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TAMING THE "FOREVER CHEMICALS": PFAS GOVERNANCE IN THE NETHERLANDS AS A WICKED PROBLEM

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ABSTRAK

Penelitian ini bertujuan menjelaskan peran dan pengaruh aktor dalam tiga domain kelembagaan yaitu pemerintah (negara), sektor industri, dan masyarakat sipil dalam tata Kelola per- and polyfluoroalkyl substances (PFAS) di Belanda. Pendekatan penelitian bersifat kualitatif dengan studi kasus tata kelola PFAS di Belanda. Data dikumpulkan melalui studi pustaka komprehensif atas kebijakan, laporan ilmiah, dan sumber sekunder terkait PFAS. Analisis data dilakukan dengan pendekatan analisis kelembagaan serta analisis konten kualitatif untuk menelaah sejarah kebijakan, interaksi aktor, serta dinamika kepentingan dalam isu PFAS. Akurasi data diuji melalui triangulasi sumber dan verifikasi silang dengan data resmi untuk memastikan konsistensi informasi. Hasil penelitian menunjukan bahwa Pemerintah Belanda telah mengeluarkan regulasi terkait PFAS, termasuk mengklasifikasikannya sebagai bahan kimia berbahaya dalam kerangka undang-undang lingkungan. Namun, implementasi kebijakan tersebut terhambat oleh fragmentasi kebijakan dan kurangnya harmonisasi dengan regulasi Uni Eropa, yang berdampak langsung pada ketidakpastian investasi, pengelolaan lingkungan, serta perencanaan tata ruang di tingkat regional dan lokal. Sektor industri mempertahankan kepentingan ekonominya melalui lobi dan narasi "penggunaan esensial", sehingga melemahkan upaya penegakan regulasi. Meski demikian, tekanan publik mendorong industri mulai berinovasi untuk mengurangi ketergantungan terhadap PFAS. Masyarakat sipil (misalnya LSM lingkungan dan akademisi) berperan penting dalam advokasi, litigasi lingkungan, dan riset independen guna meningkatkan transparansi dan akuntabilitas pemerintah maupun industri. Kesimpulannya, diperlukan kerja sama lintas sektor dalam kerangka tata kelola bersama (co-governance) untuk mengatasi permasalahan PFAS secara efektif. Kolaborasi erat antara pemerintah, industri, dan masyarakat sipil akan meningkatkan transparansi, akuntabilitas, serta penyelarasan kepentingan publik, ekonomi, dan lingkungan.

Kata Kunci: PFAS, Perspektif Kelembagaan, Tata Kelola

ABSTRACT

This research aims to explain the role and influence of actors in three institutional domains, namely government (state), the industrial sector, and civil society, in the governance of per- and polyfluoroalkyl substances (PFAS) in the Netherlands. The research adopts a qualitative approach using a case study of PFAS governance in the Netherlands. Data were collected through a comprehensive review of policies, scientific reports, and secondary sources related to PFAS. Data analysis employed an institutional analysis framework combined with qualitative content analysis to examine policy histories, actor interactions, and the dynamics of competing interests surrounding PFAS governance. Data accuracy was ensured through source triangulation and cross-verification with official data. Research results show that the Dutch government has enacted regulations addressing PFAS, including their classification as

hazardous chemicals within the framework of environmental law. However, policy implementation is constrained by regulatory fragmentation and insufficient harmonization with European Union regulations, which have had direct regional and local impacts, particularly by creating uncertainty in environmental management, investment decisions, and spatial planning processes. The industrial sector maintains its economic interests through lobbying and the narrative of "essential use," thereby weakening regulatory enforcement. Nevertheless, public pressure has encouraged industries to initiate innovation aimed at reducing reliance on PFAS. Civil society actors (such as environmental NGOs and academic institutions) play a crucial role in advocacy, environmental litigation, and independent research to enhance transparency and accountability within both government and industry. In conclusion, effective governance of PFAS requires cross-sectoral collaboration within a co-governance framework. Close cooperation among government, industry, and civil society can enhance transparency, accountability, and the alignment of public, economic, and environmental interests.

Keywords: PFAS, Institutional Perspectives, Governance

INTRODUCTION

Per- and polyfluoroalkyl substances (PFAS) have emerged over the past decade as one of the most pressing environmental and public health challenges worldwide. Classified as highly persistent "forever chemicals," PFAS are resistant to natural degradation and accumulate in ecosystems and the human body over long time horizons (Cousins et al., 2020; Sunderland et al., 2019). Recent studies have linked PFAS exposure to serious health outcomes, including cancer, hormonal disruption, immune system impairment, and reproductive disorders, prompting increased regulatory attention across Europe and North America (Renfrew & Pearson, 2021; Mišľanová & Valachovičová, 2025). As scientific evidence has expanded, PFAS have shifted from being perceived as an isolated toxicological concern to a systemic challenge of environmental governance requiring coordinated institutional responses.

