LIVING IN CONTAMINATED TERRITORIES:

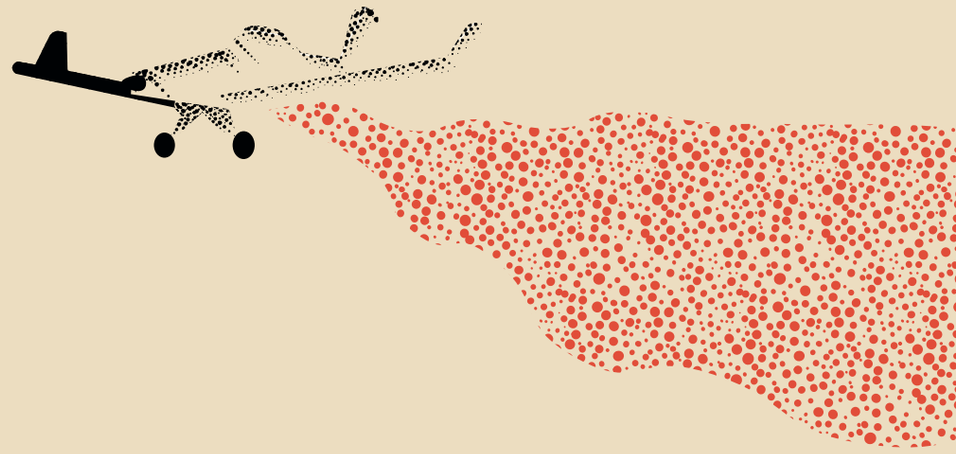
a dossier on pesticides in Cerrado waterways

SEM CERRADO ÁGUA VIDA
CAMPANHA NACIONAL EM DEFESA DO CERRADO

CPT

TPP

Ministério da Saúde
FIOCRUZ
Fundação Oswaldo Cruz



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A ACTIVE INGREDIENT (AI):

The chemical responsible for a pesticide's action on target organisms, for example herbicide, fungicide, or insecticide actions.

ACUTE MYOCARDIAL INFARCTION (HEART ATTACK):

A lesion to part of the heart muscle due an obstruction of the coronary artery, preventing oxygen-rich blood from getting to the heart.

ADJUVANTS:

Substances added to formulations, responsible for modifying certain characteristics of pesticides, facilitating their application, adherence, penetration, and absorption. They allow, for example, greater absorption of a herbicide by plants.

B BIOSAFETY:

A condition of safety achieved by a set of actions designed to prevent, control, reduce or eliminate risks inherent to activities that may jeopardize human or animal health or the envir onment.

C CUNINTENTIONAL CONTAMINANTS:

Substances (biological, physical, or chemical agents) that are not part of the initial formulation of pesticides, but are present in small quantities, and may be residues of the raw material used or be caused by the manufacturing process, inadequate storage, or cross-contamination by other substances. They can be harmful to health.

D DIABETES MELLITUS (THE MOST COMMON TYPE OF DIABETES):

A metabolic disease, resulting from the lack and/or inability of insulin to perform its functions, resulting in a permanent rise in blood sugar levels.

DIOXINS:

A group of highly toxic and persistent chemicals in the environment that are byproducts of the manufacture of chlorinated compounds. They are carcinogenic.

F FORMALDEHYDE:

a chemical commonly used in the production of resins, plastics, paper, and other materials. It is a toxic and potentially carcinogenic product, which can be present in pesticide formulations as a contaminant or an impurity from industrial processes.

G GENOTOXIC POTENTIAL:

The ability of certain substances to damage or modify the genetic material of cells.

L LEUKEMIA:

A type of cancer affecting the body's defense cells (leukocytes), produced in the bone marrow.

LH

Luteinizing hormone, responsible for the development of the ovaries and testicles.

M METABOLITES:

Residues generated by the degradation of chemicals, produced, for example, by the biotransformation of pesticide active ingredients.

N NHL:

Non-Hodgkin's lymphoma, a type of cancer of the lymphatic system.

P PESTICIDES (AGROTOXINS):

Biocides active on various biochemical mechanisms of living beings, containing one or more active ingredients (AI) and other chemicals responsible for their spreading and absorption.

S SARCOMAS:

A type of cancer that occurs mainly in the bones and soft tissues of the body, such as muscles, tendons, and cartilage.

SURFACTANTS:

Agents that increase the solubility of certain substances in water.

Source of the Rio Preto surrounded by monocultures and deforestation, Formosa do Rio Preto, Bahia. Credit: Thomas Bauer CPT.

“No Cerrado
No water
No life

The Paraguay river and its tributaries, the Cuiabá, São Lourenço and Taquari; the Paraná and Paraíba rivers; the São Francisco river – the beloved Velho Chico; the Rio Doce; the Jequitinhonha; the Parnaíba; the Itapecuru; the Tocantins; the Araguaia; the Tapajós; the Xingu; and the many tributaries of the Madeira river, not only have their beds in the Cerrado, but their waters’ very birthplace. Through valleys and plateaus, in landscapes covered by deep-rooted, thick-barked trees, rainwater finds its way into the soil and feeds one of Brazil’s foremost water recharge areas. This explains the presence of the country’s two main aquifers – the Guarani and the Urucuia-Bambuí. It is also from the Cerrado that the planet’s two largest expanses of continental floodplains – the Pantanal and the Araguaia “varjões” – gain their hydrological dynamics[1] [2].

Along the riverbanks, in the marshes, veredas and lowlands, the people of the Cerrado have established their ways of life as an interweaving of many species. Water to drink, for cooking, and – when stored in the soil – to feed the plants that grow in fields, fallows and homegardens. Water for livestock and to sprout grass on ownerless land, the commons of people who live there. Water for the spirits, for rites and rituals that celebrate life and cross over to other planes.

In these same places, deforestation of the plains has paved the way for monoculture farming systems, especially soy, which thrives on pesticides, transgenic seeds and violence against the ways of traditional Cerrado communities. These peoples are under attack constantly, in their communities, in the way they manage their biodiversity and in their homes. Arson, weapons, and death go hand in hand with the expansion of agribusiness as it overruns bodies and territories into the Cerrado. Commonly held possessions are replaced by private property, much of it taken by criminal land-grabbers. The soil is exploited to the point of exhaustion and watercourses are intensively exploited, plundered by pesticides, silting and dams.

The Dossier focuses on that scenario of conflicts. As an educational tool to produce knowledge, it uses action research both to understand and to transform reality, based on an assumption of reciprocity between academic and people’s knowledge. From this perspective, seven Cerrado communities, with the support of representatives from the Land Pastoral Commission (CPT) from Tocantins, Goiás, Maranhão, Piauí, Mato Grosso do Sul, Fase Mato Grosso and Agência 10Envolvimento, from Bahia, in partnership with the National Campaign to Defend the Cerrado and researchers from Fiocruz, decided to work collectively to denounce the violence promoted by agribusiness[3].

Having grasped the breadth of the subject and the need to delve deeper into certain issues, this study aims to understand the pollution of water in the Cerrado by pesticides approved for use on soy. We chose to

1. PORTO-GONÇALVES, Carlos Walter. Dos Cerrados e de suas riquezas: de saberes vernaculares e de conhecimento científico. Rio de Janeiro; Goiânia: FASE; CPT, 2019.

2. AGUIAR, Diana; LOPES, Helena (Orgs.). Saberes dos povos do Cerrado e biodiversidade. Rio de Janeiro: Campanha em Defesa do Cerrado; ActionAid Brasil, 2020.

3. One of the results of the action research was the production of a report with technical information on pesticides, one of the main sources of this Dossier. The full report can be accessed at: https://campanha-cerrado.org.br/biblioteca/14-biblioteca/publicacoes/426-contaminacao-das-aguas-do-cerrado.

analyze pesticides used on soy because of two interrelated factors:

I. the prominence of soy monocultures in the Cerrado, covering 52% of the country's cultivated area in 2021[4] [5];

II. the intensity of pesticides sprayed on this crop: of Brazil's total consumption, more than 60% goes to soy[6].

Considering the large volume of soy produced and pesticides used in these monocultures, our focus on the water contaminated by these chemicals is due both to the importance of the Cerrado for the whole country's water security, and to the contribution of this approach to understanding struggles by Cerrado communities in defense of their water.

4. PROJETO MAPBIOMAS. Destaques do mapeamento anual de cobertura e uso da terra entre 1985 e 2021: Cerrado. 2022. Coleção 7. Available at: https://mapbiomas-br-site.s3.amazonaws.com/MapBiomas_CERRADO_2022_09092022__1_.pdf

5. COMPANHIA NACIONAL DE ABASTECIMENTO. Acompanhamento da safra brasileira de grãos: safra 2021/22 – oitavo levantamento. Brasília, DF, v. 9, n. 8, abril 2022. Available at: https://www.conab.gov.br/info-agro/safras/graos/boletim-da-safra-de-graos?start=10

6. PIGNATI, Wanderlei Antonio; LIMA, Francco Antonio Neri de S. e; LARA; Stephanie Sommerfeld de; CORREA, Marcia Leopoldina M.; BARBOSA, Jackson Rogério; LEÃO, Luís Henrique da C.; PIGNATTI, Marta Gislene. "Distribuição espacial do uso de agrotóxicos no Brasil: uma ferramenta para a Vigilância em Saúde", in Ciência & Saúde Coletiva, Rio de Janeiro, v. 22, n. 10, p. 3,281-3,293, 2017.

The communities participating in the action research were selected based on collective dialogues with organizations involved in the National Campaign to Defend the Cerrado and active around pesticide-related issues[7]. The advance of agribusiness over these communities was another consideration, especially with regards to soy.

One of the hypotheses discussed throughout this article is that pesticides are chemical weapons used against the peoples of the Cerrado. The purpose is to exterminate people, by intentionally contaminating their bodies and territories with a substance that prevents the production and reproduction of life. How else could we interpret drinking water too dangerous to drink? Or the fish in the river, a source of food, killed before they can be caught? How can we understand pests from soy plantations being driven into a community's crops and fruit trees?

Combining different methodological approaches – reviews of specialized literature on pesticides authorized for use on soy, analysis of water samples and environmental toxicological analyses – the Dossier seeks to use everyday knowledge and critical science to substantiate how pesticides have been turned into chemical weapons.

To this end, the text is organized into four parts. In the first, we contextualize the problem and the relevance of the subject. In the second part, we focus on the methodology we have adopted for the collective production of knowledge. In the third part, we look at results and discussions, using a cross-cutting perspective while also focusing on each of the communities. Finally, in the concluding remarks, we look at how pesticides are used as chemical weapons and at possible actions to protect the waters and health of the peoples and the Cerrado.

7. Participants in this process: Federação de Órgãos para Assistência Social e Educacional (FASE), Comissão Pastoral da Terra (CPT), Associação Agroecológica Tijupá, Núcleo de Agroecologia e Educação do Campo Gwatá/UEG and Alternativa para a Pequena Agricultura no Tocantins (APA-TO).

1 PESTICIDES AND CHEMICAL WARFARE IN THE CERRADO

This section presents a history of processes associated with agribusiness and pesticides. Far from an exhaustive study, we provide general guidelines to contextualize the problem of our action research project. We highlight how, for decades, this approach to agriculture has been based on the concentration of land and wealth, and on violence. Our focus is on understanding how this happened in the Cerrado and the implications in the region of the spread of soy monocultures and the use of pesticides. On this basis, we introduce the communities taking part in the research, stressing how, for generations, they have shaped their ways of life and confronted agribusiness and pesticides. These interrelated dimensions explain the thematic relevance of our action research, and the need for ongoing studies and research on the subject.

1.1. Agribusiness spreads through the Cerrado, with pesticides as chemical weapons

The facts about pesticides compel us to deal with painful issues, reports and data imposed by the model of agriculture adopted in Brazil. Pesticides, or "agrotoxins" in Brazil, are not just products for crops or livestock. They are contaminants, toxic agents. They pollute people and their bodies; schools and students; drinking and cooking water; gardens; rivers and reservoirs that were once places of joy; the soil, where communities' food once grew.**Before delving into the knowledge of the peoples of the Cerrado, its veredas and chapadões, and into the springs and tributaries of so many rivers, we focus first of all on the ruptures and fragmentation imposed by pesticides on the Cerrado's countless forms of life.**

It was in the midst of the so-called Green Revolution, unleashed worldwide as a process connecting agriculture into industry, that pesticides became part of a specific way of farming. Although in countries like Mexico and the United States this moment dates back to the 1940s, in Brazil it was in the 1970s, during the Military Dictatorship, that the use and production of these agents intensified in the country.

However, **pesticides are not an isolated factor, but part of a package based on chemical fertilizers, commercially bred seeds and monocultures**. Brazil adopted the Green Revolution model as part of the modernization of agriculture, underwritten by state-sponsored promotion of farming based on land concentration, mechanization, monoculture, and the export-oriented cultivation of commodities such as soy, cotton and corn. Repercussions of that historical process are felt to this day.

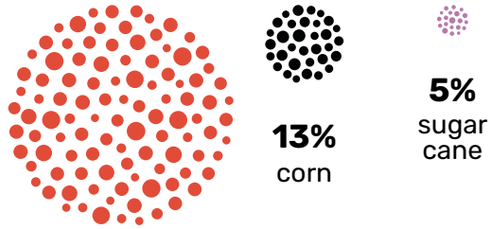
According to data from the National Supply Company (Conab)[8], in the 2020/21 crop year Brazil planted 38.5 million hectares of soy. Of that total, 20 million, or 52% of the country's soy-growing area, were in the Cerrado. A historical analysis by MapBiomas[9], shows that soy plantations in the Cerrado grew by more than 1,440% from 1985 to 2021, to cover 10% of the region's entire land area.

The spread of soy in the Cerrado has also devastated forests, waters and the peoples and communities who live there. MapBiomas' data warns that in the same period, from 1985 to 2021, more than 29.7 million hectares of plant cover were destroyed and only around 51% of the territory is still covered by native vegetation, such as forests and grasslands.

Soy is the most widely grown commodity in Brazil. According to Conab's estimates for the 2022/23 crop year, the area planted to soy is expected to surpass 43 million hectares, an increase of 4.6% over the previous year[10].

Besides covering the largest area, soy is the crop that uses the most pesticides. Of the total consumed in Brazil, more than 63% is sprayed on soy, followed by corn (13%) and sugar cane (5%)[11]. In terms of volume, that amounts to over 600 million liters of pesticides per year throughout the Cerrado, or 73.5% of the total consumed by the entire country in 2018[12]. These figures

Percentage of pesticides used on monocultures compared to total consumption in Brazil:

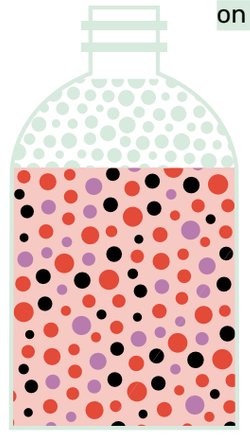


This volume is more than

600 million

liters of pesticides per year in the entire Cerrado region.

The total use of pesticides on soy, corn, and sugar cane accounts for:



73,5%

of all pesticides consumed in Brazil in 2018.

