



# Permissiveness of Brazilian Legislation, Widespread Contamination by Pesticides in Food and Water, and Risks to the Population's Health

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## PESTICIDE PERMISSIVENESS IN BRAZIL: A CRITICAL OVERVIEW

Pesticides have been widely used worldwide, and the results of scientific research have influenced the debate on the benefits and harms resulting from their handling in several areas of knowledge and a “war” of political and ideological narratives (CandiOTTO, 2021). The spraying of pesticides initiates a chain reaction process, as they are products manipulated and applied by rural workers, used directly in food, which will later be consumed by the whole society, and which spread and can accumulate in the environment (water, soil, sediments, animals, plants) and human organisms. In this sense, monitoring the presence of pesticides in food, the environment, and human bodies is essential to qualify this debate and direct decisions about the future of food production in the best possible way.

In Brazil, this “war” of narratives has intensified in recent years due to the political position of the current federal government (of President Jair Bolsonaro) to expand and release the use of pesticides. Indeed, this process has been supported by most parliamentarians, who are responsible for proposing and approving the laws. Despite resistance and denunciation from other sectors of society, the interests of people and companies linked to agribusiness have been predominant. Two examples characterize this situation: 1) While between 2000 and 2015, around 122 new registrations were granted per year (among similar ones already on the market and new active ingredients), since 2016, this average has risen to 419 (MAPA, 2020); 2) After standing still for 20 years, Bill 6,299 of 2002, which substantially modifies the legislation on pesticides, was approved in the Chamber of Deputies in February 2022, with the approval of the Federal Senate and its enactment now pending by the President of the Republic. On the other hand, despite several shortcomings, there are programs for monitoring the presence of pesticides in food and water, making it possible to know part of the situation in the country, but which already indicate the seriousness of the problem. In this context, we addressed the main recent aspects concerning food and water contamination in face of Brazilian legislation permissiveness, and its implications on people's health.

## BRAZILIAN FOOD MONITORING PROGRAM: A HISTORICAL PERSPECTIVE ABOUT FOOD CONTAMINATION BY PESTICIDE RESIDUES

Brazil has two programs that monitor pesticide residues in foods of plant origin, the Program for the Analysis of Pesticides Residues in Food (PARA), linked to the National Health Surveillance Agency

(ANVISA), and the National Program for Control of Waste and Contaminants (PNCRC Vegetal), linked to the Ministry of Agriculture, Livestock and Supply (MAPA).

Considering the results of PARA as of 2010, on average, 63% of the food samples analyzed in Brazil contain some pesticide residue resulting from the spraying of these products. Of this percentage (63%), 27% were above the limits allowed by the Brazilian legislation, and are considered unsatisfactory due to the risk they pose to human health (ANVISA, 2020). In addition, most of the sampling considered unsatisfactory stems from the presence of pesticides not authorized for the crop, which endangers farmers who are directly exposed to these products and food consumers.

Despite the advances, the number of samples analyzed in Brazil seems to be less than ideal, considering that throughout PARA (2001–2018), only 36,069 samples were analyzed, representing a little more than a third of the total number of samples analyzed, which was analyzed in the European Union only in 2018 (EFSA et al., 2020). Still, another factor that must be taken into account is that Brazil has been much more permissive concerning the Maximum Residue Limits (MRL) established and the pesticides used in the national territory. These have been banned for years in the countries of the European Union, as is the case with carbendazim, chlorpyrifos, and acephate, which expresses a picture of environmental injustice (Bombardi, 2017). Another critical element presented in the PARA reports is multi-exposure; that is, the consumer, when eating, may be ingesting more than one pesticide at a time.