Current research increasingly frames PFAS contamination as a *wicked problem*, characterized by scientific uncertainty, long-term impacts, institutional fragmentation, and deeply entrenched economic interests (Alford & Head, 2017; Renfrew & Pearson, 2021). Unlike conventional pollution issues, PFAS governance is complicated by the sheer number of compounds, their functional substitutability, and the phenomenon of "regrettable substitutions," whereby regulated PFAS are replaced by chemically similar alternatives with comparable hazards (Cousins et al., 2020). As a result, regulatory efforts often lag behind industrial innovation, creating a persistent cycle in which contamination continues despite successive policy interventions. Recent governance literature highlights that such dynamics cannot be addressed

through linear regulatory instruments alone, but rather require integrative, cross-sectoral governance arrangements (Steurer, 2013; Chaffin & Gunderson, 2016).

In the Netherlands, the PFAS issue has evolved into a particularly acute and multidimensional problem with tangible regional and local consequences. The country's dense spatial structure, reliance on river systems shared with neighboring states, and historical presence of chemical industries (such as DuPont/Chemours and 3M) have intensified both exposure risks and governance complexity. Importantly, the PFAS dilemma does not only concern the balance between environmental protection and public health; it also has direct implications for regional development and spatial planning. In municipalities and regions that depend economically on the chemical sector, an abrupt or poorly coordinated PFAS ban, introduced without a clear transition strategy, could undermine local employment and long-term economic sustainability. Conversely, regulatory inaction or delay perpetuates environmental degradation and public health risks, particularly in downstream regions affected by transboundary pollution. This tension illustrates how PFAS governance creates a policy dilemma extending well beyond the environmental domain, directly intersecting with regional planning, infrastructure investment, and territorial development strategies.

Several interrelated root causes underpin the persistence of the PFAS problem in the Netherlands. From a regulatory and spatial planning perspective, the absence of harmonized European Union standards, until very recently, for PFAS thresholds in soil and groundwater has created significant governance uncertainty at the national and regional levels (European Environment Agency, 2024). Local governments and spatial planners have faced difficulties in translating evolving PFAS norms into zoning regulations, land-use designations, and construction permit requirements. Unclear and frequently changing threshold values complicate decisions on residential development, infrastructure projects, and soil remediation, leading to delays in regional infrastructure investment and uncertainty for both public authorities and private developers. In several regions, PFOS concentrations in soil and water bodies remain far above advisory levels, yet planning authorities lack robust legal certainty to impose consistent spatial restrictions or development moratoria.

Social factors further exacerbate the problem. PFAS contamination is often

invisible, and for many years, public awareness and risk communication were limited. Only recently have biomonitoring studies revealed that PFAS levels in the blood of residents living near industrial sites exceed health-based guidance values (Rijksinstituut voor Volksgezondheid en Milieu, 2025). This delayed disclosure reflects longstanding shortcomings in transparency and risk communication by both government agencies and industries, undermining public trust. Economically, PFAS are widely used due to their functional efficiency and relatively low production costs, making industries reluctant to adopt safer alternatives despite growing evidence of harm (Renfrew & Pearson, 2021). Finally, from an environmental perspective, the extreme persistence of PFAS ensures that historical contamination continues to affect groundwater, river systems, and food chains for decades, even if current emissions were halted immediately (Sunderland et al., 2019).

These regulatory, social, economic, and environmental dimensions are tightly interwoven and further complicated by fragmented institutional coordination among the state, market, and civil society. Misalignments between Dutch national regulations and European Union frameworks limit the effectiveness of local and regional policy instruments, particularly in managing transboundary pollution and regional spatial development. At the same time, industrial lobbying and legal complexities slow regulatory enforcement, while civil society engagement in formal policymaking processes remains largely reactive rather than institutionalized. Consequently, PFAS governance in the Netherlands is not only a matter of technical regulation, but also a challenge of integrating environmental policy with spatial planning, regional economic transition, and long-term territorial governance. Figure 1 presents a conceptual schema synthesizing the multiple and interrelated drivers of the PFAS problem in the Netherlands, illustrating how regulatory gaps, industrial dependency, limited public awareness, and the persistent nature of PFAS jointly contribute to health risks and governance complexity. Figure 1 presents a conceptual schema synthesizing the multiple and interrelated drivers of the PFAS problem in the Netherlands, illustrating how regulatory gaps, industrial dependency, limited public awareness, and the persistent nature of PFAS jointly contribute to health risks and governance complexity.

