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**The challenge of proving causality in lawsuits for pesticide contamination: limits of Brazilian judiciary in mitigating this socio-environmental impact**

**O desafio da responsabilidade por danos decorrentes de contaminação de agrotóxico: limites do Direito brasileiro na mitigação desse impacto socioambiental**

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**Abstract**

Despite the long history of research into the risks caused by the extensive use of pesticides to the environment and human health, it is still challenging to identify the causal link between the event and the damage, that is, proving that a specific product, on that occasion, caused that damage. The present study aims to analyze this difficulty in liability suits for pesticide contamination, as this evidence is essential for the lawsuit to be successful. Authors such as Bombardi (2017) and Pignati *et al.* (2017), among others, contributed to the writing. Jurisprudential research was carried out in the states of Mato Grosso, São Paulo, Pernambuco, and Paraná, as well as interviews with judicial experts and a public labor prosecutor. In jurisprudence, it is clear that damages to human health and crops mainly trigger the judiciary which, in approximately half of the decisions, the causal link was not established, with the main obstacles being the failure to prove the relationship between pesticides and diseases, and pesticide drift to locations other than where it was applied. During the interviews, the complexity of these products was reported, as they are only identified under particular temporal, spatial, and quantity conditions. The combination of these analyses demonstrates the need for investment in inspection and monitoring policies, as well as laboratory structures, so the judiciary can be more effective in its actions, in addition to reviewing the pesticides allowed in Brazil and their maximum tolerated quantities.

**Keywords:** pesticide; contamination; causal link; public health.

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## **Resumo**

Apesar do longo histórico de pesquisas sobre os riscos associados ao uso intensivo de agrotóxicos para o meio ambiente e a saúde humana, ainda há grande dificuldade de identificar o nexo de causalidade entre evento e dano, ou seja, comprovar que determinado produto, naquela ocasião, ocasionou o dano. O presente trabalho tem como objetivo analisar tal dificuldade nas ações de responsabilização por contaminação de agrotóxicos, visto que essa comprovação é indispensável para que a ação judicial tenha sucesso. Autores como Bombardi (2017) e Pignati *et al.* (2017), entre outros, compuseram a escrita. Foi feita pesquisa jurisprudencial nos estados de Mato Grosso, São Paulo, Pernambuco e Paraná, e entrevistas com peritos judiciais e um procurador do trabalho. Na jurisprudência, percebe-se que o judiciário é acionado principalmente por danos à saúde humana e às lavouras e, em aproximadamente metade das decisões não foi configurado o nexo causal, sendo os principais entraves a não comprovação da relação dos agrotóxicos com doenças e o evento da deriva do agrotóxico para outros locais que não o de aplicação. Durante as entrevistas, relatou-se a complexidade desses produtos, que são identificados apenas em condições temporais, espaciais e de quantidade bastante específicas. A combinação dessas análises demonstra a necessidade de investimento em políticas de fiscalização, monitoramento e estrutura laboratorial para que o Poder Judiciário possa ser mais efetivo na sua atuação, além da revisão das substâncias químicas permitidas e suas quantidades máximas toleradas.

**Palavras-chave:** agrotóxico; contaminação; nexo causal; saúde pública.

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## **Introduction**

Brazil is known for being one of the world's largest pesticide consumers, and from 2008 to 2015, it was continuously in first place in this ranking (Carneiro, 2015). Since 2015, the discussion about this placement has progressively intensified, mainly because there are several interested parties in dissociating the country from this entitlement, in addition to the conflict between data made available by national and international bodies.

According to the Report “Pesticides use, pesticides trade and pesticides indicators”, produced by the Food and Agriculture Organization of the United Nations, Brazil would have lost this title, falling to third position in the world ranking, behind China and the United States of America (USA) (FAO, 2021). However, there is disagreement about the veracity of the data made available by the organization since the quantity considered in 2019 (377 thousand tons) is different from that made available by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) (620 thousand tons), as the Institute for Applied Economic Research (IPEA) of Brazil

points out in a study on the topic, an alarming difference of almost 250 thousand tons (FAO, 2021; IBAMA, 2021; Moraes, 2019).

Furthermore, it is worth mentioning that the data on the amounts of pesticides produced, stored, and sold published annually by the agricultural industries to the Ministry of Agriculture, Livestock and Supply (MAPA) are not made publicly available on the government's digital platforms, so citizens cannot access it quickly and without bureaucracy. Many states also do not have a database with information on the agronomic recipes issuance, which is the responsibility of the regional Engineering and Agronomy councils (CREAs), preventing the checking and inspection of this data (Carneiro, 2015; Pignati; Oliveira; Silva, 2014).

However, Brazil's leading role in global agriculture and the agricultural input sector is uncontroversial. In 2020, the country commercialized 686 thousand tons of pesticides and similar products within its borders, as observed in the consolidation of data provided by companies registering toxic pesticides and similar products (IBAMA, 2021).

The number represents an increase of 10.5% in domestic sales of Chemical and Biochemical pesticides compared to 2019, which, in turn, was around 13% higher than sales compared to 2018 (IBAMA, 2021). This growth follows the previous decade's pattern. While the global increase in pesticide consumption was 100% between 2000 and 2010, Brazil's consumption increased by 200% in the same period (Pelaez *et al.*, 2010).