The most recent PNCRC Vegetal report, which presents the results of the analyzes carried out in 2019 and 2020, reinforced what PARA had already been a warning. On average, pesticide residues are present in 61.88% of the analyzed samples, with emphasis on the high frequency of residue detection for the following foods: beans, black pepper, peppers, pears, strawberries, grapes, and wheat flour, which had more than 90% of the sample with the presence of pesticides. Another worrying factor that the PNCRC Vegetal report reveals is that 86.84% of rice samples, one of the most consumed foods in Brazil, present the detection of arsenic. In addition, cocoa bean and garlic products showed traces of cadmium in 100 and 26.32% of the samples, respectively (BRASIL, 2021).

A considerable percentage of analyzed samples (23% of the total) were categorized as unsatisfactory since they had pesticides detected above the maximum limit (5.4%), or had residues of not allowed (20.4%) or banished pesticides (20.4%). Acephate, chlorpyrifos, and methomyl were the top 3 pesticides with the most significant number of irregular detections. Pesticides that exceeded the maximum allowed limits in food included carbendazim in pineapple, cypermethrin and dithiocarbamates in lettuce, pyriproxyfen in garlic, carbendazim in sweet potato, acephate in carrot and chayote, acephate, tebuconazole and cyfluthrin in guava, prochloraz in mango, prophenofos, acephate and procimidone in bell pepper, chlorpyrifos and acephate in tomato, and acephate in grape (ANVISA, 2019).

## PESTICIDES POSE A CANCER RISK FOR BRAZILIANS THROUGH DRINKING WATER

A worrying fact refers to pesticide contamination of water for human consumption recently published by the Brazilian Ministry of Health through the Information System for Surveillance of Water Quality for Human Consumption (SISÁGUA, BRASIL, 2022). This surveillance system evaluates the presence of several substances in the water consumed by the Brazilian population, including 11 pesticides with carcinogenic potential, according to the International Agency for Research on Cancer (IARC).

Based on the last released report (2018–2021), about 13% of all the results recorded in this document correspond to the presence of pesticides in water samples, and 25% of these were detected in water samples collected directly from taps, that is, in homes or other places where the population directly consumes water.

In addition, more than 500 records in this document refer to the presence of pesticides in water distribution reservoirs that supply thousands of people, especially in big cities. Also, 148 records in the database are presented as the reason for the “complaint” collection. Therefore, Brazilian water presents a mixture composed of toxic substances above the maximum limit allowed by Brazilian legislation, which is highly permissive. Europe standards are reference for drinking water safety, and if considering the maximum limits recommended by the European Union Directive about the highest levels authorized for each pesticide (0.1 ppb) or the sum of the levels of each substance in water for human consumption (maximum of 0.5 ppb), the water currently consumed by the Brazilian population would be unfit for human consumption (Dolan et al., 2013; EU, 2020).

Even considering Brazilian legislation permissiveness, about 50 Brazilian municipalities had levels of pesticides in drinking water above the maximum limits allowed in the country. Most of these substances have been banned in European Union countries, including pesticide residues known as persistent organic pollutants (POPs). These are toxic and persistent chemical substances whose degradation takes decades and have a high capacity for cumulative contamination through the water and food chain (Hung and Thiemann, 2002; Kaushik et al., 2010; Agarwal et al., 2015; Rodríguez et al., 2017; EPA, 2022).

In this context, 7 Brazilian cities presented levels of DDT and its derivatives (DDD and DDE) above the maximum limit allowed in the country (1 ppb), which is 100 times higher than those set by the European Union for this substance (0.01 ppb). Further, 42 cities recorded levels of chlordane equal to or greater than the Brazilian upper limit (0.2 ppb), which is 20 times more than Europe’s recommended maximum levels (0.01 ppb). Both pesticides are categorized as possibly carcinogenic by the IARC and linked to liver and thyroid cancers for chlordane and testis, liver and lymphoma for DDT and its metabolites (IARC, 2019). It is estimated that 0.1 ppb of either POPs is sufficient to generate at least one cancer case in every million inhabitants (EPA, 2022b). A total of 23 Brazilian municipalities showed contamination by lindane- $\gamma$ -HCH, reaching concentrations above the maximum allowed limit (2 ppb) or up to 100 times higher (200 ppb). This situation brings attention because lindane is a proven carcinogen

(Odevale et al., 2021), and it is estimated that only 0.032 ppb is enough to generate one case of cancer in every million inhabitants (EPA, 2022b).