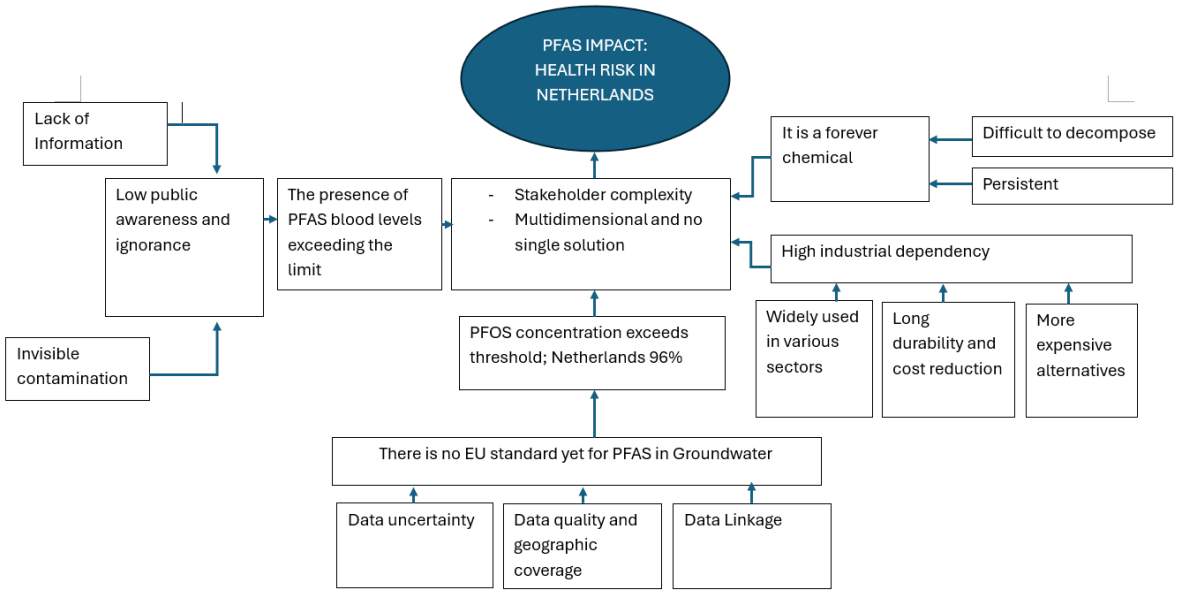


Figure 1. Schematic of the PFAS problem as a multi-faceted wicked problem in the Netherlands. Multiple interrelated factors complicate PFAS management (inspired by data from the European Environmental Agency, RIVM, Renfrew & Pearson (2021, Cousins et al. (2020), Sunderland et al. (2019)).

Despite a rapidly growing body of literature on PFAS toxicity and environmental pathways, a clear research gap remains in understanding *how institutional interactions among state, market, and civil society shape the effectiveness of PFAS governance*, particularly in relation to regional planning and spatial decision-making processes. Existing studies tend to focus either on chemical risk assessment or on regulatory instruments in isolation, offering limited insight into the cross-sectoral governance dynamics that produce policy fragmentation and delays in implementation. This study addresses that gap by applying a three-sphere governance framework to analyze PFAS governance as an institutional wicked problem, thereby offering an integrative perspective that links environmental regulation, economic interests, and spatial planning implications.

Accordingly, this research aims to analyze how interactions among the state, the market, and civil society shape PFAS governance in the Netherlands and to identify governance arrangements that are capable of addressing both environmental risks and regional development concerns. The research seeks to answer the following question: *Which form of integration among state, market, and civil society institutions is most appropriate for addressing the PFAS problem in the Netherlands in a way that supports effective environmental governance and sustainable regional*

planning? By doing so, the study contributes both empirically and conceptually to debates on wicked problems, environmental governance, and spatial planning under conditions of regulatory uncertainty.

RESEARCH METHODOLOGY

This research employs a qualitative case study approach focusing on the PFAS contamination case in the Netherlands. This approach was chosen due to the contextual characteristics of the PFAS wicked problem and the need for an in-depth understanding of local dynamics, particularly because PFAS governance outcomes vary substantially across regions depending on industrial structure, regulatory capacity, and spatial planning practices. A case study approach enables the integration of environmental, regulatory, and regional planning perspectives within a single analytical framework. Data were collected through a review of scientific reports, government policies, investigative news articles, and documentaries related to PFAS in the Netherlands. To strengthen the regional dimension of the analysis, sources also include reports and datasets produced by regional authorities, water boards, and public health institutions (such as RIVM, provincial governments, and river basin authorities), which document spatial variation in PFAS exposure and regulatory responses. One of the primary sources of analysis consists of the historical tracing of the PFAS case (a timeline of key events) and an institutional analysis from a governance perspective.

In analysing PFAS governance, this study draws on the three-sphere governance framework: state, market, and civil society, as articulated by Steurer (2013). This framework categorizes actors and governance mechanisms into three domains: the state (including government and regulators), the market (market actors or industry), and civil society (such as NGOs, communities, and media. Each sphere has distinct modes of operation and regulatory instruments; for example, the state operates through hard regulation and incentives, the market through business self-regulation, and civil society through oversight, advocacy, and partnerships. To understand the interactions among these spheres, the author employs Steurer's conceptual three-circle model with overlapping spheres (Figure 2). This model helps identify points of intersection where collaboration or conflict among actors may occur, such as through co-regulation schemes, public–private partnerships, or public pressure, and allows these interactions to be analysed spatially across national and regional governance levels.