The number of new substances registered has also increased exponentially in the country (Rodrigues, 2019). In 2021, 562 new pesticides were approved, maintaining the high approval rate seen in previous years, especially since 2015 (MAPA, 2022b). Of the 475 new registrations in 2019, around one-third contained active substances listed by the European Chemicals Association as banned or severely restricted in the European Union (EU). Most of these registrations are generic pesticides already used and not newly developed with potentially safer formulas (Sarkar *et al.*, 2021).

As demonstrated in the Geographic Atlas of the Use of Pesticides in Brazil and Connections with the European Union, prepared by Prof. Larissa Mies Bombardi from the Faculty of Geography at the University of São Paulo (USP), there is a territorial division across the globe between countries that export the pesticide and countries that consume it and, consequently, expose their population and ecosystems to the harm of

these substances, demonstrating a perpetuation of an imperialist process within global agriculture (Bombardi, 2017).

A survey carried out by Uearthed, linked to Greenpeace, in partnership with the Non-Governmental Organization Public Eye (Dowler, 2020), revealed that, in 2018, manufacturers based in the European Union planned to export 81,615 tons of pesticides banned in that bloc. Of this quantity, 42,636 tons, more than half, would be destined for developing countries, as shown by data from the European Chemicals Agency and regulators from Germany, France, Belgium, and the United Kingdom. It is worth mentioning that, according to the study, Brazil is one of the leading markets for these prohibited pesticides (Sarkar *et al.*, 2021). For example, among the ten pesticides most consumed in Brazil, Atrazine and Acephate are banned in the European Union (EU) in fourth and fifth place on the list, totaling 63,303 tons used in 2020 alone in Brazil (IBAMA, 2021).

Because of this, it is essential to strengthen the debate on the topic, given that more and more studies prove the pesticide's harmfulness to the environment and human health, especially rural workers, who have more contact and exposure (Carneiro, 2015; Sobreira; Adissi, 2003). Therefore, to contribute to this study area development, this research aims, through jurisprudential analysis and interviews with experts, to carry out an investigation into the causal link of damage due to pesticide contamination and thus understand the limitations and obstacles faced by the Brazilian legal system in mitigating and repairing these damages, guaranteeing the health and environment protection.

The causal link proof is necessary to hold the responsible agent accountable in Brazilian justice. It is the investigation object of this research because the causal link connects the event to the damage, i.e., it is the material link that links the harmful behavior (action or omission) to health or environment, and it is extremely difficult to assess, especially regarding the environmental aspect, due to the characteristics of pesticides. In most cases, there is accountability when there is proof of the causal link, which can be done through technical examination, testimonial evidence, photos, etc. The most used is technical examination proof, which does not bind the judge but is the most reliable evidence to guide him in decisions. For this reason, the prevention, precaution, and prohibition principles of ecological regression, which are fundamental to Environmental Law in Brazil, are adopted as guidelines, in addition to the inseparability between the

environment and human health (Meyer, 2022). Therefore, this research aims to provide content reiterating the need for judicial, political, and administrative decisions to reduce, prohibit, and monitor the use of pesticides.

The unique characteristics of pesticides give the evidence of causal link a vital importance since these substances are invisible and can spread through the air, water, and soil, so the human and animal poisoning can have immediate symptoms (isolated exposure) or delayed symptoms, as a result of continuous exposure and cumulative effect on the body (Gerage *et al.*, 2017). The theme is extremely complex and interdisciplinary, especially considering the evident separation of humanity from the rest of the ecosystems as a result of modern logic in which society does not feel like it belongs to nature (Loureiro *et al.*, 2019).