8. COMPANHIA NACIONAL DE ABASTECIMENTO. Acompanhamento da safra brasileira de grãos: safra 2021/22 – oitavo levantamento. Brasília, DF, v. 9, n. 8, abril 2022. Available at: https://www.conab.gov.br/info-agro/safras/graos/boletim-da-safra-de-graos?start=10_+

9. PROJETO MAPBIOMAS. Destaques do mapeamento anual de cobertura e uso da terra entre 1985 a 2021: Cerrado. 2022. Coleção 7. Available at: https://mapbiomas-br-site.s3.amazonaws.com/MapBiomas_CERRADO_2022_09092022__1_.pdf

10. COMPANHIA NACIONAL DE ABASTECIMENTO. "Produção nacional de grãos é estimada em 312,2 milhões de toneladas na safra 2022/23". Brasília, DF, 8 Dec. 2022. Available at: https://www.conab.gov.br/ultimas-noticias/4847-producao-nacional-de-graos-e-estimada-em-312-2-milhoes-de-toneladas-na-safra-2022-23#:~:text=Ainda%20assim%2C%20a%20produ%C3%A7%C3%A3o%20estimada,43%2C4%20milh%C3%B5es%20de%20hectares

11. PIGNATI et al., 2017.

12. EGGER, Daniela da Silva; RIGOTTO, Raquel Maria; LIMA, Francco Antonio Neri de Souza; COSTA, André Monteiro;

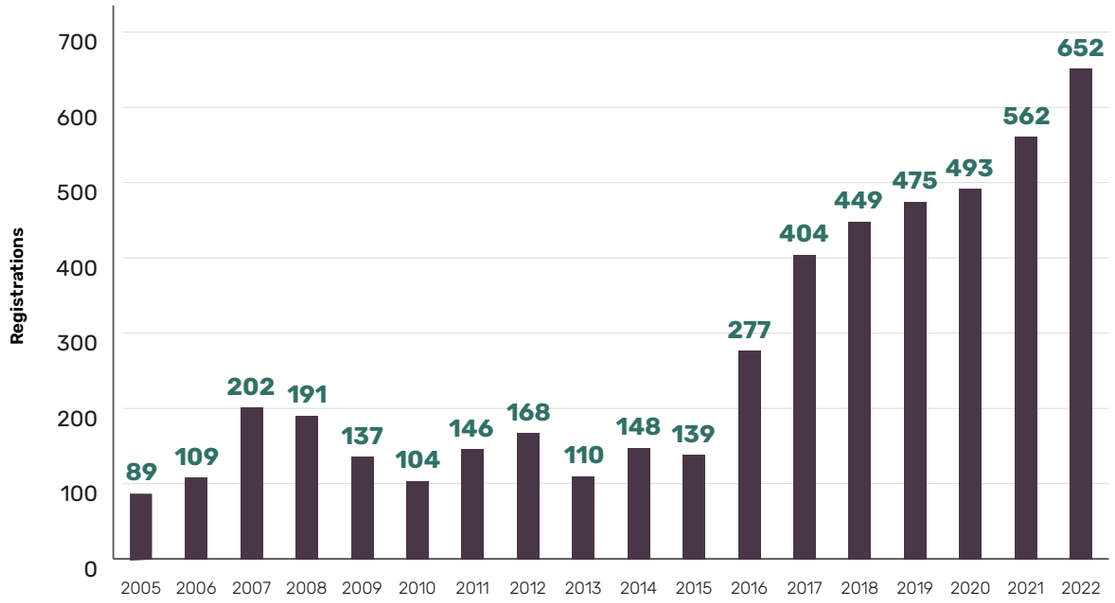
highlight the daily, unavoidable presence of pesticides in the Cerrado and on the people who live there.

After more than 50 years, the modernization of agriculture continues to evolve, finding new ways to maintain and reproduce conditions like the concentration of land and wealth. In the Cerrado, one of its most blatant expressions was the institutionalization in 2015 of the agricultural frontier area known as Matopiba (Maranhão, Tocantins, Piauí and Bahia)[13], although the decree creating it has since been revoked[14]. Far from being a contradiction, the materialization of Matopiba expresses state-sponsored leniency towards the grabbing of public lands by private agents[15].

This dimension can be seen as well in the legal framework adopted for pesticide use in Brazil. For example, incentives have been granted by the federal government to the sale of pesticides, by waiving several fees and reducing taxes[16], in addition to other facilities.

The dismantling of the tripartite pesticide registration process is emblematic of this. With Federal Law No. 12,873 of October 24, 2013[17] , the Ministry of Agriculture, Livestock and Supply (MAPA) was given exclusive authority to authorize the emergency use of certain pesticides against blights in monocultures. This sort of loophole, which excludes the Ministry of the Environment (MMA) and the National Health Surveillance Agency (Anvisa) from the process, has been used to approve an unprecedented number of pesticides[18], According to MAPA data published in the Official Gazette, 1,964 2,182 new pesticides were registered from 2019 to March 2022, as this graph reveals[19].

GRAPH 01 **Number of pesticides registered in Brazil from 2005 to 2022***



Source: Ministry of Agriculture, Livestock and Supply (MAPA)[20] * Registered through December 2022

The culmination of Brazil's attempts to relax controls over pesticide may come with the approval of Bill of Law No. 1.459/2022 (formerly PL 6.299/2002), widely known as the "Poison Package". This bill seeks to satisfy interests of the Congressional ruralista caucus, ranchers, and pesticide producers, by rewriting Brazil's 1989 pesticide law. It proposes changes that would increase the use of these products in the country, while imposing less-protective measures for human health and the environment. One of the measures, for example, is the end of the tripartite regulation system, to concentrate power to authorize a pesticide in the country under the sole responsibility of MAPA. The centralization of powers in this Ministry, which has historically served the interests of agribusiness and has no technical competence to assess human health and environmental concerns, is one more threat to people's lives and territories.

This possibility is even more dreadful considering that the bill would eliminate the ban on pesticides with "teratogenic, carcinogenic or mutagenic" properties, i.e., those that can cause functional alterations during pregnancy, such as malformations in babies, cancer, and changes to people's genes. The current law's stipulation that no pesticide may be

AGUIAR, Ada Cristina Pontes. "Ecocídio nos Cerrados: agronegócio, espoliação das águas e contaminação por agrotóxicos," in Desenvolvimento e Meio Ambiente, Curitiba, v. 57, p. 16-54, June 2021. DOI 10.5380/DMA.V57I0.76212. p. 17

13. Covering 337 municipalities and nearly 73 million hectares. See: MIRANDA, Evaristo Eduardo; MAGALHÃES, Lucíola Alves; CARVALHO, Carlos Alberto de. Proposta de delimitação territorial de Matopiba. Nota técnica 1. Campinas, SP, 2014. Available at: https://ainfo.cnptia.embrapa.br/digital/bitstream/item/139202/1/NT1-DelimitacaoMatopiba.pdf

14. It is relevant to note that Congress is currently working on Complementary Bill of Law (PLC) No. 246/2020, which establishes the Matopiba Geo-economic and Social Complex. Unlike the 2015 Decree, the language of this bill reflects debates on sustainable development and the green economy, a strategy to attract sectors interested, for example, in the carbon market. See: AGUIAR, Diana; BONFIM; Joice; CORREIA, Mauricio (Orgs.). Na fronteira da (i)legalidade: desmatamento e grilagem no Matopiba. 2021. Available at: https://www.matopibagrilagem.org/matopiba

15. According to a study by the Association of Farmworkers' Lawyers (AATR), the Matopiba agricultural frontier involves "legalizing crime", by providing legal grounds for land grabbing by Brazilian farmers and international funds. It also exploits the state's sluggishness in titling the lands of indigenous peoples and traditional communities. See: ibid

16. By way of example, consider the 100% reduction in the rates of Social Integration Program (PIS) and Public Servant Equity Formation Program (Pasep) contributions, as well as the Social Security Financing Contribution (Cofins). In addition, pesticides enjoy lower import taxes (II) and taxes on industrialized products (IPI). To learn more, see: FUNDAÇÃO OSWALDO CRUZ. GT de Agrotóxicos da Fiocruz: Fact Sheet nº 2. Isenções e reduções fiscais na comercialização, industrialização e uso de agrotóxicos no Brasil. Rio de Janeiro: Fiocruz, 2019.

17. Articles 52 to 54 of the law were then regulated by Decree No. 8,133 of October 28, 2013..

18. We have highlighted just a few examples in order to raise awareness of the debate. For a detailed discussion of the legal mechanisms in Brazil and in the international arena, see: BITTENCOURT, Naiara (Coord.). Agrotóxicos e violações de direitos humanos no Brasil: denúncias, fiscalização e acesso à justiça. Terra de Direitos; Campanha Permanente Contra os Agrotóxicos e Pela Vida. Curitiba: Terra de Direitos, 2022..

19. The approval of pesticides continues in 2023, and by March of this year 48 new pesticides had already been registered, according to the Federal Official Gazette. (DOU). LACERDA, Nara. "Movimentos reagem à liberação de agrotóxicos e cobram governo por mudanças", in Brasil de Fato, São Paulo, 17 Feb. 2023. Available at: https://www.brasildefato.com.br/2023/02/17/movimentos-reagem-a-liberacao-de-agrotoxicos-e-cobram-governo-por-mudancas

20. Available at: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.gov.br%2Fagricultura%2Fpt-br%2Fassuntos%2Finsumos-agropecuarios%2Finsumos-agricolas%2Fagrotoxicos%2FRegistrosConcedidos200020223.xlsx&wdOrigin=BROWSELINK

Vitória Farm (Horita Group), Cachoeira do Estrondo Condominium, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento.

registered if there is evidence that it can have any of these harmful effects will be overturned if the bill is approved[21].

On the direct relationship between pesticides and water contamination, Brazilian legislation is already highly permissive, especially compared to other countries' environmental and health standards, many of which are more protective. The levels of pesticide residues allowed in water in Brazil are often higher than the Maximum Permitted Values (MPV) in European Union countries. **The level of glyphosate allowed in water in Brazil, for example, is 5,000 times higher than in the European Union**[22].

Another significant difference between Brazil and the European Union's member countries refers to the sum of pesticide residues in a single sample. **In Brazil, Ordinance No. 888/2021, which sets the MPVs for pesticides in water, only assesses the values of each specific residue in a sample, regardless of the number of substances found.** In the European Union, on the other hand, it is the sum of all the residues that determines whether a sample is within permitted levels for monitoring and surveillance purposes, since exposure to mixtures can involve various agents present in a sample that interact with each other, increasing or amplifying their toxic effects[23].

21. STEVANIM, Luiz Felipe. "O veneno está na mesa," in Radis Comunicação e Saúde, Rio de Janeiro, 3 Dec 2022. Available at: https://radis.ensp.fiocruz.br/index.php/home/entrevista/o-veneno-esta-na-mesa

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23. ROSA, Ana Cristina Simões; GURGEL, Aline Monte; FRIEDRICH, Karen. "Presença de agrotóxicos em água potável no Brasil: parecer técnico do GT de Agrotóxicos da Fiocruz para a Revisão do Anexo XX da Portaria de Consolidação nº 5, de 28 de setembro de 2017 do Ministério da Saúde, para o parâmetro 'agrotóxicos'". Rio de Janeiro: [s. n.], 2020.

Soy monoculture, Campos Lindos, Tocantins. Credit: CPT Araguaia Tocantins.

In addition to this negligence regarding mixtures, the situation of aerial pesticide spraying in the Cerrado and in Brazil is deeply disturbing. **As a strategy to denounce contamination, Cerrado communities have produced many videos and photographs of airplanes spraying their lands with chemical clouds.** This is the most damaging type of pesticide application for humans exposed to pesticide cocktails that threaten the health of people living in contaminated areas. These are serious violations of rights, particularly for the most vulnerable: babies, children, the elderly, and traditional peoples and communities[24].

According to the publication "Pesticides and human rights violations in Brazil: denunciations, inspections and access to justice", produced by the Permanent Campaign Against Pesticides and For Life and by Terra de Direitos[25], aerial spraying is particularly notorious for the dispersion of chemical products due to wind drift. An analysis of studies carried out by the Brazilian Agricultural Research Corporation (Embrapa) shows that even under ideal wind and temperature conditions, for example, **only 32% of sprayed pesticides reach the target plants, while 49% fall on the soil and 16% spread through the air to surrounding areas.** The lives of residents in these areas can become unbearable due to contamination of their bodies and of commons that are fundamental to their way of life. In the European Union, for example, aerial spraying of pesticides has been banned since 2009, on the grounds

24. BITTENCOURT, Naiara (Coord.). Agrotóxicos e violações de direitos humanos no Brasil: denúncias, fiscalização e acesso à justiça. Terra de Direitos; Campanha Permanente Contra os Agrotóxicos e Pela Vida. Curitiba: Terra de Direitos, 2022

25. See: ibid.

Vitória Farm (Horita Group), Cachoeira do Estrondo Condominium, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento.

Sprayers at Alaska Farm, Cachoeira do Estrondo Condominium, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento.

that it is harmful to human health and the environment[26]

The damage associated with exposure to pesticides, moreover, is unequally distributed, falling heavily on the most vulnerable populations, such as traditional peoples and communities, riverside dwellers, peasants, and farmworkers. Nor is the damage suffered by those who cause it, the large landowners and multi- and transnational corporations. It is the Brazilian state that takes on most of the financial burden, particularly the Unified Health System (SUS).

The cost of treating diseases and illnesses associated with exposure to pesticides is significant for consumers, workers, and environmentally exposed groups, particularly people who live near monocultures. Another factor is widespread negative environmental impacts, such as the loss of biodiversity and its economic and ecological potentials, increased pest resistance and the possible costs of decontaminating the water, soil, and air.

In the Cerrado, all these costs are borne every day. Over the past 20 years, the Matopiba region has lost more native vegetation than it did in the previous 500 years, mainly due to the spread of the agricultural frontier[27], based on commodity monocultures that consume pesticides and transgenic seeds. Approximately 110 million hectares are occupied by agribusiness, making it the region with the largest area in the country planted to soy, corn, and cotton[28]. Occupation, however, does not happen in a vacuum. The Cerrado is the home, the living territory of various peoples and communities – indigenous peoples, quilombolas, evergreen flower pickers, geraizeiras, raizeiras, fundo e fecho de pasto communities, pantaneiras, babassu nut breakers, fisherwomen, retiriras, riverside communities, brejeiras, peasants, family farmers and the landless – whose ways of life are being devastated. These situations underscore the intensification of socio-environmental conflicts and scenarios of violence.

According to data organized by the CPT[29], in the greater Cerrado – both the contiguous Cerrado and its transition zones into the Cerrado-Amazon, Cerrado-Caatinga, Cerrado-Atlantic Forest and Cerrado-Cocais Zone – 3,610 conflicts over land and water were identified from 2003 to 2019, It is important to note that in 2019, the trend in the number of conflicts

26. In Brazil, state laws have been enacted to establish minimum distances between the aerial application of pesticides, residential areas (towns, cities and neighborhoods) and watercourses, including the states of Rio Grande do Sul and Goiás. In Paraná, pesticide spraying from airplanes is prohibited in urban areas. In Acre and Ceará, the measures are more restrictive. In the Acre, spraying is banned within a 10km radius of inhabited areas and conservation units, while in Ceará this type of pesticide application is entirely banned throughout the state. Ibid.

27. Ver: AGUIAR, Diana; BONFIM; Joice; CORREIA, Mauricio (Orgs.). Na fronteira da (i)legalidade: desmatamento e grilagem no Matopiba. 2021. Available at: https://www.matopiba-grilagem.org/matopiba.

28. EGGER et al.

29. COSTA, Amanda; PEREIRA, Valéria (Coord.). *Conflitos, massacres e memórias*: das lutadoras e lutadores do Cerrado. Goiânia: CPT, 2022. Disponível em: https://www.cptnacional.org.br/publicacao?task=download.send&id=14272&catid=75&m=0

Collecting water in the Serra do Centro Traditional Territory, Campos Lindos, Tocantins. Credit: CPT Araguaia - Tocantins.

turned upward, with the rise of Jair Bolsonaro's anti-democratic government. That year, more than 1,000 more cases were identified than in the previous year, involving 64,553 families. The following years were no different. In 2020, the total number of conflicts was 653, involving more than 73,000 families; in 2021 there were 593 incidents with more than 80,000 families affected.