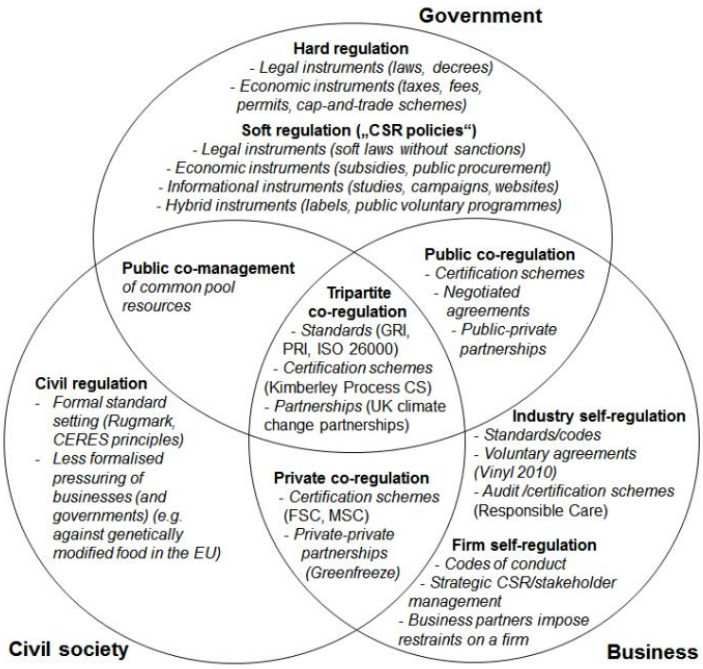


Figure 2. Three-sphere governance model (state, market, civil society) and the forms of interaction/regulation among them, adapted from Steurer (2013). The overlapping circles indicate co-regulation and co-management mechanisms (e.g., tripartite partnerships, joint regulation, corporate social responsibility, etc.) that involve more than one sphere.

The analysis proceeds in several stages. First, a historical timeline of the PFAS case in the Netherlands is constructed to map the evolution of contamination, public awareness, corporate responses, and policy measures over time. This timeline is distilled from various secondary sources, including environmental investigative journalism (for example, Zembla documentaries) and policy archives. Second, an institutional analysis is conducted by mapping key actors across the three governance spheres along with their respective roles and interests, with particular attention to regional and local authorities involved in spatial planning, permitting, and environmental monitoring. Third, coordination challenges and policy gaps across these spheres are identified, such as regulatory misalignments between national and supranational levels or limitations in public participation in decision-making processes that affect regional development outcomes. Finally, the study formulates integrated solutions and policy reflections that can be adopted both for the Dutch context and as lessons for other regions.

This case study approach enables a thick description, allowing for an in-depth explanation of why the PFAS problem remains persistent in modern society by

probing the interlinkages among scientific, economic, institutional, and spatial planning factors. The analysis is expected to yield insights into more effective environmental governance strategies for addressing persistent pollutants such as PFAS, particularly through cross-sectoral collaboration across national and regional scales.

RESULT

PFAS Case Timeline in the Netherlands

As an initial step, a timeline of the PFAS case in the Netherlands was compiled, covering developments from the earliest uses to the present situation. Table 1 presents a summary of the historical timeline of PFAS in the Netherlands, together with the involvement of major chemical companies. This timeline shows that the problem has been entrenched for decades and has continued as a result of slow regulatory responses and insufficient mitigation measures.

In addition to national and European authorities, Dutch local and regional governments possess specific statutory powers that enable them to act on PFAS contamination even while EU-level decisions are still pending. Provinces and municipalities are legally authorized to impose precautionary restrictions through spatial planning instruments, including zoning plans (*bestemmingsplannen*), environmental permits (*omgevingsvergunningen*), and soil management decisions under the Wet bodembescherming and, more recently, the Omgevingswet. These powers allow local authorities to restrict land use, delay construction permits, or require additional soil investigations and remediation in areas suspected of PFAS contamination. Water boards (waterschappen) also play a crucial role through their authority to monitor surface and groundwater quality and to issue operational measures related to water abstraction, dredging, and discharge activities. As a result, local governments are not entirely dependent on EU-level harmonization, but can adopt interim and precautionary measures to protect public health and manage spatial development risks at the regional scale.

Table 1. Timeline of the PFAS case in the Netherlands (1960s to 2025). It shows the prolonged period of pollution by companies (3M, DuPont/Chemours, etc.), health-impact research that was kept confidential, the emergence of new regulations, and recent legal actions

Decade	What happened?
The 1960's	3M opens up several chemical sites in the Netherlands and Belgium. DuPont starts buying PFOA from 3M to create Teflon. They also opened a factory in the Netherlands. The arrival of the factories was widely appreciated, as this created many job opportunities in the area. At the same time, both 3M and DuPont started doing research on the impact of PFAS on human health. Research included doing animal testing on rats. Despite these concerns, DuPont began disposing of chemical waste into the ocean, contaminating ocean currents with forever chemicals.
The 1970's	Further research on the health impacts was conducted by 3M – this time, they studied the effects on apes (demonstrating they were concerned about human risks). Results were never published, nor were authorities informed due to an internal cover-up culture.
The 1980's	The companies continue to investigate the effects on human health. Concerns are raised about the possible consequences for fertile women and their fetuses, which led to a temporary ban on women in the Teflon production line. Furthermore, DuPont is aware of its accountability – although it continues to prioritise profits over human health and the environment. They continue to claim that their Teflon products are safe and harmless.
The 1990's	Another company (Custom Powders) sets up shop in the Netherlands, and they supply dried Teflon to companies such as DuPont. Custom Powders disposed of their PFAS waste directly into the air and sewers, resulting in chemical pollution. DuPont discovers that groundwater around their factories contains alarmingly high levels of PFOA; they also conclude that the control of water pollution is an enormous struggle. This once again strengthens the accountability concerns. Another worry for DuPont is the contamination of the landfills where they dispose of waste, but they decide not to investigate this, as the results could mean they would have to take further action to solve the problem (which could lead to financial losses). 3M researches the correlation between PFAS and prostate cancer, but they decide not to publish the results. A PhD candidate who was involved in the research published some results independently.
The 2000's	Academic institutions such as Wageningen University & Research, Utrecht University, VU Amsterdam, and Antwerp University conduct their own research on PFAS contamination in the Westerschelde and the vicinity of the chemical companies. Even though these results were published, Dutch and Belgian authorities failed to take any action.