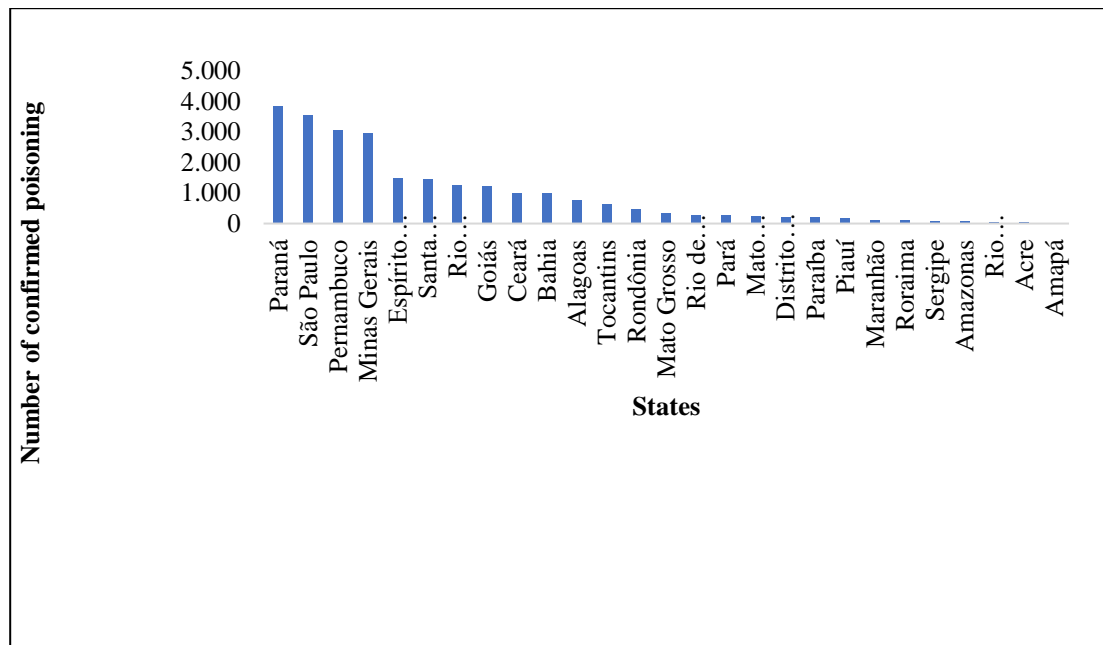
## **Methodology**

The jurisprudential analysis covers the years 2016 to 2020, as this is the period in which we have access to all data relating to the research, as some court platforms only have information from 2016 onwards and there is no update for 2021 regarding the number of tons of active ingredient sold in Brazil, at the time of this study.

To delimit the research, the three Brazilian states that had the most notifications of agricultural pesticide poisoning and the three states that consumed the most pesticides between the years of 2013 and 2020 are used as a basis. The study of these federation units is believed to be more relevant to the topic since the issue of pesticides is most significant in them, among other Brazilian states. In this way, the states of Mato Grosso (MT), São Paulo (SP), Paraná (PR), and Pernambuco (PE) were analyzed since São Paulo and Paraná have high levels of both consumption and notification of pesticide poisoning, as shown in Graphs 1 and 2.

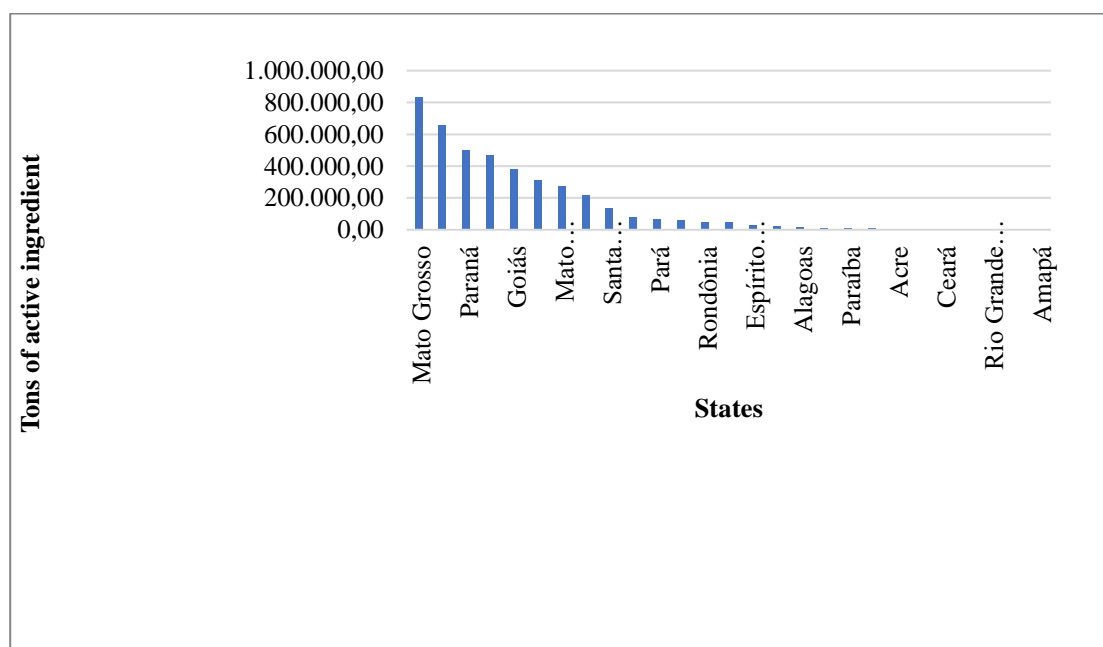
It is interesting to note that the states that consume the most pesticides are not necessarily those with the highest number of confirmed poisoning reports. The state of Mato Grosso, which is the largest consumer, has a low contamination notification rate, while the situation in Pernambuco is the opposite. The number of pesticide contamination notifications is also related to the policy of Health Surveillance practices of Populations Exposed to Pesticides adopted by each state, with Paraná having the most active network in the country (Queiroz *et al.*, 2019).

**Graph 1 - Agricultural pesticide poisoning from 2013 to 2020**



Source: Sinan, 2021.

**Graph 2 - Pesticide consumption in tons from 2013 to 2020.**



Source: IBAMA, 2021.

The jurisprudential research was carried out on the electronic platform (website) of the Justice Courts (Tribunal de Justiça), the Regional Labor Courts (Tribunais Regionais do Trabalho), and the Federal Regional Courts (Tribunais Regionais Federais), applying the terms “causal link” (“nexo causal”) and “pesticides” (“agrotóxicos”) in the search. A quantitative and qualitative analysis of the decisions was carried out regarding whether or not the causal link of the damage caused by pesticide contamination and its reasons were identified. For this, a spreadsheet was used to organize the following data into a table: state, court, case number, year of decision, proof or not of the causal link, reasons for not proving it, what suffered or could suffer contamination and, finally, if there was death.