The large number of conflicts points up asymmetrical power relations emerging in the Cerrado and Matopiba between peoples who have built their ways of life there for generations and the advance of agribusiness. Control of the territory by a small fraction, backed by the state, has disrupted traditional ways of producing and reproducing life, through the expulsion of communities, restrictions on access to territories and the commons, contamination of water and soil, and the erosion of biodiversity.

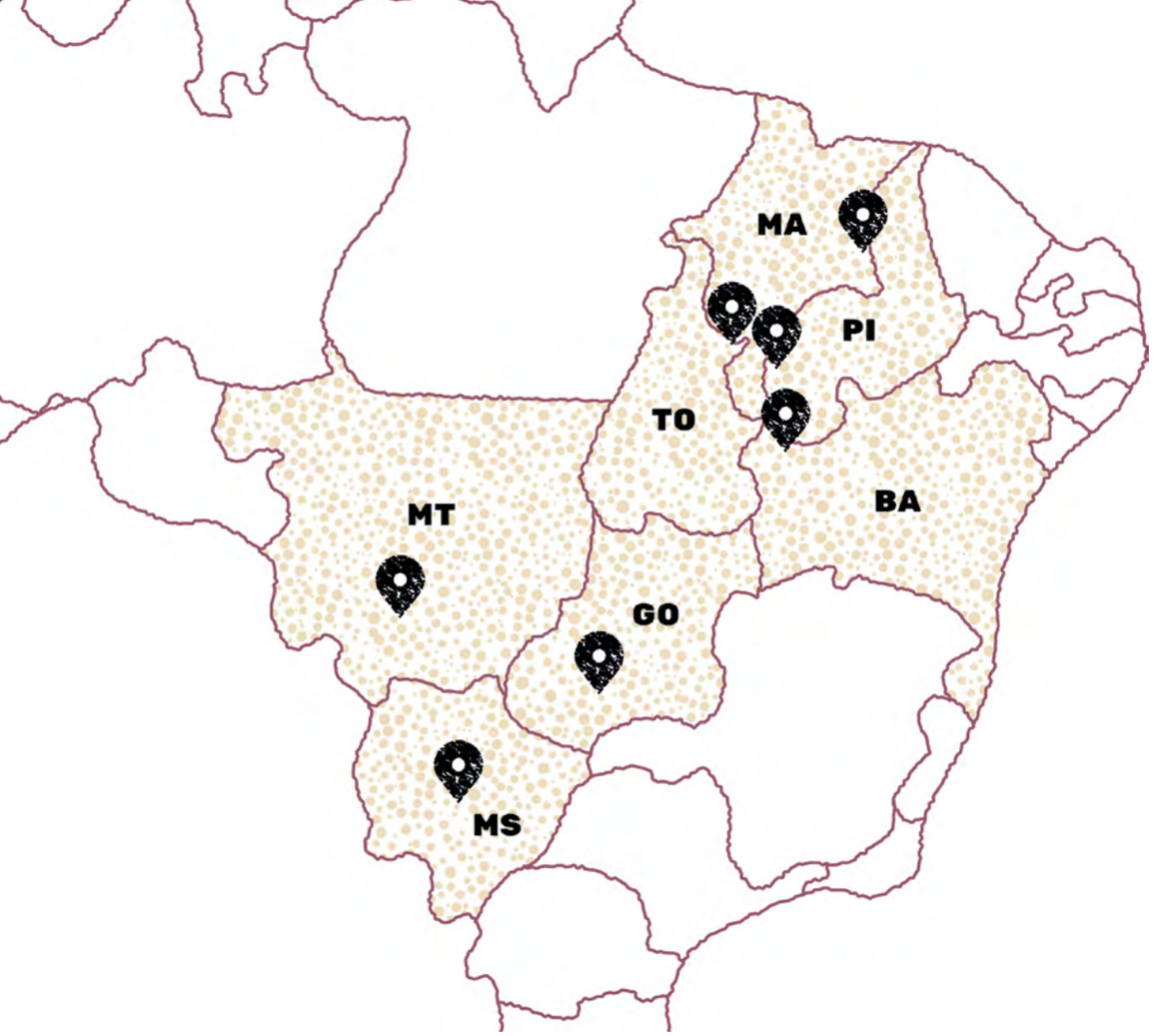
Therefore, while we focus here on the contamination of water by pesticides and its implications for consumption, fishing, and the sacred use of water by peoples, this is not an isolated issue. This model is clearly based on unequal access to land and territory, on the production of export commodities to the detriment of food production, and on the fallacy of technological solutions propagated by big agribusiness in Brazil. **As mainstays of a deadly business model, pesticides are weapons aimed at the Cerrado's peoples and its socio-biodiversity**.

1.2. Contaminated territories: research sites and constant exposure to pesticides

This action research project involved the review of specialized literature on pesticides, training processes and the collection and toxicological analysis of water samples in seven Cerrado communities, located in all the states of the region identified as Matopiba, as well as in Goiás, Mato Grosso do Sul and Mato Grosso. This section describes characteristics of those communities, their residents' ways of life and how the pesticides used on soy monocultures have disrupted socio-ecological relationships woven for generations, especially due to water contamination.

It is significant that these communities' municipalities have low municipal human development indices (MHDIs), while soy monocultures render high profits, which are concentrated in the hands of large landowners. The monocultures cover much of the area of these territories and, in addition to pesticides, depend on transgenic seeds, deforestation, arson and violence. Interrelations among these factors help us understand the problem and show how commodity exports and the purported generation of wealth do not bring social development or quality of life to the region.

The following summaries are not intended to describe all the communities' cultural and ecological wealth, but rather to highlight their day-to-day problems with the spread of Brazil's hegemonic agricultural model. The action research draws on the diversity of knowledge and practices developed by these communities over generations, while drawing attention to how pesticides are chemical weapons against all of them. Through aerial and ground spraying, all seven communities participating in the action research share the experience of living in contaminated areas. Pesticides in the water, soil, plants, and bodies of those who live there. From planes in cloudless skies, falls a rain of poison.



Collecting water in the Eldorado II Settlement, Sidrolândia, Mato Grosso do Sul. Credit: Bruno Santiago (CPT).

BARRA DA LAGOA COMMUNITY

in Santa Filomena, Piauí

Municipality:

Santa Filomena, Piauí

Population *(2021 projection)*:

6,256 people

MHDI *(2010)*:

0.544

Land area *(2021)*:

5,293.693 km²

Area planted with soy *(2021)*:

71,256 hectares (712.56 km²)

Percentage of soy area/ total land area *(2021)*:

13%

Volume of soy produced *(2021)*:

224,394 tons

Value of soy production *(2021)*:

R$ 593,275.00

Source: IBGE/Sidra and Agrolink

The twelve families with approximately 40 members who live in the Barra da Lagoa community find the means to produce and reproduce life in local rivers, marshes, and their family farms. As riverside and wetlands dwellers they not only grow a wide variety of food crops – rice, manioc, beans, watermelons, squash, fava beans, corn, sugar cane, potatoes, oranges, guavas, acerola, mangoes, cashew, lemons, tanjelos, limes, coconuts, and tangerines – but also take care of the Riozinho, a stream running through the community that supplies the families' tables with fish and water (for drinking and cooking). They know their way around the Cerrado and identify native fruits and plants such as souari, buriti and bacaba. The animals they raise – pigs, chickens, ducks, and cattle – are part of their way of life, which gains meaning through a fabric of local biodiversity, real food and food and nutritional sovereignty

The community's lack of legal certainty over land ownership and the advance of agribusiness have, however, disrupted Barra da Lagoa's way of life. The riverside and marshland dwellers' territories have been invaded and devastated, giving way to monocultures, especially soy. Various poisons – herbicides such as glyphosate and 2,4-D, desiccants, and several other insecticides, fungicides, and the like – contaminate waters essential for the community's social and ecological reproduction from local marshes and the Riozinho, which bathes many other communities as well and is essential to their lives, food, and income.

The encirclement by agribusiness and the circulation of armed individuals are a constant restriction on the community's access to the commons, while pesticides contaminate their bodies and territories. These conditions exacerbate gender inequalities too, with the women afraid to move around in their own territory and collective areas alone, as well as seeing their sources of food and income contaminated.

LEONIR ORBACK CAMP

Santa Helena, Goiás

Municipality:
Santa Helena, Goiás

Population *(2021 projection)*:
38,962 people

MHDI *(2010)*:
0.724

Land area *(2021)*:
1,142.337 km²

Area planted to soy *(2021)*:
60,000 hectares (600 km²)

Percentage of soy area/total land area *(2021)*:
52%

Volume of soy produced *(2021)*:
210,000 tons

Value of soy production *(2021)*:
R$ 525,000.00

Source: IBGE/Sidra and Agrolink

The Leonir Orback camp, organized by the Landless Farm Workers' Movement (MST), has been home to 170 families since 2015. The community grows crops collectively and harvests are shared. At the same time, each family cultivates its own homegardens and vegetable plots. The camp's produce is diverse: cassava, papaya, lemons, oranges, passion fruit, vegetables, and medicinal plants such as assa-peixe (Vernonia polysphaera), terramycin, rue, pennyroyal, aloe, figs, comfrey, lemongrass, pomegranate, boldo, sage, and mint. These seasonal crops guarantee families' food and nutritional sovereignty and security. The Renascer School provides elementary education for students, as well as informal educational spaces for local residents in topics such as gender equality, the People's Agrarian Reform, the harm caused by pesticides and ways to defend the Cerrado.

Much of the camp's and the families' water comes from a nearby lagoon, from a well and from a spring. Soy and corn monocultures bordering the camp, however, have had a direct impact on the use of this resource. The pesticides used there, including aerial spraying, have drifted to contaminate the community's water sources. Polluted water, in addition to the pesticides themselves spread through the air and into the soil, poisons residents' bodies and causes headaches, blindness, nausea, diarrhea, skin diseases, urinary, intestinal, and liver infections, anxiety, lung spots and shortness of breath. The die-off of fish, once food staples for families in the camp, is another consequence of the contaminated waters.

Other marks left by agribusiness in the camp include the practice of arson and deforestation, which generate huge amounts of smoke, leading to respiratory diseases. The erosion of biodiversity and the breakdown of socio-ecological relations, meanwhile, cause flies and other insects to proliferate, sickening livestock and the community's own environment. In addition to being contaminated, the camp's water has been diverted by agribusiness to irrigate its own monocultures.

GERAIZEIRA COMMUNITY

Formosa do Rio Preto, Bahia

Municipality:
Formosa do Rio Preto, Bahia

Population *(2021 projection)*:
26,111 people

MHDI *(2010)*:
0,618

Land area *(2021)*:
15,634.328 km²

Area planted with soy *(2021)*:
455,400 hectares (4,554 km²)

Percentage of soy area/total land area *(2021)*:
29%

Volume of soy produced *(2021)*:
1,855,000 tons

Value of soy production *(2021)*:
R$ 4,637,500.00

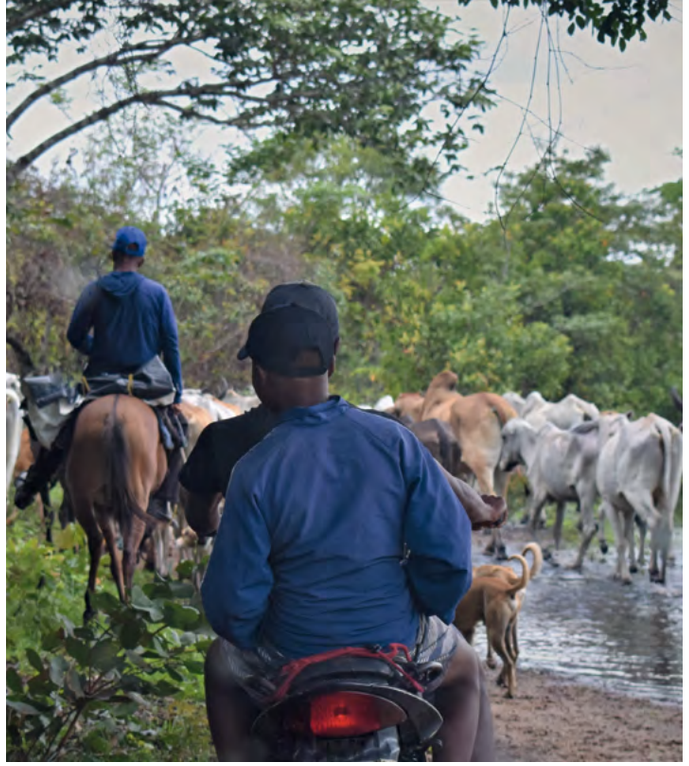
Source: IBGE/Sidra and Agrolink

The Geraizeiro communities known as Aldeia, Gatos, Mutamba, Cacimbinha and Cachoeira are home to more than 120 fighting families. The Rio Preto, a powerful river from its source and the main tributary of the Rio Grande, which flows into the São Francisco River, is born in this Geraizeiro territory. The plateaus of the Rio Preto basin are important recharge areas for the Urucuia aquifer, with an average annual rainfall of 1,600 mm. In the valleys and vereda oases, this people of indigenous origin lives off family farms and extractivism. On the plateaus, they hunt, gather native fruits, and raise cattle in large communal areas. The communities' main sources of water are the Rio Preto, the Rio Dos Santos, the veredas and small streams.

Although their traditional land tenure has been recognized by the courts, the families still face ongoing threats from agribusiness, especially the Condomínio Cachoeira do Estrondo company, which has taken over thousands of hectares

of highlands on the plateaus that divide Bahia from Piauí and Tocantins. Its brutal aggression uses deforestation, arson, and land grabbing to establish corn, soy, and cotton monocultures, with pesticides sprayed intensively by land and air, and transgenic seeds. Families say they are kept from moving freely between the communities and from accessing the territory, due to the constant presence of gunmen and threats to their lives.

Agribusiness firms violate their right to water as well. The Condomínio and its partner companies are responsible for intensive aerial and ground spraying of the pesticides described above on monocultures, the runoff from which crosses the plains to contaminate communities' water bodies, causing diseases and putting human health and the environment at risk.



Aldeia community, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento.

SERRA DO CENTRO TERRITORY

Campos Lindos, Tocantins

Municipality:
Campos Lindos, Tocantins

Population *(2021 projection)*:
310,505 people

MHDI *(2010)*:
0.544

Land area *(2021)*:
3,234.445km²

Soy planted area *(2021)*:
101,400 hectares (1,014 km²)

Percentage of soy/total land area *(2021)*:
31%

Volume of soy produced *(2021)*:
405,600 tons

Value of soy production *(2021)*:
R$ 966,545.00

Source: IBGE/Sidra and Agrolink

The Serra do Centro Traditional Territory is made up of the communities of Passagem de Areia, Raposa, Ribeirão D'Antas, Sítio, Primavera, Gado Velhaco, Vereda Bonita and Taboca. Approximately 200 families live there, sharing the waters of the Manoel Alves River and three streams: Ribeirão D'Antas, Centro and Consulta. The waters support them with fish and for household consumption, as well as irrigation to grow vegetables and fruit trees, and to wash their clothes. The Territory's residents are family farmers. They grow rice, beans, maize, and manioc, and raise small animals such as chickens and pigs, as well as cattle. They rely on fishing and hunting for their livelihoods, as well as their wisdom in identifying native Cerrado fruits and species – souari, murici, araçá, tucum, sucupira, amarelão, copaíba – used for food, traditional medicine and for sale.