	DuPont also investigates the PFOA concentration in the blood of employees of Custom Powders; their levels are extremely high. Still, the company insists there are no harmful effects known.
The 2010's	New Dutch legislation bans the use of C-8 substances, so DuPont switches to another forever chemical called 'GenX' (GenX is just as harmful to the environment and human health). Moreover, the public awareness of the dangers of forever chemicals is becoming more and more well-known. Leading to several investigations on PFAS concentration in humans and the environment, conducted by the RIVM (National Institute for Public Health and the Environment) and Dutch water authorities of Rivierenland. In anticipation of this movement, DuPont decided to split the company into a separate Dutch division (Chemours Netherlands B.V.). This is one of their tactics to create a complex legal structure to slow down the juridical processes.
2020 - 2025	It is exposed that water in the Westerschelde contains extremely high PFOS levels (a forever chemical primarily used by 3M). Consequently, 3M is prohibited from letting its PFOS waste go down the drain. Meanwhile, chemical disposal company Indaver is supplied with chemical waste produced by Chemours and 3M; the company claims to dispose of this in a safe way. Later on, it becomes clear they emit their waste in the water and air, which could be an explanation as to why the PFAS levels remained the same in the Westerschelde (even after 3M was substituted to regulation). After pressure from the Dutch government, Belgian authorities imposed regulations on Chemours, which prohibit them from sending waste to Indaver. After decades of pollution, authorities start to take (legal) action against the chemical companies. For instance, two lawsuits against 3M and DuPont with a verdict that holds them accountable for the contamination of the Westerschelde (De Rechtspraak, 2023). In response to a class action police report, Dutch authorities have even started a criminal investigation into the environmental damages caused by DuPont/Chemours (Ficq, 2023). On the EU scale, there is also more regulation. For example, the EFSA (European Food Safety Authority) imposed stricter PFAS norms, and the ECHA (European Chemicals Agency) advocated for an overall ban on PFAS (RIVM, n.d.). Recently, an agreement was reached on much stricter regulations for chemicals, which involves creating new laws and norms (Belga/ThD, 2025).

Sources: Distilled from various reports, including Zembla documentaries 2022–2025, RIVM, and court rulings.)

From the timeline above, several key milestones can be outlined: In the 1960s, 3M established factories in the Netherlands (Amersfoort, Kerkrade) and Belgium (Zwijndrecht), while DuPont began producing Teflon using PFOA

supplied by 3M. Although there were internal concerns from the outset about the dangers of PFOA, the companies did not report them to the authorities (Mansell & Samsom, 2025). DuPont even covertly discharged PFOA waste into rivers, contaminating waters that flow to the Westerschelde estuary. In the 1970s, 3M's internal animal studies showed PFOA toxicity (test monkeys died after 20 days), but the findings were concealed and not published (Mansell & Samsom, 2025). DuPont continued using PFOA in its products, though it briefly prohibited women of reproductive age from direct exposure on the production line due to concerns about pregnancy effects. In the 1980s, both companies continued researching PFAS health impacts, but primarily to assess their legal liability rather than to protect the public. The cover-up culture persisted; for example, a 1979 internal DuPont memo stated that risk information should be shared only on a limited basis ("only tell those who need to know"). In the 1990s, a new industrial actor emerged: Custom Powders in the Netherlands, which dried Teflon powder for DuPont but directly released PFAS waste into the air and drains. During this decade, DuPont discovered that groundwater around its plant was highly contaminated with PFOA and grew concerned about its liability, yet still took no meaningful action other than avoiding further investigations that could harm the business. In the early 2000s, academics (Wageningen UR, Universiteit Antwerpen, etc.) began studying PFAS contamination in the Westerschelde; the results were published, but Dutch–Belgian authorities were slow to act. DuPont found extremely high PFOA levels in the blood of Custom Powders employees, yet publicly insisted that there were "no known harmful effects." In the 2010s, the Dutch government finally issued the first regulation: banning the C-8 compound (PFOA) in 2012, prompting DuPont to switch to GenX (a replacement PFAS compound that also proved hazardous). Public awareness increased in line with several investigations by RIVM and water authorities into PFAS levels in humans and the environment. Anticipating lawsuits, DuPont spun off Chemours (a new entity in Dordrecht) to separate legal liabilities on paper.