In the labor justice case, it was found to be interesting to analyze the causal link for the granting or not of unhealthy hazard pay, a discussion that focuses on the type of worker exposure (eventual, continuous, or intermittent) and on proving due protection concerning these chemical agents, which occurs mainly through Personal Protective Equipment (PPE) and training. Finally, to instigate future research on the topic, the number of decisions that granted claims for compensation for moral damages due to degrading conditions in the workplace were counted.

The interviews were carried out with environmental expert technicians and a labor prosecutor. The entire procedure was approved by Plataforma Brasil (research ethics system), and the interviewees received and signed the Free and Informed Consent Form in the terms required by the platform. The question script is shown in Chart 1.

In total, four interviews were carried out, three with environmental experts and one with a labor prosecutor from Mato Grosso. Only the prosecutor chose to do the interview via video call and accepted the recording, while the others preferred to respond in writing. The experts have already worked in the states of Mato Grosso, Paraná, São Paulo, Rio Grande do Sul, Santa Catarina, Rio de Janeiro, Bahia, and Pará.

**Chart 1 – Interview script**

- a) Do you accept recording this interview?
- b) In which state(s) and justice instance do you act as an expert?
- c) What is your professional experience regarding the use of pesticides? What were the most common pesticides in contamination investigations?
- d) In your opinion, what factors are involved in deciding whether to use certain types of pesticides?
- e) In a context of suspicion about pesticide contamination, what would be the most appropriate possibility to investigate it?
- f) What is the most considerable difficulty in investigating pesticide contamination?
- g) How is the social and environmental impact of contamination measured?
- h) What are the challenges for accountability for damages caused by the inappropriate use of pesticides?
- i) To what extent can the Public Administration help investigate pesticide contamination?
- j) Considering this research topic, is there any other subject that you consider relevant to be discussed?
- k) Do you have recommendations of other people who would be interesting to interview?

**Source:** Authors, 2022.

## **Results and Discussion**

Firstly, it is clear that the discussion on the topic focuses on labor justice in the Brazilian justice system. Of the 161 decisions on contamination that were the basis of this research, 91 (56%) were in the Regional Labor Courts (Tribunais Regionais do Trabalho). In the common state court (Justiça Estadual Comum), there were 67 decisions (42%), and at the federal level, there were only three decisions (2%), all of them in the state of Paraná. Furthermore, data on the goods discussed, presented by the states, for all cases analyzed can be seen in Table 1.



**Table 1** - Percentage of assets affected in decisions by state studied.

State	Animals	Soil	Water	Crops	Health	Collective goods
MT	2,17%	0,00%	0,00%	8,69%	82,60%	23,91%
SP	7,35%	1,47%	0,00%	13,23%	73,52%	4,41%
PR	17,94%	2,56%	0,00%	20,51%	58,97%	10,25%
PE	0,00%	0,00%	0,00%	0,00%	100,00%	0,00%

**Source:** Data obtained during the research, 2023.

The lack of debate on the causal link in environmental damage (animals, soil, and water) is evident in Table 1, i.e., the judiciary has not discussed the topic and, therefore, has not been pacifying the jurisprudence in a more or less protective way. For example, in Pernambuco, the damage to any asset other than human health was not discussed, and in none of the states was water contamination the main object of an action. Therefore, environmental damage can have consequences that are often ignored at first glance, which also do not reach the judiciary system. Impacts such as fish reduction due to river water contamination affect the dynamics of riverside populations, that is, they harm not only the biological diversity but also the cultural diversity of the place (Gonçalves, 2012). Added to this is the relatively low number of decisions per year, demonstrating the slowness of justice or lack of demand from the judiciary, as shown in Table 2.

Among the health problems discussed in the labor court, the following stand out: cancer, impairment of the respiratory system, nervous system, and skin symptoms, as shown in Table 3.

**Table 2** - Number of decisions per year in each court and number of decisions per year in the Labor Courts regarding hazard pay

STATE	Court/ hazard pay	YEAR				
		2016	2017	2018	2019	2020
MT	TJMT	0	2	1	1	2
	TRT23	4	5	14	10	7
	HAZARD PAY	14	7	19	14	3
SP	TJSP	2	14	10	4	6
	TRT2	1	1	1	0	2
	TRT15	3	6	5	7	6
PR	HAZARD PAY	4	4	1	10	3
	TJPR	2	4	9	8	2
	TRT9	0	2	1	3	5
PE	TRF4	0	0	0	0	2
	HAZARD PAY	6	14	16		19
	TJPE	0	0	0	0	0
PE	TRT6	1	2	2	2	1
	HAZARD PAY	1	4	5	3	3

Note: TRT (Tribunal Regional do Trabalho - Regional Labour Court), TJ (Tribunal de Justiça – Justice Court).

Source: Data obtained during the research, 2023.

**Table 3** - Main diseases and symptoms in decisions by state

Disease/Symptom	State				Total
	MT	SP	PR	PE	
On skin	1	3	1	3	8
Cancer	3	6	2	0	11
Respiratory system	2	3	4	0	9
Nervous system	0	4	3	2	9
Among the respiratory and nervous system symptoms, the following stand out:					
Câncer de pulmão	1	1	2	0	4
Doença de Parkinson	0	1	1	2	4

Source: Data obtained during the research, 2023.