In a process of private appropriation of their commons since the mid-1990s, the Campos Lindos Agricultural Project has been a threat to life in the Territory. Soy monocultures planted nearby by the project violate local populations' rights: access both to water and to the families' food and nutritional security from traditional fields, homegardens, and the extraction of socio-biodiversity. The waters of the Manoel Alves River, the Centro River and the Ribeirão D'Anta and Consulta streams, their main sources of water, are now contaminated by pesticides sprayed from the air and on the ground, making it impossible to drink or use, and killing the fish, a major food source. Residents say the pesticides cause skin diseases as well, in both adults and children.

The recurring "opening up of new areas and farms" for soy plantations is seen by local populations as one of the evils brought by agribusiness, with deforestation of previously conserved areas, arson, more pesticides, and the encirclement of communities. In addition to poisoning their bodies, another result of the expansion of agribusiness is an environmental imbalance that brings more insects and weeds into traditional gardens and family farms.

Plantation in the Serra do Centro Traditional Territory, Campos Lindos, Tocantins. Credit: CPT Araguaia Tocantins.

COCALINHO TERRITORY

Parnarama, Maranhão

Municipality:
Parnarama, Maranhão

Population *(2021 projection)*:
35,108 people

MHDI *(2010)*:
0.542

Land area *(2021)*:
3,245.525 km²

Area planted with soy *(2021)*:
11,000 hectares (110 km²)

Percentage of soy/total land area *(2021)*:
4%

Volume of soy produced *(2021)*:
35,200 tons

Value of soy production *(2021)*:
R$ 96,448.00

Source: IBGE/Sidra and Agrolink

The Cocalinho quilombo community is made up of 170 families, whose ancestors arrived there in the late 18th century and early 19th century. Until they settled where the community is located today, they lived in different parts of the territory, especially along watercourses, which even then were controlled by ranchers, known then as "colonels".

Amidst the Cerrado's biodiversity, the Cocalinho families cultivate fields, vegetable plots and homegardens. They

ensure food and nutritional security with a combination of varieties of corn, rice, cassava, sugar cane, beans, maxixe, okra, pumpkin, watermelon, melons, fava beans, chayote, chili peppers, spring onions, coriander, lettuce, cabbage, yams, and sweet potatoes. The seeds they plant every year are stored in the families' home seed banks, organized by the women, who also raise small animals such as chickens, pigs, and goats.

The community is located between plateaus and marshes. In the plateaus they can pick araçá, olho de boi, souari, mangaba, puçá, cajuí, murici, and guabiraba; while the marshes provide buriti, juçara, bacaba, avocados, bacupari, jackfruit, mangos, and coco-anajá. The Cocalinho community's ways of life, political organization and resistance are also woven into their festivals and religious celebrations. The Our Lady of Fatima festival, the Saint Benedict circle, the crioula drum, bumba meu boi, mina drum, forró de caixa, baião, reisado, and divindade are some of these moments of cultural joy and strength.

For generations, families have defended the territory, but this has not stopped the spread of agribusiness. Many streams have dried up and disappeared under pressure from monoculture systems. Since 2009, such destruction has only gotten worse, with the arrival of the Suzano Pulp and Paper company, especially due to pesticides sprayed on its eucalyptus plantations by tractors and from the air. Some homes are less than 25 meters from the monoculture fields. The residents describe how their water sources are polluted, the skin and lung diseases that appear, as well as headaches and bone aches. The birds, bees and native vegetation dying are further signs of the destruction of socio-ecological relations by pesticides.

CUMBARU COMMUNITY

Nossa Senhora do Livramento, Mato Grosso

Municipality:
Nossa Senhora do Livramento, Mato Grosso

Population *(2021 projection)*:
13,093 peoples

MHDI *(2010)*:
0.638

Land area *(2021)*:
5,537.413 km²

Soy planted area *(2021)*:
2,988 hectares (29,88 km²)

Percentage of soy/total land are *(2021)*:
0.53%

Volume of soy produced *(2021)*:
9,243 tons

Value of soy production *(2021)*:
R$ 19,688.00

Source: IBGE/Sidra and Agrolink

The Cumbaru Traditional Community is made up of 25 families who were born and raised in the area and have made their livelihoods there. Through festivals on saints' feast days, dances, and songs such as cururu and siriri, they celebrate the culture that unites them, sharing values learned over generations such as solidarity, hospitality, and honesty, involving women, men, and children.

In their fields and homegardens, families grow cassava, corn, and bananas, while in the Cerrado forests they practice agro-extractivism, especially by picking cumbaru nuts, which give the community its name. Part of the families' income comes from companies in the area, which employ local residents and, at the same time, exploit their mineral water springs.

The waters that run through the community – the headwaters, the spring, and the small reservoir, which is used collectively – are contaminated with pesticides sprayed on the nearby soy plantations.

Both the water and their bodies are contaminated by pesticides that cause headaches, bad smells and difficulty sleeping, especially for elderly residents.

Collecting water in the Eldorado II Settlement, Sidrolândia, Mato Grosso do Sul. Credit: Bruno Santiago (CPT).

ELDORADO II SETTLEMENT

Sidrolândia, Mato Grosso do Sul

Municipality:
Sidrolândia, Mato Grosso do Sul

Population *(2021 projection)*:
60,792 people

MHDI *(2010)*:
0.686

Land area *(2021)*:
5,265.695 km²

Area planted with soy *(2021)*:
245,000 hectares (2,450 km²)

Percentage of soy/total land area *(2021)*:
46,5%

Volume of soy produced *(2021)*:
931,000 tons

Value of soy production *(2021)*:
R$ 2,234,400.00

Source: IBGE/Sidra and Agrolink

The Eldorado II settlement was established on December 17, 2005. It currently consists of more than 750 titled plots, with approximately 700 families. The territory harbors tributaries and springs of the Anhanduí River basin, which is part of the Pardo River basin, and of the larger Paraná River basin. In the waters running through the settlement, families fish, swim, and farm. They produce cassava, scarlet eggplants, avocados, oranges, tangerines, pumpkins, and other food crops, mainly for local consumption and the families' food and nutritional security.

The peasants' lives and farming practices are now encircled by agribusiness. Around the settlement, soy and corn monocultures are constantly expanding, dependent on huge amounts of pesticides sprayed by large machinery and from the air. Meanwhile, the lack of adequate public policies to support small farmers and pressure from landowners end up forcing residents to adopt extreme measures, such as leasing their land.

This option brings the risks of pesticide contamination even closer to the families because agribusiness starts growing soy and other monocultures on the plots where they once lived and grew their own food. Furthermore, residents who start working on those plantations use pesticides themselves with backpack sprayers, often with no personal protective equipment (PPE).

Pesticides destroy their pastures, leaving no grass to feed their livestock. In fields and plantations, families see their food poisoned by pesticides sprayed directly or brought by the wind. Burning eyes and faces, swelling and headaches are among the health problems reported by families due to the presence of pesticides in their lives.

2 METHODOLOGICAL APPROACHES: PRODUCING KNOWLEDGE AND DENOUNCING VIOLENCE

This section discusses methodology in our action research. We have sought to produce collective knowledge by combining academic knowledge, from technical and specialized sources, with other kinds of knowledge long woven by the Cerrado peoples into their own daily lives. Our strategy thus combines a broad review of the literature on pesticides, water collection procedures for the seven communities, and laboratory testing of samples with real-life experiences of Cerrado peoples in their own bodies and territories. We also discuss the importance of developing critical science, part of whose epistemic basis involves addressing conflicts and asymmetries of power.

2.1. Action research and a "science of places"

Throughout the pages of this research project, different types of knowledge have intermingled. The skills of walking in the forest, extracting dye from the thick bark of trees and caring for animals are mixed with the identification and characterization of pesticides and their active ingredients (AIs), and the risks they pose to human health and the environment. Pesticides are in the water, people's bodies, soil, and food. Much more than invisible products carried into communities by the wind, which no one sees coming, transparent in the air, they are real forces in the illness of families, they kill bees and birds, erode biodiversity, and enter rivers where children and mothers are poisoned as they wash clothes or play along the shore.

This study on the contamination of water by pesticides authorized for use on soy is based on the "science of places"1, the concrete reality of life in communities and territories of the Cerrado. This means adopting action research as a pedagogical exercise in the production of knowledge to be shared among participants[2], both community residents and researchers. This perspective likewise raises criticisms of how conventional science is allied with the interests of industrial sectors and is based on divisions between subject and object, nature and culture, nature and society.

From this standpoint, the aim of action research goes beyond understanding a particular issue to the critical formulation of paths and analyses, giving context to the problem at hand. Researchers and participants who work together, in a process of reflection and action, can combine their different interpretations of reality.

The seven Cerrado territories and communities involved in the action research as researchers, collecting water samples and mapping their territories, were chosen through collective discussions with various organizations in the National Campaign to Defend the Cerrado, active around pesticide issues as well. These include the Federation of Organizations for Social and Educational Assistance (FASE), the Land Pastoral Commission (CPT), the Tijupá Agroecological Association, the Gwatá/UEG Agroecology and Field Education Center and the Alternative for Small-Scale Agriculture in Tocantins (APA-TO). In the process, they considered the advance of agribusiness, especially soy plantations, into these communities and the impacts caused by the pesticides used in those monocultures.

In the context of water contamination by pesticides authorized for use on soy, we know that action research takes place in an asymmetrical power relationship, which bears directly on its chances of making a difference. Thus, it is not a naïve reading of reality, but the elaboration of a counter-narrative. It is science that is critical of the hegemonic discourse of agribusiness and uses a variety of sources and data to show how pesticides are used as chemical weapons.

1. ALMEIDA, Sílvio Gomes de. "Construção e desafios do campo agroecológico brasileiro", in Agriculturas, Rio de Janeiro/AS-PTA, 2009. Special issue: Agricultura familiar camponesa na construção do futuro.

2. FRANCO, Maria Amélia. "Pedagogia da pesquisa-ação", in Educação e Pesquisa, São Paulo, v. 31, n. 3, p. 483-502, Sept./Dec. 2005.

2.2. Collective work: gathering water samples in the seven communities

Toxicological analyses were carried out to detect environmental contamination by pesticides in all seven communities. Water samples were collected3 in two cycles by field teams made up of members of the movements and organizations working in the area (as described above) and community residents.

The participants in the action research underwent group training workshops, to learn the correct way to collect, store and transport water samples, ensuring biosafety conditions and the integrity of the material.

The first cycle took place from February to March 2022, a period close to the soy harvest, in five states: Bahia, Goiás, Maranhão, Piauí and Tocantins. The second cycle, in turn, took place between November 2022 and February 2023, during the soy planting season, in seven states: Bahia, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Piauí and Tocantins. Each collection point was photographed and georeferenced. The samples were analyzed by the Toxicology

3. Only non-chlorinated samples were taken, which were preserved by adding acetic acid at a rate of 1mL/L.

Laboratory at Cesteh/Ensp/Fiocruz[1].

The water collection points were selected based on their importance for each community: water used for irrigating fields and homegardens; for fishing; for animal watering; for community games and recreation; for domestic use, such as washing clothes and dishes; and for food, whether for drinking or cooking. One of the guidelines was that the collection points should be close to monoculture plantations, especially soy, where pesticides are applied both by land and from the air.

Water samples were analyzed from 37 points in the first cycle and 56 points in the second cycle, as shown in the table below. Two samples were collected at each point, totaling 74 samples in the first cycle and 110 in the second. Most of the collection points were the same in both cycles.

Based on the analyses of water samples from the Cerrado communities, a survey of specialized literature on pesticides identified each products' risks to people's health and to the environment.

To identify the carcinogenic potential of active ingredients, we consulted the classification lists of the World Health Organization's International Agency for Research on Cancer (IARC/WHO)[2] and the US Environmental Protection Agency (USEPA)[3], as well as the European Community's lists of pesticide candidates for substitution[4] and potential endocrine disruptors[5] [6].

TABLE 1 **Collection sites and details on the number of collection points by type of source**

Territory	Municipality	State	Type of Source						
			River/ Creek	Spring	Lake	Swamp	Dam reservoir	Waterhole/ Well	Household
CYCLE 1									
Geraizeira Traditional Communities	Formosa do Rio Preto	BA	8	0	0	0	0	0	0
Leonir Orback Camp	Santa Helena	GO	1	2	0	0	4	1	0
Cocalinho Territory	Parnarama	MA	1	1	1	0	1	3	1
Barra da Lagoa Santa Community	Santa Filomena	PI	1	2	2	0	0	1	0
Serra Serra do do Centro Traditional Territory	Campos Lindos	TO	8	0	0	0	0	0	1
CYCLE 2									
Geraizeira Traditional Communities	Formosa do Rio Preto	BA	8	0	0	0	0	0	0
Leonir Orback Camp	Santa Helena	GO	2	2	0	0	3	1	0
Cocalinho Territory	Parnarama	MA	1	1	1	0	1	3	1
Eldorado I and II Settlements	Sidrolândia	MS	5	0	0	0	3	0	0
Cumbaru Community	Nossa Senhora do Livramento	MT	0	1	0	0	0	6	1
Barra da Lagoa Community	Santa Filomena	PI	1	2	1	3	0	1	0
Serra do Centro Traditional Territory	Campos Lindos	TO	8	0	0	0	0	0	0

Source: produced by Aline Gurgel.

1. The multi-residue analysis of pesticides in water was carried out by gas chromatography with triple quadrupole mass spectrometry detection, using solid phase extraction with a hydrophilic and hydrophobic HLB phase cartridge as the sample preparation methodology, concentration of the extract under a nitrogen atmosphere and identification using the aforementioned instrumentation. This method has a quantification limit of around 0.1 ng/mL, allowing these pesticides to be assessed at residual levels in water samples (RANGEL, 2008).
Os IAs glifosato, 2,4-D e paraquate foram analisados por kits The active ingredients glyphosate, 2,4-D and paraquat were analyzed using immunodiagnostic kits. This technique is based on the competition reaction between the derivatized analyte (which must be present in the sample in its original form) and the conjugated enzyme for the binding sites of the antibody added to the reaction medium, which must contain the enzyme substrate (ABRAXIS, 2016).

2. INTERNATIONAL AGENCY FOR RESEARCH IN CANCER. Pentachlorophenol and Some Related Compounds: IARC Monographs on the Identification of Carcinogenic Hazards to Humans. 2019. Available at: https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Pentachlorophenol-And-Some-Related-Compounds-2019.

3. ENVIRONMENTAL PROTECTION AGENCY. Chemicals Evaluated for Carcinogenic Potential by the Office of Pesticide Programs. Washington: [unnumbered], 2021.

4. EUROPEAN COMMISSION. Ad-hoc study to support the initial establishment of the list of candidates for substitution as required in Article 80(7) of Regulation (EC) N° 1.107/2009: Final Report. Directorate General for Health and Consumers. 2013. Disponível em: https://food.ec.europa.eu/system/files/2016-10/pesticides_ppp_app-proc_cfs_report-201307.pdf

5. EUROPEAN COMMISSION. Which substances are of concern? Chemicals: Environment. 2022. Disponível em: https://ec.europa.eu/environment/chemicals/endocrine/strategy/substances_en.htm

6. COMMISSION OF THE EUROPEAN COMMUNITIES. Community Strategy for Endocrine Disrupters: a range of substances suspected of interfering with the hormone systems of humans and wildlife. Brussels, 17.12.1999. Available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:1999:0706:FIN:EN:PDF

3

WATER CONTAMINATED BY PESTICIDES USED ON SOY PLANTATIONS: SPECIALIZED TECHNICAL LITERATURE AND THE KNOWLEDGE OF THE PEOPLES OF THE CERRADO

This section presents the results and lessons learned from our analysis of waters contaminated by pesticides in the Cerrado. First, we present the pesticides authorized for use on soy in Brazil, their characteristics, and their sales figures. Then, the results of our analysis of water samples collected in the seven communities participating in the action research, considering the number of pesticides identified, their mixtures and the shortcomings of Brazilian legislation's attempts to identify these products in water. These dimensions, all directly associated with risks to human health and the environment, are part of the daily lives of Cerrado communities, threatening their bodies and their territories.

