel Louise Carson (1907-1964) was saying her final farewell to this planet that had been so important to her. During that year and a half that was left for her, she was torn apart by anonymous scriverers. Monsanto (now part of Bayer), Velsicol (its assets was later channeled through Novartis to Syngenta, now owned by ChemChina), American Cyanamid (Monsanto → Bayer) and the National Agricultural Chemical Association (USA) did everything at their competency to discredit Rachel Carson. Her book, however, found its way to the hearts of the readers, although she could not live to see this success. With her colored balloon, she *sailed over* the astonished corporate artillery battery trained to shoot at heavy bombers. She is the origin

of modern environmental NGOs activists, and her impact led to the establishment of the United States Environmental Protection Agency (US EPA), the overseas equivalent of the European environmental ministries. By the way, such a portfolio of environmental affairs was, uniquely in the European Union, abolished in 2010 in Hungary.



Figure 1. Rachel Carson at a Senate hearing in 1963 (Photo: United Press International)

Carson's book is now the zero-kilometer stone of environmental movements related to plant protection, a fundamental piece of work that projects visions for us in literary English. Practically all relevant observations have already been stated about the book, so hereby, I restrain myself to listing whatever happened in plant protection after that work of Carson. The inventory will not be merciful and cannot be complete either, of course, due to the volume allowed for this writing.

In the century of chemistry, we thought that everything could be solved by skillfully chosen chemicals, we just need to find the *right* molecules in each group of interest. As a researcher, I used to be chasing this illusion for nearly two decades, along with excellent chemists. Today we know that selectivity in this area is just a wandering daydream. No active substances (medicines, pesticides, etc.) exist without side-effects. Ecological systems are incredibly complex, and the toxicological reactions of each organism are different. Just by looking at allergies (the immune system), it is apparent that group responses, sometimes individually different (hypersensitivity) reactions are not uncommon within the human population.

The first huge scandal among pesticides undoubtedly erupted around the chlorinated hydrocarbons (DDT and more than a dozen others: lindane, camphechlor, aldrin, etc.).⁶ The main problem was their slow degradation (persistence) compounded by the bioaccumulation and biomagnification effects. The result has been the environmental recirculation of these substances,⁷ which led to the fact that DDT decomposition products (DDE, DDD) to date appear in human mothers' milk. The situation is similarly alarming in the soot extraction zone of incinerators without a flue gas washer, where dioxin-like compounds are expected to occur. The mechanism of physiological action of chlorinated hydrocarbons has remained hidden for a long time. It is now clear that they exert immune and hormone-disrupting effects, and in this way, they can also trigger malignant diseases (e.g., lindane, also known as γ -HCH).

Compared to Carson's era, the number of pesticides that can be used has increased by sixfold. It grew from 50 pesticide active ingredients in the 1960s to over 350 in 2001-2002, and stabilized at around 250 compounds in 2008 as a result of the EU's re-registration activities.⁸ Based on the findings of the Rapid Alert System of Food and Feed of the EU, more than 400 actions per year were required between 2012 and 2015 on the EU import food market due to pesticide residues.⁹ This is not negligible at all, and almost a third of this represented serious threats to consumers.

Tyrone B. Hayes' research revealed to the world the severe endocrine-disrupting effects of triazine herbicides (atrazine and similar compounds), observed on genetically male clawed frogs,¹⁰ which, following hermaphrodite development, became neo-females.¹¹ The results explain why amphibians are the most rapidly disappearing group in the animal kingdom and why what astonishing variety of pesticides interfere with the wildlife in our environment.

The European Union is currently reviewing environmental endocrine disruptors, but no practical results have yet been achieved, although azole fungicides (also used as pharmaceuticals) have been targeted. Triazine herbicides¹² (atrazine, cyanazine, prometryn, simazine, etc.) were banned in the European Union by 2007,¹³ except for terbuthylazin, which can still be used, although it shares common metabolites with the banned compounds.

In the EU pesticide re-registration program, in the first half of the 1990s, soil disinfectants based on nerve agent (e.g., fonofos) jeopardizing soil-borne invertebrates deteriorating organic matter and initiating humus formation (e.g., arthropod larvae, worms, springtails, oribatid mites) were identified as problematic. The occupational health risk of these was also found outstanding. Thus, active ingredients aldicarb, carbofuran, carbosulfan, diazinon and phorate became banned by 2008 in the EU re-registration process.