Cancer is the disease that most affected workers who sought justice in search of employer liability, with lung cancer being the most common one. Lung cancer was not included as a disease that affected the respiratory system, as there is a more specific category. However, it can be said that pathologies related to the respiratory system have a prominent place in this research. Psychiatric illnesses (2), kidney problems (3), and liver problems (2) were also addressed, in addition to decisions that only dealt with intoxication and cholinesterase testing<sup>1</sup>.

Among the 22 cases of human death that came to court, all in the labor sector, three had a proven causal link or concausality<sup>2</sup> with exposure to pesticides, one was a medical error that ended up not being relevant to the present research, and the other two were cancer cases (processes n. 0000933-46.2013.5.23.0003 and 1000904-11.2018.5.02.0254). It is worth noting that the contamination, nor the death, of fetuses, children and adolescents were not discussed in any case, which expresses the absence of this type of process in the Brazilian justice system, i.e., an unfeasible protection of these subjects that hold rights, but are incapable<sup>3</sup> in the face of the Brazilian judiciary system. In research carried out by Pignati *et al.* (2017), researchers analyzed the incidence of acute pesticide poisoning, fetal malformation, and mortality from childhood cancer, and they proved the relationship between the increase in pesticide consumption and these illnesses in Mato Grosso state. Furthermore, during the period from 2007 to 2014, more than 300 babies suffered from poisoning, an average of 42 babies per year (Bombardi, 2017).

Overall, an average of 53.6% of the cases that reached court considered the causal link in the decisions to be proven. Among the reasons for non-proof, as most of the decisions were related to human health, the highlight was the impossibility of relating exposure to the pesticide and to the disease developed, as can be seen in Table 4.

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<sup>1</sup> ” A valuable indicator of the relationship between exposure to pesticides and health problems is the level of the enzyme cholinesterase in the blood. The inhibition of cholinesterase through phosphorus compounds or carbamates causes the accumulation of acetylcholine, and the body begins to present a series of symptoms (muscarinic, nicotinic and central effects).” Available at: <http://www.ufrj.br/institutos/it/de/acidentes/vene4.htm>, accessed on March 5, 2024.

<sup>2</sup> Concauses are factors that trigger or worsen a disease, along with other pre-existing, concomitant or supervening factors. In this sense, contact with pesticides can be considered a cause along with other factors such as smoking, lifestyle, genetic predisposition, etc. The concause does not give rise to or interrupt the causal link, but reinforces it (Morsello, 2007).

<sup>3</sup> Article 3 of the Brazilian Civil Code.

**Table 4** - List of reasons for difficulty in proving the causal link by state

State	Drift	Delay in the assessment	Assessment was not done	Non-significant risk	Unable to link to diseases	Others
MT	8,33%	8,33%	8,33%	12,50%	50%	12,50%
SP	20,51%	5,12%	0%	7,69%	61,53%	12,82%
PR	26,66%	6,66%	6,66%	0%	53,33%	20%
PE	0,00%	0,00%	0,00%	0,00%	100%	0,00%

**Source:** Data obtained during the research, 2023.

Drift is also a recurring factor in decisions, especially in state courts, typical in cases of animal deaths and contamination of crops between neighboring properties. In the case of animal death, primarily cattle, drift, coupled with the delay in carrying out examination/assessment on the animal and the environment, makes it impossible to identify the pesticide on site and, if identified, for it to be associated with the factor causing the damage (Araújo, 2018).

Regarding this topic, all the experts interviewed stated that the ideal condition for investigating contamination is the immediate collection and analysis of material from the entire ecosystem that may have suffered damage. Samples must be collected and processed in less than 24 hours to prevent physical and/or chemical degradation. For example, if the death of bees is being analyzed, samples must be taken from the soil, water, surrounding vegetation, everything in the ecosystem, in addition to the bees themselves.

The interviewees also addressed the relevance of collecting all documentation on the pesticide most likely to have contaminated the environment, including invoice, agronomic prescription, and diagnosis of the technician responsible. The lack of material evidence of pesticide use can make it challenging to establish the causal link, hence the importance of documentary investigation. One of the interviewees stated that the assessment requires methods that detect substances in very low concentrations (trace concentrations - parts per billion or parts per trillion) and that few laboratories in Brazil are equipped for these analyses, which results in the issuance of reports that are not consistent with reality, as the analytical method does not detect the substance. Therefore, the lack of modern laboratories with adequate equipment for analysis is identified as the most significant limiting factor in the performance of examinations/assessments for courts.

Interviewees also raised the topic of fragilities in the public sector policies, such as the lack of inspection of prohibited pesticides and the permissibility concerning the quantity of pesticides tolerated in water, for example. One of the experts states that “These are new substances and the long-term effects of the presence of these molecules in our food and drinking water are unknown.” In this sense, when comparing the maximum residue limit allowed in drinking water, Bombardi (2017) reinforces his thesis about the disparity in the treatment of legislation on these products in different countries (Table 5). In the Atlas by Bombardi (2017), she also compares the residue allowed in food, which is in line with what was reported by the expert. Therefore, the permissibility and lack of urgency of this issue are manifested not only in the lack of laboratories and equipment for analysis but also in Brazilian legislation and regulation.