Entering the 2020s, the PFAS issue rose to the national agenda. The Netherlands, together with Germany, Sweden, Denmark, and Norway, initiated a proposal to ban PFAS entirely in the European Union (European Chemicals Agency, 2025). Meanwhile, it emerged that water at the Westerschelde estuary contained very high

PFOS concentrations due to 3M's waste in Belgium. Investigative reports revealed that the Belgian waste-processing company Indaver had continued discharging PFAS-contaminated effluent into the River Scheldt despite ongoing legal disputes over its permit, enabling transboundary pollution to reach the Western Scheldt estuary in the Netherlands (Belga News Agency, 2022; Indaver, 2023). In response to growing public pressure, Flemish regulators tightened permit conditions, and Indaver significantly reduced its intake of PFAS-bearing waste by early 2024 (Indaver, 2024). These developments catalyzed broader accountability mechanisms: Dutch residents and environmental groups filed mass claims against Chemours and DuPont for long-term PFAS emissions from the Dordrecht plant (Scott, 2023), while the Rotterdam District Court's 2023 ruling established Chemours' liability for unlawful PFOA discharges between 1984 and 1998 (Reuters, 2023). Parallel legal initiatives emerged in Belgium, where fishing-sector organizations sought to hold 3M accountable for the ecological and economic impacts of PFAS contamination in the Scheldt (Mc Bride, 2023). Simultaneously, policy debates intensified as experts, water authorities, and NGOs urged the Dutch government to implement a national PFAS ban without waiting for final EU-level decisions. Their 2024 *noodkreet* underscored the urgency of immediate regulatory intervention to mitigate ongoing exposure to "forever chemicals" (ANP, 2024). This growing pressure prompted national authorities to consider unilateral measures, reflecting a shift toward more assertive governance in response to regulatory fragmentation, cross-border pollution dynamics, and the limitations of existing EU procedures for chemical control.

The timeline above underscores that for decades chemical companies have known about the dangers of PFAS but failed to take preventive action, and even tended to conceal information for economic gain. As a result, regulation has consistently lagged behind the pace of contamination. Authorities have acted only after evidence of health impacts came to light and public pressure mounted. As of 2025, the European Union is still finalizing a broad PFAS ban, while contamination continues. This raises the question: why, after decades of research and regulatory initiatives, have PFAS mitigation efforts not yielded effective results? The findings of this case study indicate that the answer lies in the institutional dynamics among the actors.

Key Actors and Policies Related to PFAS

Key actors in PFAS governance in the Netherlands can be mapped into three main groups (state, market, civil society) in line with Steurer's framework. In the state sphere, important actors include the national government (in particular, the Ministry of Infrastructure and Water Management, IenW), institutions such as RIVM (the Dutch National Institute for Public Health and the Environment), the EU food authority (EFSA), local governments (the Province of South Holland and the Municipality of Dordrecht in the Chemours case), water boards (regional bodies that monitor water quality), and the European Union. They are responsible for establishing regulations, environmental standards, and law enforcement to protect the environment and public health. On the market side, the main actors are the chemical industry: multinationals such as DuPont/Chemours and 3M, as well as chemical waste processors like Indaver and suppliers such as Custom Powders. These industrial actors produce and use PFAS compounds, so their compliance and initiatives are crucial to the success of policy. Finally, in the civil society sphere, actors include universities and researchers (who generate independent scientific data), environmental NGOs (e.g., Greenpeace, Stichting Stop PFAS), affected community groups, and the media. They play roles in monitoring, advocating for transparency, and pressuring government and industry to be accountable.

Each of these actor groups has different, and sometimes conflicting, interests and rationalities. The government seeks to fulfill its responsibility to protect the public and the environment, but is also burdened with maintaining an investment-friendly climate and complying with EU rules. Industry focuses on profitability and business stability, and thus tends to resist policies that could increase costs or disrupt operations. Civil society, meanwhile, demands the right to a clean environment and transparent information. Tensions arise, for example, when the Dutch national government intends to implement PFAS regulations that are stricter than those of the EU—industry protests due to concerns about high costs and loss of competitiveness if rules are not aligned at the European level. On the other hand, the public presses the government to act more swiftly to protect the local environment, such as calls from water boards for the Netherlands to ban PFAS before 2026. The government finds itself pulled between these forces and often opts for compromises that leave both sides dissatisfied. For instance, the government

issued transitional provisions (overgangsrecht) so that new PFAS requirements in the Omgevingswet would not immediately halt industrial activity, but instead be phased in. However, this compromise is viewed by NGOs as too slow, while industry still regards it as a threat.

The development of PFAS policy and regulation in the Netherlands can be summarized as follows. Prior to the 2010s, there were virtually no PFAS-specific regulations; only general rules such as the Wet bodembescherming (Wbb) on the obligation to prevent soil contamination (Zorgplicht). In 2012, the government banned the use of C8 (PFOA) after evidence of health risks emerged. This pushed the industry to transition to GenX. In 2017–2018, the Chemours GenX contamination case came to the fore, triggering temporary restrictions and further studies by RIVM. Toward 2020, the Ministry of IenW announced a national PFAS restriction project to map PFAS exposure and identify mitigation measures. The government also set rules requiring companies working with PFAS (for example, in the soil dredging sector) to minimize the use and release of PFAS, especially as PFAS had been added to the list of Substances of Very High Concern (SVHC). In 2020, the Netherlands, together with several EU countries, drafted a proposal for an EU-wide PFAS ban, an important initiative given the ease with which PFAS cross borders, as in the River Scheldt case. In 2022, the European Union began banning certain PFAS in food contact materials. In 2023–2024, legal pressure mounted: a coalition of 11 environmental organizations sued the Dutch government (the Ministry of IenW) for allegedly failing to protect citizens from PFAS. In October 2023, a Dutch court granted a class action brought by residents against Chemours concerning PFOA, and the government announced plans to accelerate a national PFAS ban. Even so, by the end of 2025, a comprehensive EU-level PFAS ban had not yet been formally enacted.