These mixtures of pesticides can impact human health, but it is difficult to determine how deeply, especially for POPs that have not degraded and accumulates in the human body. Adding to this is that several cities present concomitant contamination by multiple substances derived from the sewage treatment process, industrial residues, and radioactive substances such as uranium, recently detected in 22 Brazilian municipalities from Minas Gerais state.

## PERPECTIVES

Despite the importance of the results presented in these monitoring programs, little has been done to minimize evidence of contamination of food and water by pesticides. PARA, PNCRC Vegetal, and SISÁGUA present themselves today as more traditional instruments than directing public policies and practical actions. In addition to the difficulty of establishing corrective actions, since, as far as we know, it is impossible to remove pesticide residues from food and water with low-cost and straightforward methods, the most important thing is lacking, which would be preventive actions against the use of pesticides, to reduce the spraying of these products in Brazil. As demonstrated, on the contrary, there is an incentive to expand its use so that future monitoring, if carried out with scientific and methodological rigor, tends to worsen this situation.

In Brazil, the broad commercialization and use of pesticides, combined with the high permissiveness of the residue limit, cause the aggravation of cases of human and environmental contamination. In addition, the lack of technical assistance and adequate guidance, especially for the most impoverished farming families, and inspections of compliance with laws and enforcement standards, lead to blaming rural workers for disrespecting basic safety standards, as is often the case of non-use of personal protective equipment (PPE).

However, even taking the recommended precautions, people who apply the substances are subject to higher levels of exposure. The families of agricultural workers are also vulnerable due to residues that can be present on the skin, clothes, and shoes of those who apply pesticides.

Contamination of food and drinking water transcends exposure beyond the areas of cultivation and farming families. Populations living close to crops and consumers of products with pesticide residues are now exposed to the harmful effects of chemical agents.

An example of how economic interests are more valued than nature and the life of the Brazilian population deals with the active ingredient Paraquat, which had its toxicological

reassessment carried out by ANVISA in 2017, in which they concluded the association with the development of Parkinson's Disease. It was decided to ban marketing through Resolution RDC No. 177, of September 21, 2017, published in the Official Gazette on September 22, 2017. However, due to pressure from conservative parliamentarians, there was an expansion deadline until August 31, 2021, for the product to be used by farmers who had stock.

In addition to human contamination, commodities such as soy compete in the international market at the expense of intensifying deforestation, environmental degradation, and water and soil contamination (Porto, 2018). Pesticides can remain in the environment for decades and pose a global threat to the ecological system on which food production depends. The UN (2017) highlights that the excessive and incorrect use of pesticides causes the loss of biological diversity, destroying populations of natural predators and reducing the nutritional value of food.

Contamination of ecosystems can deprive local populations of cultivating their land and accessing food sources and livelihoods. The main concern of regulatory authorities is usually the risk that pesticide residues can pose to human health. However, some products such as neonicotinoids (e.g., imidacloprid), which is a category of systemic insecticide which aims to damage the central nervous system of "target pests," can cause damage to various forms of wild fauna and flora (UN, 2017).

Some preventive actions are necessary, such as using personal protective equipment, guidance for use as recommended on the packaging, triple washing of packaging, and return to manufacturers (reverse logistics). However, many farmers find it difficult to proceed correctly due to illiteracy or difficulty understanding the indications on labels, lack of guidance from sellers and other professionals, or even because they do not realize that these products are toxic and harmful to the community health.

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CP, LP, and SG equally contributed to Conceptualization, data collection and analysis, manuscript writing, review and; editing, and revisions.

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