**Table 5** - Comparison between the maximum residue limit allowed in drinking water in Brazil and the European Union

Pesticide	European Union	Brazil	Additional quantity
Atrazine	0,1 µg/L	2 µg/L	20x
Acephate	0,1 µg/L	sem limite	---
Malathion	0,1 µg/L	sem limite	---
Carbofuran	0,1 µg/L	7 µg/L	70x
2,4-D	0,1 µg/L	30 µg/L	300x
Chlopyrifos	0,1 µg/L	30 µg/L	300x
Diuron	0,1 µg/L	90 µg/L	900x
Mancozeb	0,1 µg/L	180 µg/L	1800x
Tebuconazole	0,1 µg/L	180 µg/L	1800x
Glyphosate	0,1 µg/L	500 µg/L	5000x

**Source:** Bombardi, 2017.

When approached about the social impact of the intensive use of pesticides, the best way to assess it, indicated by the interviewees, was to quantify the incidence of diseases related to pesticide contamination, such as cancer. In liability for an illicit act, for example, if a company is not providing PPE or is not correctly storing the chemical

agent, it becomes easier to establish the causal link. The challenge is when the individual or community is sick and affected by chronic intoxication (Marques; Silva., 2021).

Regarding the use of individual protection equipment, the results of jurisprudential research add a lot to the debate. Many workers go to court for hazard work pay, that is, they discuss the potential risk of contamination by the agent. In total, 156 decisions discussed the additional payment, and as the results were very different in each state, an individual analysis is shown in Table 6.

**Table 6 - Percentage of proof of causal link for additional granting of hazard conditions by state**

State	Yes	No
MT	47,82%	52,18%
SP	42,64%	57,35%
PR	61,53%	38,46%
PE	62,50%	37,50%

**Source:** Data obtained during the research, 2023.

Most of the courts decided not to grant the additional amount, with the exception of the state of São Paulo, for the reasons set out in Table 7.

**Table 7 - Reasons for not granting the additional hazard pay due to exposure to pesticides**

	MT	SP	PR	PE
Occasional exposure	38,09%	25%	29,03%	0%
No direct exposure	19,04%	50%	3,22%	8,33%
Sealed packaging	19,04%	0%	3,22%	0%
Habitual but intermittent exposure	2,38%	0%	0%	0%
Agent not listed in NR15	2,38%	12,5%	6,45%	17%
Testimonial evidence	2,38%	0%	0%	0%
Assessment did not happen	2,38%	0%	10%	8,33%
Use of PPE	2,38%	12,5%	22,58%	25%
Other reasons	11,9%	0%	16,12%	41,66%

**Source:** Data obtained during the research, 2023.

Among the reasons presented, it is clear that possible exposure or lack of direct exposure with the products stands out, in addition to the fact that, regardless of the use or not of individual protection equipment or the potential for contamination of a pesticide, if it is not on the list of Regulatory Norm nº 15 (NR 15)<sup>4</sup>, the worker will not receive the additional payment. Regarding this, the expert who carried out the report for case 0000724-17.2019.5.09.0663 explained that:

NR 15, more specifically Annex 13, regarding activities with pesticides, is obsolete in relation to the constant innovations and modifications of pesticide compositions because, despite the pesticides sold undergoing several modifications in their formulations, they continue to be extremely harmful to human health and maintain their toxicological classifications.

On the other hand, in the expert report on case 0001755-44.2015.5.09.0071, another expert stated that:

If the toxic product, although **harmful to health**, does not contain the chemical agent listed in annexes 11 or 13 of NR-15 in its composition, there will be no right to unhealthy hazard pay. According to NR 15, annex 13, there is no link to unhealthy conditions in the activities carried out by the complainant, although he handled seeds that contained toxic products (highlighted).

Therefore, the Regulatory Standard can be applied strictly in court, leaving it to the expert judgment and, subsequently, the judge, to decide on compensation for the express violation of the worker's right to health and life. It is worth mentioning that among the pesticides not listed is Glyphosate, and the issue of products that are used illegally and, obviously, are not included in the NR 15 list, is not addressed.

The active ingredient Glyphosate, also known as Round-Up and Ranger Pro, has a prominent place within national agriculture, considering that the quantity sold of this product, around 241,000 tons, exceeds that of all others combined, that is, a this single active ingredient represents more than half of the tons used in Brazil (IBAMA, 2021).

In 2015, one of the World Health Organization's (WHO) cancer research groups, the International Agency for Research on Cancer (IARC), with the help of 17 experts from 11 countries, classified glyphosate as a “probable carcinogen” (IARC, 2015). Bayer,

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<sup>4</sup>Available at: <https://www.gov.br/trabalho-e-emprego/pt-br/aceso-a-informacao/participacao-social/conselhos-e-orgaos-colegiados/comissao-tripartite-partitaria-permanente/arquivos/normas-regulamentadoras/nr-15-atualizada-2022.pdf>, accessed on March 5th, 2024.

the company that owns Monsanto, the manufacturer of glyphosate, has around 18 thousand legal proceedings in the United States due to the proven causal link between the ingredient and the emergence of cancer. Of these cases, three resulted in the company's conviction, the most emblematic being that of Dewayne Johnson, in which, in August 2018, the company was ordered to pay almost 290 million dollars to the worker, victim of incurable lymphoma caused by Round products. Up and Ranger Pro on the school grounds where he worked for just two years, between 2012 and 2014 (Oliveira, 2019; Sandoval, 2019).