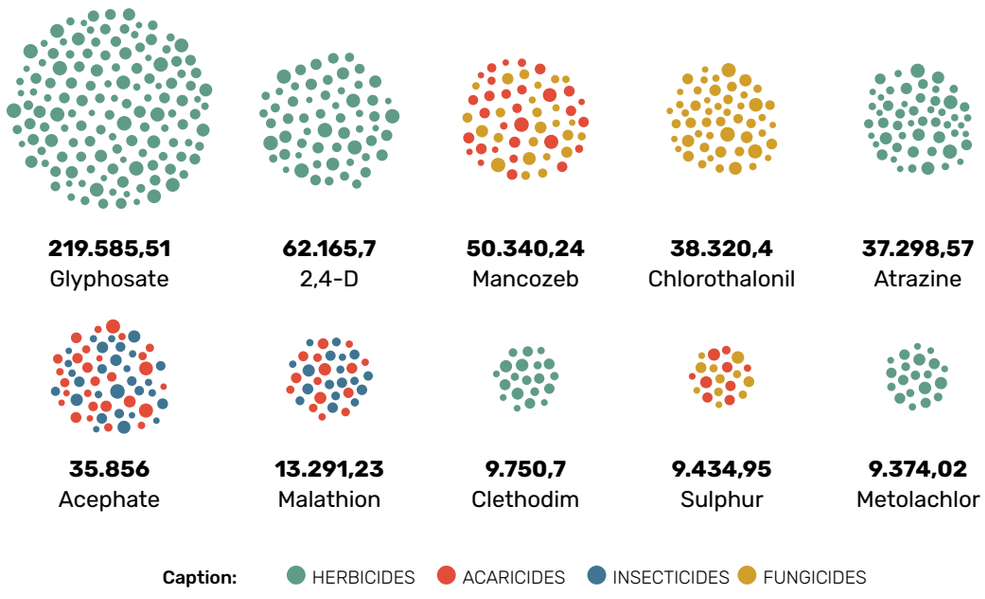
3.1. Pesticides authorized for use on soy: identification enables resistance

One of our action research strategies was to identify which active ingredients (AIs) are authorized for use in Brazil and their sales volume.

We found that there are now 494 AIs authorized for use on different crops in Brazil. Of this total, 216 are authorized for soy, representing 43.72% of all approved agents. These figures underline the large number of chemicals that can be used on this crop.

Not only is the number of AIs allowed on soy striking, but their sales volumes as well. According to data for 2021, all ten of the AIs with the highest sales volume in the country are authorized for soy, thus confirming why this monoculture is the largest consumer of pesticides in Brazil, as we see in this figure.

FIGURE 1 **Volume in liters of pesticide AIs most sold in Brazil in 2021.**



Source: produced by Aline Gurgel (2021).

Pesticide active ingredients authorized for use on soy in Brazil

quizalofop-p-thefuryl monfluorothrin acephate pendimethalin
lufenuron flumetsulam bromuconazole prothioconazole acifluorfen
thiabendazole chlorfluazuron 1,4-dimethoxybenzene acetamiprid
fipronil pyridaben azoxystrobin clethodim imazaquin abamectin
gibberellic acid clodinafop 2,4-D chlorimuron MCPA fluroxypyr
copper hydroxide clomazone clodinafop-propargyl atrazine
flupyradifurone cyproconazole mancozeb fluroxypyr-meptyl
kresoxim-methyl azadirachtin copper oxychloride buprofezin
mesotrione triclopyr cyprodinil bifenthrin 4-indol-3-ylbutyric acid
cyfluthrin (z,e)-9,12-tetradecadienyl acetate fenpyrazamine
chloransulam-methyl acifluorfen-sodium fluopyram cypermethrin
imazethapyr flumioxazin chlorimuron-ethyl spinetoram alachlor
benzalkonium chloride difenoconazole sethoxydim diflubenzuron
diclofop chlorantraniliprol chlorpyrifos linuron diquat kinetin
isoxaflutole dimoxystrobin tebufenozide triclopyr-butotyl
clothianidin carbosulfan epoxiconazole ethephon alpha-cypermethrin
tepraloxydim cuprous oxide spinosad imazapyr sulfentrazone
diquat dibromide glufosinate beta-cypermethrin diuron
pyraflufen etofenprox bixafen copper sulfate boscalid
diclofop-methyl thiophanate-methyl cadusafos saflufenacil
carfentrazone-ethyl metominostrobin chlorfenapyr flutriafol
fluquinconazole trifluralin fluazifop-p thiodicarb acetochlor
fluxapyroxad basic copper carbonate isofetamid dinotefuran
fluazifop-p-butyl iprodione zeta-cypermethrin carboxin
fluensulfone ipconazole spiromesifen imidacloprid fenarimol
beta-cyfluthrin fenpropimorph pyraclostrobin diclosulam phosphine
metalaxyl-m flufenoxuron methomyl benzovindiflupyr glyphosate
imazamox cyantraniliprole fenitrothion captan fenoxaprop-p
metam lambda-cyhalothrin cartap hydrochloride fomesafen
metsulfuron-methyl propineb myclobutanil ethiprole sulfur
cymoxanil paraquat metaflumizone malathion mineral oil
thiamethoxam metiram oxyfluorfen flubendiamide gamma-cyhalothrin
bentazon halauxifen-methyl fludioxonil novaluron chlorothalonil
metconazole (z)-9-tetradecenyl acetate fenoxaprop-p-ethyl
pyraflufen-ethyl profenofos cartap dimethenamid dicamba
deltamethrin propiconazole oxine-copper picoxystrobin
carbendazim lactofen chromafenozide haloxyfop-p fluazinam
triflumuron methoxyfenozide triazophos glufosinate-ammonium salt
diatomaceous earth florpirauxifen-benzyl esfenvalerate procymidone
benzyladenine tebuconazole flumicloraque-pentyl pyroxasulfone
haloxyfop-p-methyl propargite thiacloprid indoxacarb
metam-sodium fenpropathrin quizalofop-p-ethyl nicosulfuron
imazapic metribuzin tetraconazole emamectin benzoate
(z)-11-hexadecenyl acetate trifloxystrobin sulfoxaflor
permethrin pyriproxyfen propaquizafop thiram s-metolachlor
paraquat dichloride teflubenzuron aluminum phosphide
quizalofop-p cyclaniliprol magnesium phosphide diafenthiuron

Pyrethroid · Aryloxyphenoxypropionic acid · Triazole · Inorganic
Benzoylurea · Strobilurin · Organophosphate · Diphenyl ether
Neonicotinoid · Pyridine carboxylic acid · Imidazoline · Bipyridyl
Chloroacetamide · Pyrazole · Sulfonylurea · Others

Serra do Centro Traditional Territory, Campos Lindos, Tocantins.
Credit: CPT Araguaia Tocantins.

In addition to this data, it is important to consider the progressive growth in the volume of pesticides sold in Brazil. **Of the three top-selling AIs in 2021, glyphosate sales grew by 27%, 2,4-D by 8% and mancozeb by 63% compared to 2017, during the period of democratic disruption in the country**.

Chlorothalonil, a fungicide ranked 13th in volume of sales in 2017, rose to fourth place in 2021, an increase of 563%. Atrazine sales also increased over the same period. Last but not least, it should be noted that the AIs clethodim and s-metolachlor, which were not even among the top-20 best sellers in 2017, in 2021 rose to eighth and tenth places respectively in terms of sales volume.

The data compiled on AIs authorized for use on soy raises at least two significant issues. First of all, a large share of the total number of AIs goes to soy, highlighting the widespread consumption of pesticides by this type of monoculture, as already noted. The second point concerns how their use, in terms of volume, has grown year on year. This underscores not only the collapse of this model of agriculture and the fallacy of technological solutions, but the intensification of ongoing contamination of Cerrado peoples' bodies and territories as well, especially considering that more than 50% of soy crops are located in the Cerrado.

3.2. Living in contaminated places: the threat posed by pesticides to the Cerrado's water and communities

In all the Cerrado communities where water was sampled, at least one pesticide residue was identified. This is important, both because of the constant presence of these chemicals in the lives of communities dealing with the contamination of their water, of their common goods – soil, crops and food – and of their own bodies; and because it is still difficult to analyze the presence of pesticide residues in water using the quantitative parameters set out in Brazilian legislation – and even so, they were found without exception in the samples collected.

In the territories participating in the action research – the Barra da Lagoa Community (PI), the Leonir Orback Camp (GO), the Geraizeira Community of Formosa do Rio Preto (BA), the Serra do Centro Territory (TO), the Cocalinho Territory (MA), the Cumbaru Community (MT) and the Eldorado II Settlement (MS) – **a total of 13 different AIs were identified in the water samples collected**. *Atrazine, 2,4-D, azoxystrobin, cyproconazole, difenoconazole, epoxiconazole, etofenprox, fipronil, glyphosate, metolachlor, picoxystrobin, pyraclostrobin,*

POSITIVE SAMPLES IN THE ACTION RESEARCH

46,15%

of the pesticides found in the action research are banned in the European Union*:

Atrazine
Cyproconazole
Epoxiconazole
Fipronil
Metolachlor
Picoxystrobin

*The European Union has challenged the renewal of glyphosate's registration, but for now, despite its high carcinogenic potential, it is still allowed in both the EU and Brazil.

TABLE 2 **Percentage of water samples contaminated by pesticides in the two cycles of the action research**

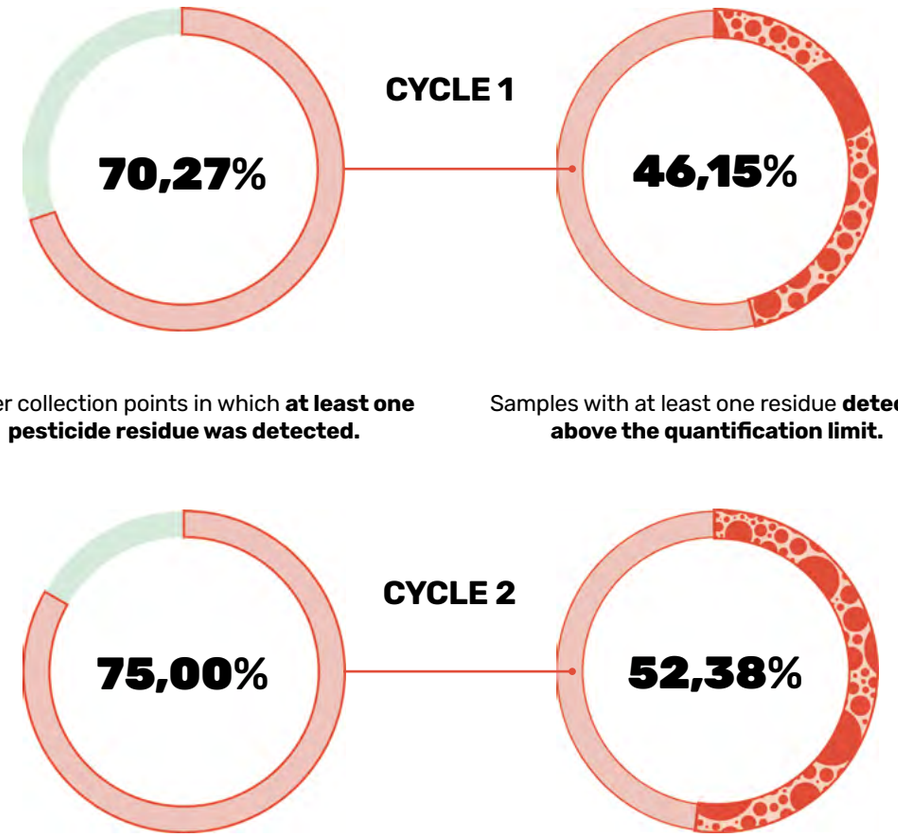
Parameters	BA		GO		MA		MS[1]		MT		PI		TO	
	CYCLES (%)													
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
2,4-D	-	12,50	12,50	75,00	-	-	NA	16,66	NA	25,00	-	-	-	100,00
Atrazine	-	12,50	50,00	-	25,00	12,50	NA	12,50	NA	-	33,33	-	57,14	-
Azoxistrobina	-	-	-	-	-	-	NA	-	NA	-	66,66	-	-	-
Cyproconazole	-	-	-	-	-	12,50	NA	-	NA	-	33,33	-	-	-
Difenoconazole	-	-	-	-	-	12,50	NA	-	NA	-	-	-	-	-
Etofenprox	-	-	12,50	-	12,50	-	NA	-	NA	-	16,66	-	14,28	-
Epoxiconazole	-	-	-	-	-	12,50	NA	-	NA	-	-	-	-	-
Fipronil	-	-	-	100,00	-	-	NA	-	NA	-	-	-	-	-
Glyphosate	12,50	75,00	87,50	12,50	50,00	87,50	NA	66,66	NA	25,00	83,33	50,00	100,00	-
Metolachlor	-	-	-	-	-	12,50	NA	-	NA	-	-	-	-	-
Picoxystrobin	-	-	-	-	-	12,50	NA	-	NA	-	-	-	-	-
Pyraclostrobin	-	-	-	-	-	12,50	NA	-	NA	-	-	-	-	-
Trifloxystrobin	-	-	-	-	-	12,50	NA	-	NA	-	-	-	-	-

Key: (-) not detected | (NA) not analyzed

1. 2,4-D, glyphosate and paraquat measured in only 75% of the points, due to the absence of collected samples.

Source: produced by Aline Gurgel.

GRAPH 2 **Percentage of pesticides detected in the action research**



Water collection points in which **at least one pesticide residue was detected.**

Samples with at least one residue **detected above the quantification limit.**

Source: produced by Aline Gurgel.

and trifloxystrobin are the names of the AIs found in the communities' water, used for drinking, cooking, swimming, and caring for animals and gardens. All of them are registered for use on soy crops in Brazil, although many are banned by the European Union (EU) for their high toxicity or threats to the environment and people's health.

As explained in the second section of this Dossier, the action research involved two cycles of water samples. The first took place in February and March 2022 and the second in November 2022 and February 2023. Comparing the two cycles, more pesticides were detected in the second than in the first. This could be due to a number of factors, such as the use of different pesticides at specific times of the crop year and/or a variation between residue levels at the time of collection and when they were measured, based on the analytical technique adopted.

At least one pesticide residue was identified in just over 70% of the water points sampled in the first cycle, and this rate rose to 75% in the second cycle of the action research. These figures show the degree of the contamination suffered by communities.

Specifically, on the detection of AIs above the quantification limit, in the first cycle more than 46% of the samples contained residues above the limit; in the second cycle this figure was approximately 52%.

Of the 13 pesticides identified in the water samples, it was possible to do quantitative analysis on eight of them (61.53%)[1]. Of these eight, four are among the ten most sold in Brazil in 2021. Glyphosate ranks first, followed by 2,4-D (second), atrazine (fifth) and metolachlor (tenth), as we see in Figure 01.

Glyphosate was detected in all seven states included in the action research,

1. We were unable to determine residue levels due to the quantification limit of the method used for the following pesticides: etofenprox, fipronil, difenoconazole, epoxiconazole and pyraclostrobin. However, as discussed throughout the section, this is not an indication that the sample is free of pesticides..