Another great result of the European re-registration has been the prohibition of mutagenic (e.g., aldicarb, captan, carbaryl, chlorothalonil, deltamethrin, dichlorvos, dimethoate, malathion, phorate, thiram, ziram, etc.) and thereby carcinogenic compounds (lindane, glyphosate,* 2,4-D,* chlorothalonil, etc.).¹⁴ However, among them, herbicide active ingredients glyphosate and 2,4-D can still be used today,* and in the scope of mosquito control, the insecticide active ingredient deltamethrin has been sprayed on the population of our villages for decades.¹⁵

Does *Silent Spring* convey a long-term message? Suspicions about pesticides have become dominant and led to the support of organic farming among environmentally conscious consumers. European Union politicians also moved in this direction. Yet there appears an enormous problem. How to provide the human population of our planet, quite overgrown compared to the local resources (China, India, and Africa), with food if we return to an agricultural system that promises a lower production level? Balance (resource ↔ consumer) is in a rather critical state here too. In many places, the Earth's resources are no longer in harmony with the human population, leading to severe pollution, deterioration of soil fertility (think of the dramatic decrease in the number of horses, thus in their manure), and, on the long run, starvation. Replacing organic manure with compost made from industrial sewage sludge and urban green waste biomass contaminated with exhaust gases is a great fault. The solution now is not to completely deny the use of pesticides, but to select them strictly according to ecotoxicological criteria.¹⁶ I think that only Carson, who had experience at her age only with chlorinated hydrocarbons, would also agree today.

I think the strict active substance re-registration is an excellent concept that seeks to optimize our present-day possibilities. As regards fungicides, the European re-registration has not yet solved much (alternative technologies are lacking), and the elimination of endocrine disrupting compounds also very slowly progresses. We have not yet consistently reviewed pre-harvest desiccation (see

the ban of diquat and bromoxynil), which is therefore based predominantly on the water-polluting active ingredient glyphosate.¹⁷⁻¹⁸ We did not dare to start reassessments based on immunomodulatory effects, since it would almost completely preclude the use of agrochemicals. European Union progressing based on the precautionary principles. The Scandinavian countries are leading the way toward respect for nature and consumers. Unfortunately, most of the chemical plant protection technologies of our time are emergency technologies. Producing sustainably with chronic water- and soil-polluting compounds is an absurd idea. The practice of plant protection attempted to develop environmentally friendly technological forms. The original principles of integrated pest management (IPM) and even of ecological plant protection (EPM)¹⁹ are beautiful, but operational practices are lacking. As many farmers, that many practices exist, since the multi-faceted and comparative toxicological assessment of the pesticide active ingredients is delayed all over the world, and the focus remains in fact chemical plant protection, with only a promise of biological protection.²⁰ Precision plant protection does not even strive for this, it is only lobbying for the use of expensive and energy-intensive space technology, which channels the income generated by agriculture to that sector. Its buzzword collection (e.g., the use of high-tech technology, digitalization: machinery control by smartphones) is dazzling, but it is not in relation to the economic opportunities of the agriculture in Eastern European and developing countries. Let's not forget that tractor exhaust gases can be absorbed on soil granules and can be detected there. Can a *sensu stricto* organic farming practice exist without horses (also consider horse manure)?

Organic farming, which is supposed to be carried out without synthetic pesticide active ingredients, has problems at a much more fundamental level of safety. When converting to organic farming, the soils are currently not checked for their content of persistent pollutants (e.g., chlorinated hydrocarbons – even though those are common contaminants), and there is no monitoring of the irrigation water, even though water can carry a wide variety of synthetic pollutants. Preparations containing copper and sulfur alter the microbial soil-borne communities, copper also is accumulative, and its immunomodulatory effect is well known.²¹ Active ingredients of natural origin are mostly formulated with synthetic substances. Moreover, residues may also be originated elsewhere from the agriculture. During mosquito control with deltamethrin in our environment, approximately half of the active ingredient reaches ground level.²² The solution would be biological plant protection²³ if the use of super-selective technologies against pest communities was not extremely complicated. The absence of a single link leads to the collapse of the sustainable model built with awkward tediousness. We live in the *Plastic Age*, and we made the planet so much lame. A catch-22 if all this is projected on overpopulation. The balance between resources and consumers is fatally damaged, pollution has caused global warming, as well as a shortage in energy and raw materials.

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