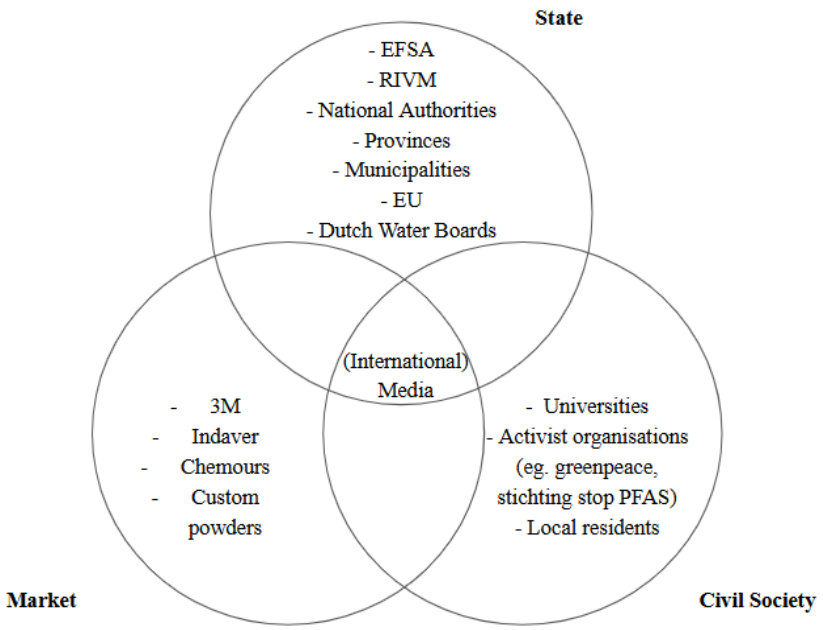


Figure 3. Mapping of PFAS actors in the Netherlands across the three governance spheres (state, market, civil society). The government (State) spans national authorities up to the EU; the market sphere comprises major chemical companies; and civil society includes universities, NGOs, and local residents. The media (including international outlets) sit in the middle as a conduit for information and public opinion.

The constellation of actors and PFAS policies in the Netherlands can be visualized in Figure 3, which maps the three "circles" (State, Market, Civil Society) along with example actors within them and the role of the media as a connector. This figure illustrates the sheer number of stakeholders involved, making coordination challenging.

DISCUSSION

The above analysis confirms that the persistence of the PFAS problem in the Netherlands is not merely a technical matter, but reflects institutional gaps in governance. There are several main discussion points regarding actor interactions and governance constraints on PFAS. The findings of this study are consistent with previous research by Alford and Head (2017) and Cordner et al. (2021), who argue that wicked environmental problems are often sustained by deep-seated conflicts of interest between regulatory authorities and powerful economic actors. The PFAS case clearly demonstrates the tug-of-war between the government's goal of protecting the public and the environment and the economic interests of industry. On the one hand, the Dutch government seeks to implement strict environmental

standards (for example, labeling PFAS as SVHC and promoting an EU ban). On the other hand, it faces strong lobbying by chemical companies that seek to delay or soften regulation (Colley & Neill, 2025; Calatayud et al., 2025). Industry emphasizes potential economic losses, high transition costs, and threats to employment if PFAS are suddenly banned outright. The result is that policy often becomes a compromise and proceeds slowly.

For example, although the Netherlands is among the pioneers of the EU PFAS ban proposal, critics argue that the government should have acted more decisively at the national level without waiting for EU consensus. Power asymmetries are also evident: multinationals such as Chemours have the resources to influence political decisions, even restructuring (creating new entities) to complicate legal enforcement against them. This illustrates the state's limited capacity to regulate global corporations in the context of hazardous chemicals, a pattern also observed in other cases of chemical governance in Europe (Bernauer & Betzold, 2012).

The findings of this study align with recent research showing that inconsistencies between supranational and national priorities frequently generate regulatory delays and fragmented implementation in EU environmental governance systems (Nagel & Laguna, 2022; Hanke et al., 2024). Within the PFAS context, the Netherlands is bound by EU-wide chemical regulations, which in principle facilitate coordinated transboundary action, as seen in the joint proposal for an EU PFAS restriction. However, differing levels of perceived urgency among member states hinder collective decision-making: countries facing higher contamination pressures, such as the Netherlands, tend to push for accelerated regulation, while others favor slower negotiation processes. Such temporal misalignment creates windows for implementation lag during which PFAS contamination continues. The Indaver case on the Belgium–Netherlands border illustrates how firms can take advantage of regulatory asymmetries across jurisdictions. These dynamics reinforce broader evidence that multi-level governance structures often struggle to achieve coherent environmental policy outcomes when problem pressure varies across political levels.