Glyphosate was under re-evaluation of its registry from 2008 until 2020, the year in which the National Health Surveillance Agency (ANVISA) decided to maintain it in Brazilian agriculture, even though there was a technical opinion prepared by the Brazilian Association of Public Health (ABRASCO), in 2019, for the ban of this pesticide. Furthermore, to make the situation even worse, a cycle of dependence on soybean crops is demonstrated, where the product is most used, since, with the increase in transgenic seedlings, plantations have shown increasing resistance to applications, i.e. they require increasingly greater quantities, characterizing a chemical-dependent model (Altieri, 2012; Carneiro, 2015; Pignati *et al.*, 2017).

Maintaining a system that goes beyond the ecological limitations of the environment makes its own existence unsustainable. Analyzing large-scale agriculture, it consists of: (1) the use of technology and (2) the expansion of the area of cultivated land, simplifying the various ecological processes that occur in a plantation free from these circumstances and, in this simplification, it is that dependence on external inputs is installed, which maintains the “dynamic balance” (Gonçalves, 2012; Spadotto, 2006).

The data demonstrate a national trend of maintaining and increasing the use of these products, which is driven by the developmental policy of exporting primary goods. Approximately 80% of the amount of pesticides used in Brazil in 2015 was for the cultivation of soybeans, sugar cane and corn. This policy has an impact from the environmental, nutritional, and occupational perspectives e, and proves to be of great economic interest (Pignati *et al.*, 2017).

The labor prosecutor interviewed explained that protection standards are not sufficient to guarantee workers' right to health. The supervisory part of its action, which consists of giving effectivity to existing mechanisms, such as Regulatory Standard 31



(NR 31), which establishes minimum duties for safety and health at work in agriculture, and provides a basis for routine action, such as storage inspection, equipment and uniform washing, is insufficient if it is not added to the preventive part of the prosecutor's office, which is related to promoting debate on the topic with civil society, other bodies and within the judiciary, to think collectively on this theme.

Regarding proof of PPE use, and here “use” is considered as the delivery of certified equipment throughout the exposure period, in addition to carrying out training in handling chemical substances effectively, it is noted that employers are not able to prove that they follow the appropriate protection standards to prevent workers from being poisoned by pesticides, as its shown in Table 8.

**Table 8 - Proof of the use of PPE in expert assessment reports**

State	Yes	No	n/a
MT	15,78%	73,68%	10,52%
SP	27,27%	72,72%	0,00%
PR	14,75%	70,49%	14,75%
PE	18,75%	37,50%	43,75%

**Source:** Data obtained during the research, 2023.

In a decision in case 0001031-06.2015.5.23.0021, the judge understood that despite there being suspicions, there was no evidence of a causal link between pesticide poisoning and work at the defendant company and that, even if there was a link in relation to illness, there is no demonstration of the employer's fault. The plaintiff's second witness stated that he wore full clothing to apply the poison, as well as glasses and a mask. However, the expert report stated that the defendant company did not attach the plaintiff's "Individual Protection Equipment Delivery Control Sheet" to the plaintiff's report.

This type of decision demonstrates that the personal perception of the judge(s) is a factor of great relevance in configuring the causal link, and he understood that the witness' version had greater weight than the lack of a delivery control form. of protective equipment. The value of scientific evidence and the inherent risk of the activity may be dangerously reduced.

It is worth noting that Precedent No. 289 of the Superior Labor Court (TST) stipulates that "the mere provision of protective equipment by the employer does not exempt him from paying the additional hazard pay. It is up to him to take measures that lead to the reduction or elimination of harmfulness, including those relating to the effective use of the equipment by the employee".

In the state of Mato Grosso, which has the highest rate of non-attestation, according to the 2017 agricultural census, 11,523 rural producers in the state do not know how to read and write, with 11,357 never attending school (IBGE, 2017). This makes it difficult, for example, to verify the veracity of the delivery of PPE made by employers since this is proven via the worker's signature, who can be induced to sign something without knowing the content. In this context, a total of 26 decisions condemned employers who failed to provide minimum conditions for their employees, who lived in degrading conditions, often without having an adequate place to eat, drink water, rest, and go to the bathroom. Among these, 15 were in the state of Mato Grosso.

Underreporting of contamination was a recurring point in bibliographical research. Throughout the research, several authors give an account of underreporting as an essential dysfunction that weakens the debate on the topic (Pignati *et al.*, 2017; Scardoelli *et al.*, 2011; Sobreira; Adissi, 2003).

In this scenario, contaminations do not appear in public data, and consequently, the problem of pesticide poisoning severity is attenuated. This lack of data and notifications prevents epidemiological mapping that would support the proof of causality. The prosecutor states that if the technical analysis of the causal link does not consider these factors, the chances of liability will be very restricted, especially in the case of chronic diseases, since, sometimes, not even the worker knows what they were exposed to or how long.