Sprayer on soybean fields at Fazenda Alaska, Condomínio Cachoeira do Estrondo, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento.

POSITIVE SAMPLES IN THE ACTION RESEARCH

Glyphosate*

CYCLE 1: **67,57%**

CYCLE 2: **28,57%**

*Detected in all the participating states

in both cycles, with the exception of the second cycle in Serra do Centro Territory (TO). However, in the state of Tocantins, it was detected in 100% of the first cycle points, showing its widespread presence in the range of water sources analyzed, such as rivers, streams, and water collected from community homes (cisterns, wells and untreated water collected directly from taps).

This AI was present in more than 67% of the water samples collected in the first cycle, and in 40% of them it could be quantified. In the second cycle, glyphosate was found in more than 28% of the samples, and in around 18% it could be quantified. In all cases, its levels were below Brazil's official maximum permitted value (MPV). Far from representing safety, however, this finding reveals the laxness of regulations on the use of pesticides in Brazil.

The active ingredient 2,4-D was detected in Bahia, Goiás, Mato Grosso, Mato Grosso do Sul and Tocantins, in at least one of the water collection cycles. In the second cycle, 2,4-D was present in 100% of the samples from Tocantins and 75% of the samples from Goiás. Due to the methodology adopted for detecting this AI in water, its presence was only counted when it was possible to quantify residue levels.

Both glyphosate and 2,4-D are very soluble in water, which means they are more likely to get into and spread through water. Chemicals with this quality tend to be eliminated from the soil and can easily be washed away by rain or irrigation water and then reach the water supplies of rural territories and communities.

Comparing Brazilian and European legal standards, the MPV for glyphosate in water in the EU is 0.1 µg/liter, while in Brazil it is 500 µg/liter. For 2,4-D, Brazilian legislation allows 30 µg/liter, while in the EU the value is 01.µg/liter[41]

GRAPH 3 **Comparison between legislations for the maximum permitted value (MPV) for drinking water (µg/liter)**

IA	EU limit	Brazil limit	How many times higher?
2,4-D	0,1 µg/l	30 µg/l	**300**
Glyphosate	0,1 µg/l	500 µg/l	**5,000**

Source: ROSA; GURGEL, FRIEDRICH, 2020.

The third most frequently detected pesticide in the analyses was atrazine, banned in the European Union and present in all states in at least one cycle, with the exception of Mato Grosso. In Maranhão, atrazine levels were detected in the water of the Cocalinho community at more than twice the MPV, according to Brazilian standards.

Etofenprox was detected in four of the five states analyzed in the first cycle (GO, MA, PI, TO), but it was not possible to determine the residue levels in the samples where its presence was verified. Cyproconazole (an AI banned in the European Union) was detected in one sample from Maranhão in cycle 2 and in one from Piauí in cycle 1, and its presence could be quantified in both cases. Azoxystrobin was detected in four of the six samples analyzed in Piauí in cycle 1 and was quantified in 50% of the cases.

Fipronil, another AI banned in the European Union, was detected in 100% of the samples from the state of Goiás, but at unquantifiable levels. The AIs difenoconazole, epoxiconazole – banned in the European Union – and pyraclostrobin were detected in one of the samples from Maranhão, but once again at unquantifiable levels. It should be noted, however, that pyraclostrobin does not have residue levels established in Brazilian regulations. Metolachlor and picoxystrobin, both banned in the European Union, as well as trifloxystrobin, were detected in the same sample from Maranhão and at quantifiable levels, and these last two AIs have no residue levels established in Brazilian standards, which is indicative of the significance of this finding.

1. LAZZERI, Thais. Agrotóxicos: Brasil libera quantidade até 5 mil vezes maior do que Europa. Repórter Brasil, São Paulo, 27 nov. 2017. Available at: https://reporterbrasil.org.br/2017/11/agrotoxicos-alimentos-brasil-estudo/

FINDINGS FROM THE ACTION RESEARCH

Region	PI	GO	BA	TO	MA	MT	MS
Pesticide found	• atrazine • azoxystrobin • cyproconazole • etofenprox • glyphosate	• 2,4-D • atrazine • etofenprox • fipronil • glyphosate	• glyphosate • atrazine • 2,4-D	• atrazine • etofenprox • glyphosate • 2,4-D	• glyphosate • atrazine • cyproconazole • difenoconazole • etofenprox • epoxiconazole • metolachlor • picoxystrobin • pyraclostrobin • trifloxystrobin	• glyphosate • 2,4-D	• atrazine • glyphosate • 2,4-D
↑BR Above Brazil's maximum limit	—	—	—	—	atrazine **2x higher**	—	—
↓BR Below Brazil's maximum limit	✓	✓	✓	✓		✓	✓
↑UE Above EU maximum limit	glyphosate **14 x higher**	2,4-D: **28 x higher**	2,4-D **20.5 x higher** glyphosate **1.3 x higher**	glyphosate **at limit** 2,4-D **30x higher**	glyphosate **2x higher**	2,4-D: **32x higher**	2,4-D: **32x higher**
Not authorized in the EU	• atrazine • cyproconazole	fipronil	atrazine	atrazine	• cyproconazole • epoxiconazole • metolachlor • picoxystrobin		atrazine

It should be noted that, whatever the detected concentrations are, pesticides can harm people's health and the environment. **Claims about safe doses of exposure, for example, do not apply to pesticides that can cause cancer and/or endocrine disruption. For such effects, associated with AIs such as glyphosate, 2,4-D, and atrazine**. any non-zero dose is sufficient to damage a person's health. Furthermore, not every effect depends on the dose. Some chemicals present different profiles, with significant damage observable at low doses, while at high doses those effects do not occur.

Complex effects of low doses are often observed after exposure to endocrine disruptors, for example. This means that even if a pesticide detected in the water is below the MPV established by Brazilian law, its very presence is enough to indicate environmental contamination and higher risks of damage to health, threatening all forms of life in the area. **Thus, even when a pesticide has been detected (i.e., at levels above the detection limit) but it is not possible to determine the precise residue level (since it is below the quantification limit), there is still a potential for harm**.

In several water samples, at least two different pesticides were detected. Of particular note are the communities in Maranhão – where nine chemicals were detected in a single sample in the second cycle, including atrazine at levels more than twice those allowed by Brazilian standards – and Piauí – where four chemicals were detected in two different samples, each during the first cycle. In cycle 1, more than one AI was identified in 53.85% of the points where pesticide parameters were detected; in cycle 2, this percentage was 23.81%. **Exposure to mixtures of pesticides can be much more dangerous than contact with single products, since these poisons can interact with each other, adding to or potentiating their toxic effects**.

The results of the action research

POSITIVE SAMPLES FROM ACTION RESEARCH

MARANHÃO

9 AIs detected in a single sample*

CYCLE 2:

Atrazine
Cyproconazole
Difenoconazole
Epoxiconazole
Glyphosate
Metolachlor
Picoxystrobin
Pyraclostrobin
Trifloxystrobin

***Exposure to mixtures of pesticides can be much more dangerous than to a single product.**

Collecting water in the Eldorado II settlement, Sidrolândia, Mato Grosso do Sul. Credit: Bruno Alface (CPT).

Cocalinho Quilombola Territory, Parnarama, Maranhão. Credit: CPT Maranhão.

show that contamination of water and of communities is a fact in the Brazilian Cerrado. The figures show that this is a frequent occurrence, even though we analyzed fewer AIs than the total number of AIs authorized for use in the country.

Despite the severity and potential harm associated with exposure to pesticide mixtures, Brazilian regulations completely disregard such effects. Executive Order 888/2021[1], which sets the MPVs for water, ignores combinations of different pesticides in a single sample and considers only individual values, regardless of the number of chemicals found. In countries with more protective environmental and health legislation, as is the case in the European Union, the sum of residue levels is considered to determine permitted levels for monitoring and surveillance purposes[2].

We also stress the gravity of the presence of the pesticides azoxystrobin, etofenprox, picoxystrobin, pyraclostrobin and trifloxystrobin in the water samples collected, since their monitoring is not even required by Executive Order 888/2021[3]. These pesticides in fact have no MPVs, because they are simply not included in the official standard, on the list of chemicals to be monitored for health risks.

Such gaps mean there are no benchmarks for these chemicals to be regularly monitored in the territories, either in human water supply systems fed by surface sources or in others fed by underground sources. Even though the Order stipulates that "the collection of samples for the analysis of pesticide chemicals shall take into account the evaluation of their use in the watershed of the contributing source, as well as the seasonality of the crops"[4], nthere is no requirement to monitor unlisted AIs. As a result, various sources may be contaminated by chemicals not covered by the Order and this information may be left out of water monitoring databases.

Finally, individual characteristics of residents and variable conditions of vulnerability in each territory can intensify the impacts of poisoning by pesticides, making children, people with comorbidities, farmworkers, and traditional peoples and communities, for example, more susceptible.

1. BRASIL. Ministério da Saúde. *Portaria GM/MS n° 888, de 4 de maio de 2021*. Brasília, DF: Ministério da Saúde, 2021. Disponível em: https://www.in.gov.br/en/web/dou/-/portaria-gm/ms-n-888-de-4-de-maio-de-2021-318461562.

2. ROSA, Ana Cristina Simões; GURGEL, Aline Monte; FRIEDRICH, Karen. Presença de agrotóxicos em água potável no Brasil: parecer técnico do GT de Agrotóxicos da Fiocruz para a Revisão do Anexo XX da Portaria de Consolidação n° 05, de 28 de setembro de 2017 do Ministério da Saúde, para o parâmetro "agrotóxicos". Rio de Janeiro: Fiocruz, 2020.

3. BRASIL, 2021.

4. BRASIL, 2021.

3.3 Diseases, risks, and everyday stories of contamination of people's bodies and their territories in the Cerrado

"In terms of disease, it's getting worse, isn't it? People are getting sicker, aren't they? Before they were healthier, we were all healthier."

Interview in the Barra da Lagoa community, Piauí

During talks, social gatherings, and analytical discussions with the residents of the communities participating in the action research, pesticides were associated with the declining health of people in the Cerrado communities, and of their waters, their commons and so many forms of life intertwined with their everyday routines. In their narratives and reflections, they refer to their bodies and territories as extensions of each other, and the suffering of one is experienced inseparably from the other. Farm plots contaminated by pesticides make the body sick. Contaminated water makes fish, a staple food for so many communities, useless. Plants and sacred places are lost, along with knowledge passed down for generations. In the words of the residents of the Leonir Orback Camp in Goiás, these interrelations stand out:

"So, we get contaminated through our pores, and we eat the food too, we eat the same [...] medicinal herb leaves that are already contaminated by the poison."

Leonir Orback Camp, Goiás

There, as in all the communities involved in the action research, people refer to pesticides as "poison", toxic products felt kilometers away as soy plantation are sprayed. This approach to agriculture causes diarrhea, nausea, dizziness, and multiple infections. In Maranhão, in the Cocalinho Quilombola Community, residents now consider their common diseases to include itching, vomiting, eye allergies, headaches, bone pains, redness of the skin and renal colic.

Collecting water in the Geraizeiras Communities, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento.

From the standpoint of geraizeiro residents in the Formosa do Rio Preto Community in Bahia, measuring how much pesticides endanger the lives of people and territories is a delicate task, because these products are carried in the water, in people's bodies or in the soil, and cause a variety of problems:

"In this case it affects everything. From the headwaters down. The poison comes, sometimes it falls into this stream here, it falls into the river... All the streams pour into the river. Whoever drinks from the river... The streams pour into the river, they're drinking all the poison [...]. And anyone who drinks here [...] the spring is there, the poison falls there, it comes here in the [...] stream."

Statement from the Geraizeira Community in Formosa do Rio Preto, Bahia

Analyses by the communities on damages and risks posed by pesticides highlight how these products have affected biodiversity and the ecological balance. One of the points they highlight,

in addition to widespread contamination of the commons, is, for example, the emergence of invasive species such as the whitefly. These insects proliferate mainly due to the elimination of natural predators, causing losses in farmers' fields and homegardens and disrupting families' food and nutritional security:

"There are many pests [...] there are more pests now, it seems. There are a lot of pests. It's like ... Let's see how things are [...] the beans are no good for eating. To cook [...] in the pressure cooker, it doesn't work, it's no good. Beans used to be good and now they're no good [...]."

Statement from the Cocalinho Territory, Maranhão

In Mato Grosso, in the Cumbaru Community, residents have experienced a rise in the population of wild boars that attack their fields in search of food, since the native vegetation has been cleared and replaced by soy monocultures. Another concern they mention is the disappearance of bees due to pesticide spraying. In addition to the ecological imbalance, communities explain that pesticides brought in by air or water have a direct impact on their crops. In their words, "cassava leaves curl", "cassava roots don't thicken", "bananas don't ripen", "cashew leaves dry out", "beans don't cook".

"This little piece of land here? If you plant a vegetable garden, you won't harvest a thing, you'll just kill yourself and [...] what comes through the air? It comes in, falls into your garden, onto your plants [...]"

Statement from Eldorado II Settlement, Mato Grosso do Sul

In their subtle comprehension of relations between people and nature, Cerrado peoples believe that, if pesticides are used to eliminate life forms and if they can enter plants, there can be no doubt that they will harm humans. Likewise, they point out that if people aren't healthy after coming in touch with pesticides, then plants can't be either. The understanding and analysis of the presence of pesticides by members of the action research's participating communities, furthermore, shows how they have been used as chemical weapons, disrupting the production and reproduction of life. For the peoples of the Cerrado it is clear that life depends on connections they make with the territory where they live, through the body, the land, the forest, and the waters.

3.4. Pesticides authorized for use on soy: cancer, endocrine disruption and environmental contamination

Considering the day-to-day contamination of Cerrado communities participating in the research and the fact that 216 AIs are authorized for use on soy in Brazil, we analyzed the risks associated with diseases, especially cancer and endocrine disruption. These diseases were chosen because of their severity and because in many cases they are potentially irreversible. Endocrine disruption can lead to disorders in hormone production, for example, with repercussions throughout a person's life, especially when exposed during critical developmental periods, such as pregnancy and childhood[1].