Weak transparency and accountability, and the role of civil society. The findings of this research are consistent with recent work on corporate influence and environmental governance, which shows

how strategic control over scientific information can delay regulation and narrow opportunities for meaningful public participation (Gaber & Woodruff, 2023; Newig et al., 2018) demonstrate, using previously confidential internal documents from DuPont and 3M, that these companies had evidence of significant PFAS toxicity decades before this knowledge became widely available to regulators or the public, and actively used tactics such as suppressing unfavorable studies and distorting public discourse to postpone regulatory action. This systematic opacity meant that civil society actors, local communities, NGOs, and investigative journalists could only mobilize once contamination and health impacts became publicly visible, rather than being involved in earlier, preventative decision-making. In line with Newig et al.'s (2018) argument that participatory and collaborative governance improve environmental outcomes only when embedded in robust institutional designs, the PFAS experience suggests that ad hoc, crisis-driven forms of participation (lawsuits, protests, media exposés) cannot substitute for formalized transparency obligations and structured consultation mechanisms. Strengthening legally mandated disclosure of PFAS emissions and exposure data, alongside institutionalized channels for civil society input, is therefore essential to shift from reactive contestation toward proactive, co-productive oversight of PFAS governance.

Challenges of cross-sector policy integration: The findings of this study corroborate Chaffin & Gunderson's (2016) argument that adaptive governance fails when policy domains remain siloed and lack mechanisms for coordination across sectors. Wicked problems such as PFAS demand holistic solutions, yet in the Netherlands, coordination gaps persist between environmental, economic, and public health policies. Environmental regulations introduced without parallel economic support measures can provoke resistance from industry, while pro-growth policies that neglect environmental risks undermine public trust. The PFAS case demonstrates how highly technical regulatory processes, spread across multiple governance levels, limit the effective communication of public health risks and constrain coordinated regional responses. These findings are in line with governance studies that emphasize the importance of interministerial task forces and co-management platforms in addressing complex environmental risks.

Beyond the anticipated patterns of institutional fragmentation and industry

resistance, one unexpected finding of this study is the relatively proactive role played by local authorities and water boards in managing PFAS risks, despite limited formal mandates and regulatory uncertainty at the EU level. While national policy often remained cautious and conditional on European harmonization, local actors increasingly relied on precautionary spatial planning instruments, monitoring regimes, and interim restrictions to manage immediate risks. This contrasts with earlier governance literature, which tends to portray local authorities primarily as implementers rather than adaptive risk managers. Another unexpected finding is the extent to which investigative journalism functioned as a de facto governance mechanism, effectively substituting for formal transparency obligations by generating public pressure and triggering legal and political responses.

Overall, the discussion reinforces that the delayed and fragmented response to PFAS contamination in the Netherlands is rooted in suboptimal institutional interaction. These findings both confirm and extend existing governance theories by demonstrating that effective responses to wicked environmental problems require not only regulatory strength, but also adaptive multi-level coordination and institutionalized transparency. The combination of legal pressure, economic transition incentives, and open data governance emerges as a critical pathway for restoring public trust and improving long-term PFAS governance outcomes.

CONCLUSION AND SUGGESTIONS

Conclussion

The Dutch PFAS case demonstrates how persistent chemical pollution constitutes a governance-based wicked problem rather than a purely technical or regulatory issue. For decades, PFAS contamination has persisted due to conflicts of interest, institutional fragmentation, and weak accountability mechanisms. The government is caught between safeguarding public health and maintaining an investment-friendly climate; industry has exploited regulatory loopholes and enforcement gaps; and civil society involvement has largely emerged only after substantial environmental and health impacts became evident. Consequently, PFAS mitigation efforts have remained slow, partial, and insufficient to address the long-term and transboundary nature of the problem.

Nevertheless, the findings indicate that more effective PFAS governance is possible through stronger institutional integration.

Addressing PFAS requires an adaptive co-governance approach in which the state, market, and civil society share responsibilities through coordinated regulation, transparency, and oversight. Without synchronized action across local, national, and European levels, regulatory fragmentation will continue to undermine environmental protection. The Dutch experience thus illustrates that governance integration, not merely stricter regulation, is a key condition for managing persistent pollutants such as PFAS.

Suggestions

Based on the findings, several concise policy recommendations can be formulated:

1. Adopt a precautionary, class-based regulatory approach. Regulating PFAS as a single chemical class and applying the essential-use principle can prevent regulatory delays and avoid cycles of regrettable substitution, while allowing limited use only where PFAS are indispensable for health or safety.
2. Strengthen legal accountability through the polluter pays principle. Environmental liability frameworks should ensure that remediation costs are borne by polluters rather than the public. Continued use of civil and criminal litigation can reinforce deterrence and corporate accountability.
3. Support innovation in remediation and substitution. Public funding and incentives should prioritize research on PFAS remediation technologies and safer chemical alternatives, enabling industry transition without undermining regional economic competitiveness.
4. Enhance transparency and public participation. Open access to PFAS monitoring data and emissions reporting, combined with institutionalized public engagement mechanisms, can improve oversight, rebuild trust, and reduce reliance on reactive media-driven accountability.

Future research could build on this study in several ways. First, comparative studies across different European regions could examine how variations in industrial structure and local governance capacity influence PFAS policy outcomes. Second, empirical research focusing on the socio-economic impacts of PFAS restrictions at the regional and municipal levels would deepen understanding of the trade-offs between environmental protection and local development. Third, further work could explore the effectiveness of co-governance arrangements in practice,

particularly how formal cooperation between governments, industries, and civil society shapes long-term outcomes for managing persistent pollutants.

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