The Prosecutor talks about consolidating a more effective contamination notification system towards a more effective health surveillance through the Unified Health System (SUS). In this way, the SUS would be used not only to treat, but to bring a transversal look at the problem, trying to identify, quantify, and map illnesses, to understand the dimension of the issue. It is known that there is a relationship, that contamination is real. However, robust data on events depends on better management of

information and notification in the public administration, especially in the SUS, which is responsible for this surveillance.

It can be understood that having the correct data on contaminations (notifications) and expertise to analyze the suspicion, and in turn, the causal link itself, would be a way of having an epidemiological picture that provokes the State to change its parameters and establish protective measures to reduce the use of substances. A better characterized epidemiological picture in terms of notifications of contamination identification of the nexus by the health system (notification + investigation) provides the basis for better expert reports and, in turn, judicial and governmental decisions.

Regarding other actions taken by public authorities on the topic, several suggestions emerged throughout the interviews, including: implementing mandatory risk analysis during the investigation, strengthening prevention and precautionary principles, propaganda and education on the appropriate use of pesticides, and increased inspection of products from production to application.

These were the most “practical” responses based on existing legislation and organization. Solutions were also raised to change how legislation deals with the issue, reducing the quantities and active ingredients allowed, and strengthening public policies to reduce pesticide use. Law No. 7,802 of 1989 regulates the subject at the federal level, including experimentation, production, packaging and labeling, transportation, storage, marketing, commercial advertising, use, import, export, destination of waste and packages, registration, classification, control, inspection and surveillance of pesticides, their components and the like, in conjunction with Decree N. 4,074, of 2002.

The Law mentioned above was considered a significant advance in the control of substances, and it prohibits, in art. 3rd, §6th, the registration of products that reveal teratogenic, carcinogenic, or mutagenic characteristics that may cause defects in the unborn child, hormonal disorders, and whose characteristics cause damage to the environment. However, contrary to greater legislative rigor, there was, at the time and to date, no investment in material and human resources so that this law could be effective in supervising and controlling the registration of pesticides, i.e., an investment in equipment, train, and finance research and inspection teams, which would also strengthen the database regarding contamination (Pelaez *et al.*, 2015; Sobreira; Adissi, 2003). From the

above, the gap from legislation is evident, considered by many to be permissive, but which, even in its rigor, lacks effectiveness in practical reality.

Government incentives for the use of pesticides have been in place since 1950 when the products became popular and disseminated through the Green Revolution after the Second World War (Lucchesi, 2005). Pelaez *et al.* (2015) explains that this political movement took place in two ways: the first is the reduction of costs through tax exemptions, and the second is the rural credit lines that have emerged since then.

Cunha and Soares (2020) carried out a detailed study that presents the current federal and state incentives, and even demonstrates the loss of monetary revenue suffered by the country due to this choice, and how this influences the preference of the conventional agriculture method over organic agriculture, for example.

The Green Revolution and the form that agricultural production took thereafter demonstrates that, as Nancy Fraser (2020) points out, it is much more than an economic system, since it represents an institutionalized social order. Thus, essentially non-economic actions, such as the organized apparatus of public power (incentive policies and laws) and the strengthening institutions that maintain the balance between humans and nature, are essential for its maintenance.

## **Final Considerations**

From the disparity in the data available on the tons consumed, addressed in the introduction, to the exemption from taxes on these products to the detriment of the lack of investment in pesticide inspection and registration mechanisms and forensic laboratories, to the underreporting of cases of contamination in the health service, the system seems purposely flawed, hampering the perception of reality and preventing a robust scientific basis for decision-making, both in the judicial, political and administrative spheres.

It is clear that this issue cannot, like many other topics, depend solely on the judiciary for its advancement, as this is little actioned in comparison to the complexity and size of the problem in Brazil. Processes that would be fundamental, such as the protection of the environment, fetuses, children and adolescents, are hidden and debated

only in academic research, which, in turn, does not seem to demonstrate the strength to influence legislative decisions and policies to reduce the use of these substances.

The solutions are joint technical and social initiatives that, while strengthening the public sector through a review of permitted active ingredients and permitted quantities, also improve supervision, investment in laboratories, research and a monitoring network for notifications in the SUS. In addition to public policies that promote more sustainable agriculture, debate and social awareness are essential. As Fisher (2020) puts it, it is necessary to separate the real from reality and, thus, expose the inconsistencies of apparent reality. The environmental crisis, greatly amplified by agribusiness, is one of the many flaws in the reality of the current system. The debate about reducing the use of pesticides always raises the question: How can we feed the entire population?

Approximately 800 million people worldwide suffered from food insecurity in 2021 (FAO, 2021). Feeding everyone, an argument used to maintain this agricultural system based on short-term profit for large multinationals that supply agricultural implements (Meyer, 2022) is so far from the existing situation that it seems naive to imagine its possibility, while the impact on ecosystems and exposure of workers and rural populations to contamination follow in step with the strategies implemented aiming at greater productivity.

Replacing the aforementioned question with other questions changes the already ingrained perception of many. Productivity of what? For whom? How do so many people go hungry if the production area and use of agrochemicals increase every year? Who benefits from the technological advances of the Green Revolution? Who suffers the social and environmental losses?

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