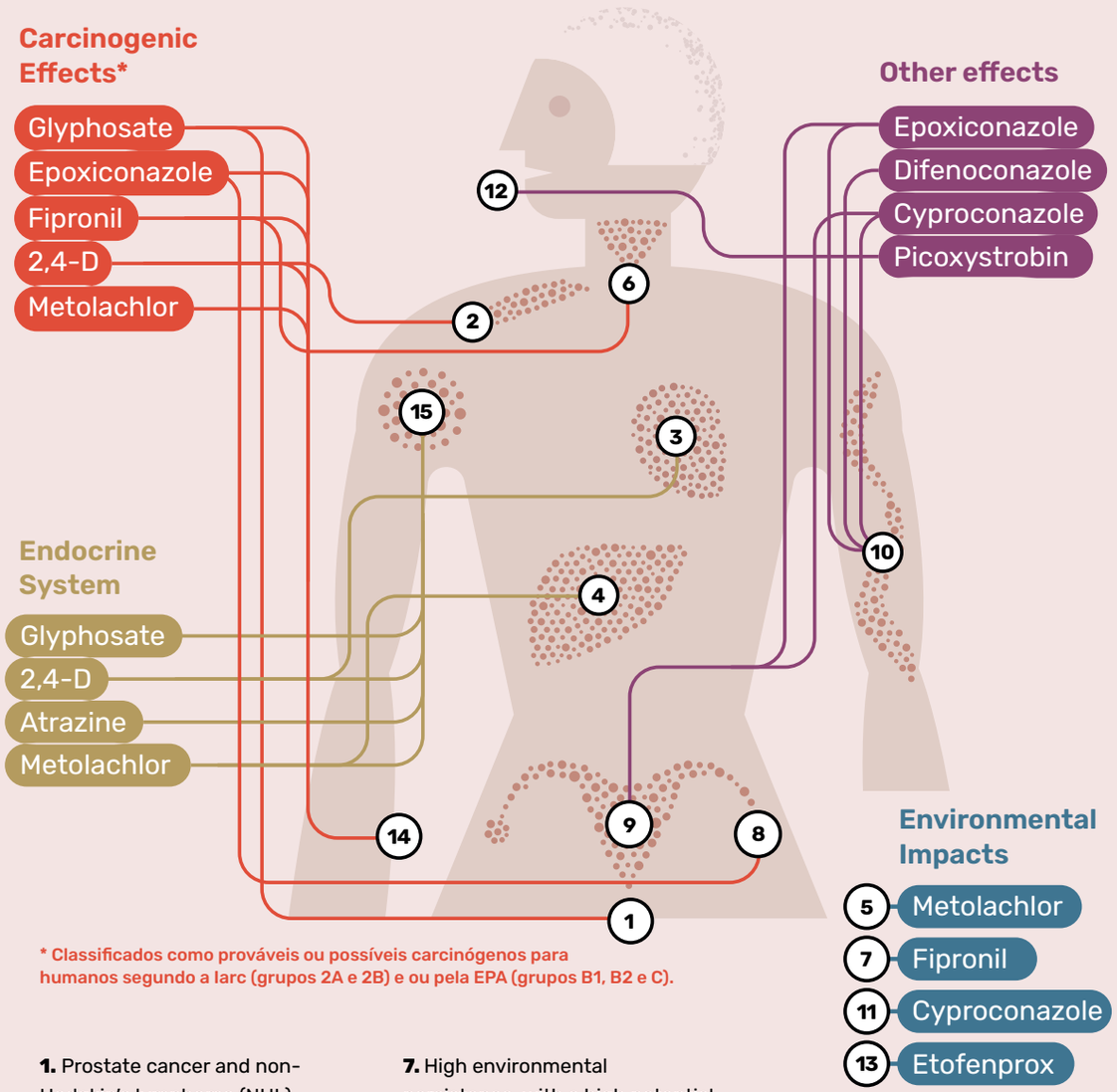
Another important point about these two impacts caused by pesticides – cancer and endocrine disruption – is that they are not dose-related. This means that any level of exposure above zero is enough to damage one's health. So, even if the MPV for the residue detected is not reached, as was the case with most of the water samples from the seven communities, this does not mean, under any circumstance, that exposure levels can be considered safe. Indeed, both cancer and endocrine disruption are effects that make the registration of a pesticide illegal under current Brazilian legislation [2] [3].

1. CASTRO-CORREIA, C.; FONTOURA, M. "A influência da exposição ambiental a disruptores endócrinos no crescimento e desenvolvimento de crianças e adolescentes" in Revista Portuguesa de Endocrinologia, Diabetes e Metabolismo, Lisbon, v. 10, n. 2, p. 186-192, 2015.

2. BRASIL. Decreto nº 4.074, de 4 de janeiro de 2002. Brasília, DF: Presidência da República, 2002. Available at: http://www.planalto.gov.br/ccivil_03/decreto/2002/d4074.htm.

3. BRASIL. Lei nº 7.802, de 11 de julho de 1989. Brasília, DF: Presidência da República, 1989. Available at: https://www.planalto.gov.br/ccivil_03/leis/l7802.htm.

SOME EFFECTS ASSOCIATED WITH PESTICIDES DETECTED IN CERRADO WATERS



* Classificados como prováveis ou possíveis carcinógenos para humanos segundo a Iarc (grupos 2A e 2B) e ou pela EPA (grupos B1, B2 e C).

1. Prostate cancer and non-Hodgkin's lymphoma (NHL)

2. NHL, sarcomas (tumors), colon cancer and leukemia

3. Changing fat levels, decrease the level of "good" cholesterol, increased triglycerides, sugars in the body and the thyroid hormone, greater risk of acute myocardial infarction, obesity and diabetes, problems in the menstrual cycle, ovulation, and fertility.

4. Increased incidence of tumors, particularly liver tumors

5. Dangerous for the environment

6. Thyroid tumors

7. High environmental persistence, with a high potential for accumulation in terrestrial and aquatic environments; impacts on insects that are essential for maintaining ecological balance and very toxic to bees

8. Increase in ovarian tumors

9. Potential to cause reproductive toxicity in humans

10. Abnormal build-up of fats in certain organs and tissues

11. Dangerous for the environment and very toxic to aquatic organisms and may cause long-term effects on aquatic environments

12. May be fatal if inhaled

13. High environmental toxicity:

a) very persistent in water, soil, and sediments

b) very toxic to aquatic organisms and

c) highly toxic to bees

14. Probable, possible, evidence suggestive or limited evidence of being a potential human carcinogen

15. Endocrine disruption

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CARCINOGENICITY

Carcinogenicity is the potential of certain chemicals to cause cancer. To put it simply, cancer is a set of pathological clinical expressions characterized by the loss of control over cell growth and by the ability to invade adjacent tissues or spread to other regions of the body.

As explained in section two of this Dossier, to identify carcinogenic and endocrine-disrupting risks of pesticides authorized for use on soy, we consulted the lists of the World Health Organization's International Agency for Research on Cancer (IARC/WHO) and the US Environmental Protection Agency (USEPA). The IARC has analyzed only 36 pesticide AIs for their carcinogenicity and, of this total, 15 are authorized for use in Brazil. As for the USEPA evaluation of carcinogenic potential, 52 AIs are classified as "probable" or "possible" carcinogens for humans[1].

What might be considered imprecision, in fact, represents a huge gap in knowledge about the carcinogenicity of these products, suggesting that the number of pesticides that cause these diseases may be much higher than is currently known.

Glyphosate and **malathion** are classified by the IARC as probable human carcinogens[2] [3]. This is due to evidence of the development of prostate cancer and non-Hodgkin's lymphoma (NHL); as well as NHL and leukemia, respectively[4] [5].

2,4-D has been declared by the same agency as a possible human carcinogen, especially due to its relationship with the development of NHL, sarcoma (cancer of the bones and soft tissues)[6]. colon cancer (part of the digestive tract) and leukemia.[7]

Chlorothalonil and **metolachlor** are other possible carcinogens, according to the USEPA[8]. **Diuron** is classified as a carcinogen[9], **mancozeb**[10] and **chlorothalonil**[11]. are probable human

1. FRIEDRICH, Karen; SILVEIRA, Gabriel Rodrigues; AMAZONAS, Juliana Costa; GURGEL, Aline Monte; ALMEIDA, Vicente Eduardo Soares; SARPA, Marcia. "Situação regulatória internacional de agrotóxicos com uso autorizado no Brasil: potencial de danos sobre a saúde e impactos ambientais" in Cadernos de Saúde Pública, Rio de Janeiro, v. 37, n. 4, 2021

2. INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC). Some organophosphate insecticides and herbicides: Glyphosate. IARC Monographs on the evaluation of carcinogenic risks to humans. v. 112. Lyon: Iarc, 2017. Available at: http://monographs.iarc.fr/ENG/Monographs/vol112/mono112.pdf.

3. INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC). Malathion Monographs. v. 112. Lyon: Iarc, 2015. Available at: http://monographs.iarc.fr/ENG/Monographs/vol112/mono112-07.pdf.

4. INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC), 2017

5. INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC), 2015.

6. GARABRANT, David H.; PHILBERT, Martin A. Review of 2,4-dichlorophenoxyacetic acid (2,4-D) epidemiology and toxicology. Critical Reviews in Toxicology, London, v. 32, n. 4, p. 233-257, 2002.

7. YI, Sang-Wook; OHRR, Heechoul; HONG, Jae-Seok; YI, Jee-Jeon. Agent Orange exposure and prevalence of self-reported diseases in Korean Vietnam veterans. Journal of preventive medicine and public health, Seoul, v. 46, n. 5, p. 213-25, sep. 2013

8. ENVIRONMENTAL PROTECTION AGENCY. R. E. D. facts chlorothalonil. Washington, DC: Usepa, 1999.

9. ENVIRONMENTAL PROTECTION AGENCY. Diuron: Draft Human Health Risk Assessment for Registration Review. Washington: USEPA, 2020. Available at: https://www.regulations.gov/document/EPA-HQ-OPP-2015-0077-0044.

10. ENVIRONMENTAL PROTECTION AGENCY. Reregistration Eligibility Decision (RED) for Mancozeb (EBDC). Washington: USEPA, 2005a. Available at: https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-014504_20-Sep-05.pdf.

11. ENVIRONMENTAL PROTECTION AGENCY. Chlorothalonil Reregistration Eligibility Decision. Washington: USEPA, 2007.

carcinogens and the AIs **acephate**, **carbendazim** and **cypermethrin** are possible human carcinogens. Due to the effects of diuron, the USEPA recommended that it be banned from all crops in the United States in April 2022[1]

Metolachlor is suspected of being an endocrine disruptor and exposure is associated with a higher incidence of tumors, particularly hepatic tumors (associated with the liver)[2], in addition to being considered hazardous to the environment.

To make things worse, many pesticides may contain substances in their composition that are more toxic than the AI itself, such as surfactants, adjuvants or even metabolites. Particularly noteworthy is the case of **glyphosate**, which has co-formulants, contaminants and metabolites that are more toxic than the AI. One co-formulant, the surfactant POEA[3] is used in glyphosate-based pesticides in Brazil, as well as in other types. Although this substance was banned by the European Food Safety Authority (EFSA) for lack of sufficient evidence to set safety limits for chronic exposure, it is still authorized in Brazil. Major reasons for concern[4], include:

- the potential acute toxicity of the chemical POEA, which is greater than that of glyphosate;
- the few studies done and the need for further study into the genotoxic potential of POEA;
- the need to investigate possible endocrine disruption caused by the product, since adverse effects on reproductive function and development have been reported in individuals who have had contact with it.

Another aspect of **glyphosate**-based pesticides is the presence of unintentional contaminants, such as formaldehyde, considered by the IARC to be carcinogenic to humans[5].

2,4-D contains other significant toxicological contaminants, such as dioxins, generated as impurities in the manufacture of pesticides, and which are known to be carcinogenic[6].

Fipronil primarily targets the nervous system, thyroid, and liver, and has been classified by the USEPA as a possible human carcinogen, due to the occurrence of thyroid tumors[7] after contact with it. This AI has been associated with thousands of cases of poisoning in humans, including serious cases with fatal outcomes[8].

1. ENVIRONMENTAL PROTECTION AGENCY. Diuron Proposed Interim Registration Review Decision Case. n. 0046, March 2022. Washington: USEPA, 2022b. Available at: https://www.regulations.gov/document/EPA-HQ-OPP-2015-0077-0044

2. EUROPEAN FOOD SAFETY AUTHORITY. "Peer review of the pesticide risk assessment of the active substance S-metolachlor excluding the assessment of the endocrine disrupting properties" in EFSA Journal, v. 21, n. 2, 2023.

3. Chemical compound POEA = polyoxyethyleneamine.

4. ASSOCIAÇÃO BRASILEIRA DE SAÚDE COLETIVA. Parecer Técnico sobre processo de reavaliação do ingrediente ativo de agrotóxico glifosato utilizado na agricultura e como produto domissanitário. Rio de Janeiro: Abrasco, 2019.

5. ASSOCIAÇÃO BRASILEIRA DE SAÚDE COLETIVA, 2019.

6. AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA. Parecer técnico de reavaliação nº 07, de 2015/GGTOX/Anvisa. Reavalia os riscos à saúde humana do ingrediente ativo ácido 2,4-diclorofenoxiacético (2,4-D). Brasília, DF: Anvisa, 2015.

7. ENVIRONMENTAL PROTECTION AGENCY. *Comments on proposed interim registration decision for tebuconazole*. Washington, D. C.: Usepa, 2022a.

8. ENVIRONMENTAL PROTECTION AGENCY. *Fipronil*: review of human incidents. Washington, D. C.: Usepa, 2011.

Epoxiconazole fhas been classified by the USEPA as a probable carcinogen for humans, mainly due to the increase in ovarian tumors after exposure to the product. It is similarly presumed to be a potential cause of reproductive toxicity in humans, affecting fertility and development (ENVIRONMENTAL PROTECTION AGENCY, 2006a, b; EUROPEAN CHEMICALS AGENCY, 2012; UNIÃO EUROPEIA, 2019).

Difenoconazole has presented evidence suggestive of a carcinogenic potential, while the limited evidence for **cyproconazole** makes it suspected of causing reproductive toxicity in humans[9].

Among the AIs in the strobilurin chemical group, **picoxystrobin** shows evidence of a carcinogenic potential[10]. It can be fatal if inhaled.

ENDOCRINE DISRUPTION

Endocrine disruption occurs when an external substance interferes with the production, secretion, transport, binding, action, or elimination of hormones. These, in turn, are responsible for functions such as the development, reproduction, metabolism, and behavior of organisms.

Of the AIs classified as endocrine disruptors, at least three authorized for soy and among the most widely sold pesticides in Brazil have been classified as potentially harmful to humans or wildlife.

Of particular note is the endocrine action of **2,4-D**, which can alter fat levels[11] in the body, decrease the level of "good" cholesterol[12] , and increase triglycerides, sugars, and the thyroid hormone, raising risks of acute myocardial infarction, obesity, and diabetes[13]. Higher levels of luteinizing hormone (LH) in the body, especially for women spraying 2,4-D, are associated with problems in menstrual cycles, ovulation, and fertility[14].

Herbicides such as atrazine and **glyphosate** also alter endocrine functions[15][16]. Atrazine, as we have seen, was banned in the European community due to its toxicity, particularly due to endocrine disruption[17]. Overall, of the 77 pesticides

9. ENVIRONMENTAL PROTECTION AGENCY, 2020.

10. ENVIRONMENTAL PROTECTION AGENCY, 2020

11. YI et al., 2013.

12. l HDL = high-density lipoprotein.

13. SCHREINEMACHERS, Dina M. "Perturbation of lipids and glucose metabolism associated with previous 2,4-D exposure: a cross-sectional study of NHANES III data, 1988-1994" in Environmental Health, v. 9, n. 1, 2010. Available at: https://ehjournal.biomedcentral.com/articles/10.1186/1476-069X--9-11#citeas

14. FRIEDRICH, Karen. Avaliação dos efeitos tóxicos sobre o sistema reprodutivo, hormonal e câncer para seres humanos após o uso do herbicida 2,4-D. Rio de Janeiro: Fiocruz, 2014

15. DEFARGE, Nicolas; TAKÁCS, Eszter; LOZANO, Verónica Laura; MESNAGE, Robin; DE VENDÔMOIS, Joël Spiroux; SÉRALINI, Gilles Eric; SZÉKÁCS, András. "Co-Formulants in Glyphosate-Based Herbicides Disrupt Aromatase Activity in Human Cells below Toxic Levels" in International Journal of Environmental Research and Public Health, v. 13, n. 3, 26 Feb. 2016. DOI 10.3390/IJERPH13030264. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4808927/

16. ROBERTS, James R.; KARR, Catherine J.; PAULSON, Jerome A.; BROCK-UTNE, Alice C.; BRUMBERG, Heather L.; CAMPBELL, Carla C.; LANPHEAR, Bruce P.; OSTERHOUDT, Kevin C.; SANDEL, Megan T.; TRASANDE, Leonardo; WRIGHT, Robert O. "Pesticide Exposure in Children" in PubMed, v. 130, n. 6, 1 Dec. 2012. Available at: https://pubmed.ncbi.nlm.nih.gov/23184105/.

17. EUROPEAN COMMISSION. Ad-hoc study to support 616 the initial establishment of the list of candidates for substitution as required in Article 80 (7) of 617 Regulation (EC) n 1107/2009 Final Report. Directorate General for Health and Consumers. 2013. Available at: https://food.ec.europa.eu/system/files/2016-10/pesticides_ppp_app-proc_cfs_report-201307.pdf.

Cumbaru Community, Nossa Senhora do Livramento, Mato Grosso. Credit: FASE Mato Grosso

that are candidates for substitution in the European Community, 68% are authorized in Brazil[1].

OTHER MAJOR HEALTH AND ENVIRONMENTAL EFFECTS

In addition to associations with cancer and endocrine disruption, a number of other effects, on both human health and the environment, deserve our attention in this Dossier, to highlight possible harm caused by pesticides.

The pesticide **etofenprox** is a candidate for substitution in Europe[2], besides being included in the List of Pesticides in Observation in those countries, which covers products that have not been banned but which offer a potential for serious and/or cumulative risks to human health and/or the environment. The reasons for its inclusion on this list are mainly associated with its high environmental toxicity, since this AI is considered: a) very persistent in water, soil, and sediment; b) very toxic to aquatic organisms and; c) highly toxic to bees.

Fipronil is very persistent in the environment, with a high potential for accumulation in both land and aquatic environments. This means that environments contaminated with fipronil are long-term exposure threats to various animal species, in particular humans and other animals and aquatic organisms of importance for human nutrition.

This AI has major impacts on beneficial insects, which are fundamental to maintaining ecological balance. It is considered highly toxic to bees[3], which are responsible for pollinating many agricultural and native species.

Cyproconazole is an environmental hazard, very toxic to aquatic organisms, and can cause long-term effects in water.[4] . In humans, compounds from the triazole chemical group, such as **epoxiconazole, cyproconazole**, and **difenoconazole**, are known to damage lipid metabolism, responsible for the balance of fats in the body, and can cause abnormal accumulation of fats in certain organs and tissues[5].

It is important to point out that these analyses focus on the risks caused individually by each active ingredient. Analyses of mixtures of pesticides and their chemical reactions demand much more in-depth study, since so little is known about what they may do to people and the environment. Even so, through the voices of the communities and specialized technical literature, this survey has highlighted everyday risks faced by Cerrado peoples from pesticides contaminating the water that flows into their own bodies, and into the region's rivers, streams, marshes, and soils.

1. FRIEDRICH et al., 2021..
2. EUROPEAN COMMISSION, 2013.

Collecting water in the Aldeia Community, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento.

The pesticides fipronil and etofenprox stand out as highly toxic for bees and other insects that are fundamental for maintaining ecological balance.

3. ENVIRONMENTAL PROTECTION AGENCY. Section 18 Ecological Risk Assessment for Fipronil Use to Control Cabbage Maggot in Turnip and Rutabaga. Washington, D. C.: USEPA, 2005b. Available at: https://archive.epa.gov/pesticides/chemicalsearch/chemical/foia/web/pdf/129121/129121-2005-08-31a.pdf.
4. EUROPEAN CHEMICALS AGENCY. Cyproconazole Product-type 8. Echa, 2016.
5. ENVIRONMENTAL PROTECTION AGENCY, 2022a.

Final Considerations and avenues to hope

The collective knowledge produced by Cerrado communities, researchers, and consulting organizations, systematized throughout the pages of this Dossier, has shown how pesticides in water invade people's bodies and territories. By combining different perspectives, from laboratory analyses of water samples to the everyday perceptions of people in the Cerrado, we were able to provide an overview of what it is like to live in the midst of pesticide contamination.

This dimension reveals why we consider pesticides to be chemical weapons. These chemicals prevent the production and reproduction of life for peoples of the Cerrado. In their bodies, these products turn into headaches, diarrhea, various ailments, and diseases that can be irreversible, such as cancer and illnesses caused by endocrine disruption. On the other hand, in their territories, where people plant, play and cultivate their ancestry, pesticides are spreading, carried by river waters, and blown around by clouds of aerial spraying. Bodies and territories, however, as the Cerrado peoples teach us, should not be treated as separate dimensions. People's lives are intertwined into the Cerrado, in the waters that flow in its rivers, on the ground and inside each person.

The Dossier's findings show the devastating growth of soy monocultures, taking over the Cerrado and those who live there. The Cerrado holds more than 50% of the area planted with soy, which is also the crop that consumes the largest volume of pesticides. Approximately 60% of all the chemical products used in the country go to soy, leaving no doubt about the severity of contamination in the region, and how it may escalate if necessary measures are not taken.

Research into specialized bibliographies revealed that, more than 43% of the active ingredients (AIs) on the market in Brazil are registered for use on soy and that all ten of the country's top-selling pesticides can be used on this crop. These facts alone raise a specter of contamination for communities in the Cerrado, At least one pesticide residue was identified in all seven communities participating in the action research where water was collected.

In the water samples collected in the communities, 13 AIs were identified, all of which are authorized for use on soy. VAround 50% of them are banned in the European Union, due to evidence of the harm they cause, as is the case with atrazine. Analyses of risks caused by these agents point to irreversible diseases such as cancer, endocrine disruptions, diabetes and heart attacks, and the extinction of key species for the maintenance of socio-ecological cycles, such as bees and other pollinators of both native and cultivated plants.

Most of the studies available on the risks posed by these products discuss their individual effects. Yet exposure to a mixture of pesticides can be much more dangerous, since chemicals can interact and combine or intensify their toxic effects. This heightens our concerns, especially considering that, for instance, one sample collected in the state of Maranhão contained nine different AIs.

Another notable aspect is the fact that none of the water samples collected contained pesticides above Brazil's official Maximum Permitted Value (MPV). Nevertheless, a look at the European Union's legal mechanisms compared to Brazil's shows that one of the samples with 2,4-D in our study contained over 30 times the legal limit for those countries and, in one of our glyphosate samples, the concentration was approximately 14 times greater. Another significant legal difference is the ban on the aerial spraying of pesticides in member countries of the European Community, while in Brazil this practice is not only allowed, but routine. Videos and reports from Cerrado communities were included in the action research report to denounce how poisons rain down on people's bodies and territories.

Two analytical lessons can be drawn from this comparison. The first is the permissiveness of Brazilian legislation. The Brazilian state operates actively and with negligence, allowing a high volume of pesticides in water for drinking, cooking, growing food and playing, in the case of children. The second lesson concerns colonial relations between northern and southern countries. Geopolitical power asymmetries imposed over centuries allow protective measures to be taken by peoples in the North,

Geraizeiras Communities, Formosa do Rio Preto, Bahia. Credit: Agência 10envolvimento

often to the detriment of those in the South.

The data and reports gathered from communities with the goal of producing collective knowledge have allowed this Dossier to present a complex understanding of the contamination of waters, people's bodies, and territories by pesticides in the Cerrado. We set out to describe and denounce this scenario in the belief that we can compose new narratives and new forms of agriculture, and that we cannot put off either hearing what people have to say about their everyday injustices, or actually becoming part of this struggle. Yes, the struggle of the peoples of the Cerrado is up to all of us.

It is from this standpoint that we have compiled a list of urgent measures to curb pesticide contamination and defend the territories of life. These recommendations were drafted and approved at a Special Session in Defense of the Territories of the Cerrado, of the Permanent Peoples' Tribunal[1], , following a process of broad, collective reflection.

1. CAMPANHA NACIONAL EM DEFESA DO CERRADO. *Agenda jurídico-política para frear o Ecocídio do Cerrado e o Genocídio dos seus povos*. Brasília, DF: Campanha Nacional em Defesa do Cerrado, 2022.

Recognizing that the intensive use of pesticides in the Cerrado expresses a policy aimed at killing its peoples and, therefore, is evidence of the crime of Eco-Genocide in the Cerrado, the Peoples' Tribunal has endorsed our recommendations and announced that a feeling of justice, of that "Justice that springs from the earth," from the waters, from the forests, can be achieved as we discover new avenues to hope. It is with this hope that we carry on.

1. Build territories free of pesticides, transgenic crops and other biotechnologies as part of a process of resistance, transition and increasing protection of our genetic and cultural heritage associated with agrobiodiversity (articles 225-II, 215 and 216 of the Federal Constitution), local interests and farmers' and consumers' rights, in light of widespread contamination and the impossible coexistence of transgenic technology and various types of pesticides with conventional and agroecological production systems;

2. Approve Bill No. 6.670/2016 to establish the National Policy for the Reduction of Pesticides (PNARA), to implement actions aimed at gradually reducing the use of pesticides, protecting health, and strengthening agroecological production initiatives;

3. Through institutional actions and policies, encourage the production and use of alternative agro-ecological solutions for pest and disease management and for seed protection (seed dressings), with the participation of the diverse peoples of rural areas in the studies and development of parameters to produce these solutions;

4. Reject Bill 6,299/2002, widely known as the "Poison Bill" – now under consideration in the Federal Senate – aimed at making the use of agrochemicals even more flexible in Brazil and, if it is approved, challenge its constitutionality in court;

5. Ban pesticides outlawed in other countries, especially in the producers' country of origin;

6. Ban aerial pesticide spraying nationwide, based on Ceará's State Law No. 16,820/2019;

7. Regulate the ground spraying of agrochemicals, by setting reasonable minimum distances for the application and spraying of pesticides in Permanent Preservation Areas, keeping it at least 1,000 meters from areas with beekeeping and meliponiculture, and from community centers (especially production areas, extractive areas, clinics, and schools), and by protecting areas with water from contamination, as well as, and especially, indigenous, peasant and traditional territories;

8. Recognize that the current norm setting a distance of only 100 meters between fields with landrace and transgenic corn seeds (RN 04/07 issued by the National Technical Commission on Biosafety – CTNBio) is insufficient to curb contamination of the genetic heritage of landrace corn and the loss of associated traditional knowledge;

9. Set and implement an effective policy for continuous, intersectoral inspections of pesticide production plants and of the consumer units where pesticides are used, with close attention to labor, socio-environmental and health dimensions. Likewise, inspection of the storage and disposal of pesticide packaging should be expanded and intensified, with campaigns to ban the reuse of packaging and explain its dangers;

10. Ban chemical weeding in urban areas, with specific laws;

11. Include in the federal Pesticides Law (Law 7,809/89) a time limit on the registration of pesticides, to ensure periodic re-evaluations of each product's registration;

12. Revive the policy and measures for ongoing assessment of pesticide residue levels in plant-based foods, with proper dissemination of subsequent reports and analyzed data, especially through the Program for Analysis of Pesticide Residues in Food (PARA);

13. Remove tax exemptions for pesticides, so that future tax revenues can be used to mitigate socio-environmental and health impacts of pesticide use, as well as to promote agro-ecological policies and practices;

14. Institutionalize, in environmental-protection authorities (Ministry of the Environment and State and Municipal Environmental Departments), a specific channel to denounce contamination from the use and spraying of pesticides and related rights violations, with the drafting and broad dissemination of public protocols to file such complaints;

15. Set up a network of laboratories to analyze pesticide residues (in water, food, sediments, animals, and blood), as well as PCR tests to detect contamination by GMOs, especially to protect landrace corn seeds;

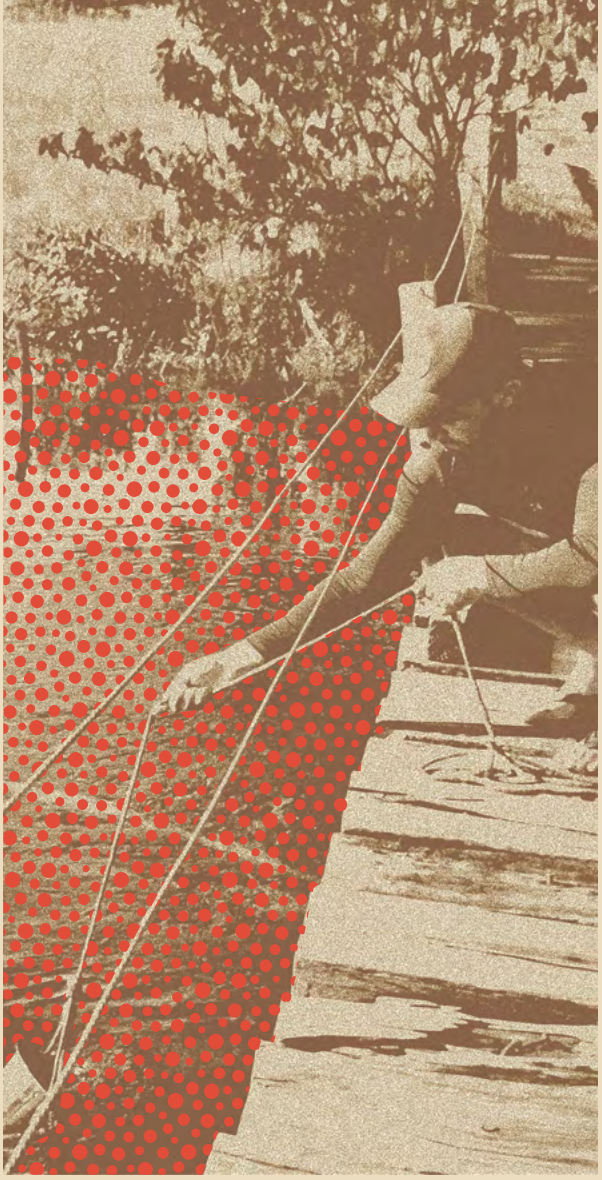
16. Implement a permanent training program for health professionals on proper procedures for the care, diagnosis, and surveillance of suspected cases of pesticide contamination or intoxication, stressing the compulsory notification requirement through the federal Notifiable Conditions Information System (SINAN), and ensuring proper dissemination of these procedures to the entire population;

17. Review standards for pesticide residues in water, and procedures to assess and control drinking water potability, to expand the list of pesticides analyzed in potability assessments, to adopt the maximum limits set in the European Community for pesticides in water, as recommended by the Technical Opinion of the Working Group on Pesticides of the Oswaldo Cruz Foundation – Fiocruz, and to ensure that alternative water sources,

especially community sources, are included in such assessments;

18. Lead the Brazilian state to promote a broad, participatory re-evaluation of practices now qualified as “low-carbon agriculture,” despite significant negative impacts on the environment and local populations. Examples include “no-till” practices using more pesticides (especially glyphosate, along with other desiccant herbicides, such as 2,4-D) and the expansion of monocultures of soy, corn, sugar cane and brachiaria pastures;

19. Enforce the principles and provisions of the Federal Constitution, the Biosafety Law 11,105/2005, and the Cartagena Protocol, to ensure that any product developed with genome modification, even if it does not contain recombinant material, must undergo an assessment of its health and environmental risks and that, if commercially released, it must be labeled and monitored. This means that Brazil must repeal the CTNBio’s Normative Resolution (RN 16/2018), which exempts products developed using modern biotechnologies with “new precision-breeding techniques” (NPBTs) that do not introduce a gene from one species into another, and whose end product is considered “equivalent” to a conventional one (containing no recombinant genes), from biosafety risk assessments imposed by law for GMOs.



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This Dossier is the fruit of an action research project, using participatory methodologies produce knowledge together with Cerrado communities, researchers and local organizations. The main objective of the investigation was to identify residues in the water of seven communities, especially of pesticide used on soy monocultures. The outcome is that the peoples of the Cerrado suffer contamination of their bodies and territories every day, in the water they drink, cook with or use in their fields and gardens, and in ponds and lakes where children play. By disrupting human lives, pesticides are perceived to be chemical weapons pointed at the Cerrado and its peoples.