

## **A ONE HEALTH APPROACH TO AGRICULTURAL POLLUTION REGULATION**

### **EL ENFOQUE “UNA SOLA SALUD” Y LA REGULACIÓN DE LA CONTAMINACIÓN**

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**ABSTRACT:** Pollution constitutes a major global crisis, contributing to biodiversity loss, climate change, and severe health risks across all living species, with greater impact on vulnerable populations. Agriculture pollution – from fertilisers, pesticides and plastics- illustrates how siloed legal frameworks fail to address the cross-sectoral and cumulative effects of hazardous substances on all living species. This paper argues for integrating a One Health approach into pollution regulation, recognising the interconnectedness of human, animal, plant and ecosystems health to improve currently fragmented regulatory frameworks. Focusing on agricultural pollution, it examines the existing governance of agrochemicals, highlights legislative and judicial developments, and identifies opportunities to strengthen regulation through normative integration, multisectoral governance, stewardship, and stakeholder participation, core elements of One Health regulation. Incorporating One Health into pollution regulation can help address the complex, cumulative and transboundary nature of agricultural contaminants, enabling legal frameworks to move from reactive, sectoral responses to proactive, integrated strategies that

balance health, environmental, and production objectives across all species and ecosystems.

**RESUMEN:** La contaminación constituye una crisis mundial de primer orden que contribuye a la pérdida de biodiversidad, el cambio climático y genera graves riesgos para la salud de todas las especies vivas, con impactos desproporcionados en las poblaciones vulnerables. La contaminación agrícola —procedente de plaguicidas, fertilizantes y plásticos— ilustra cómo los marcos jurídicos fragmentados no logran dar una respuesta eficaz a los efectos acumulativos y transversales de las sustancias peligrosas. Este artículo aboga por integrar el enfoque de “Una Sola Salud” (*One Health*) en la regulación de la contaminación, reconociendo la interconexión entre la salud humana, animal, vegetal y de los ecosistemas. Centrándose en la contaminación agrícola, examina la regulación de los agroquímicos y la evolución de la jurisprudencia e identifica oportunidades para elaborar normas holísticas que incorporen diversos objetivos regulatorios, establezcan mecanismos de coordinación intersectorial, promuevan el uso responsable y sostenible de estas sustancias, y favorezcan la participación de las partes interesadas, elementos clave del enfoque “Una sola salud”. La incorporación de este enfoque a la regulación de la contaminación puede ayudar a integrar la naturaleza compleja, acumulativa y transfronteriza de los contaminantes agrícolas, favoreciendo el desarrollo de marcos jurídicos que evolucionen de respuestas reactivas y sectoriales a estrategias preventivas e integradas dirigidas a promover la salud de todas las especies y los ecosistemas.

**RESUM:** La contaminació constitueix una crisi mundial de primer ordre que contribueix a la pèrdua de biodiversitat, el canvi climàtic i greus riscos per a la salut de totes les espècies vives, amb impactes desproporcionats sobre les poblacions vulnerables. La contaminació agrícola —provinent de plaguicides, fertilitzants i plàstics— il·lustra com els marcs jurídics fragmentats no aconsegueixen donar una resposta eficaç als efectes acumulatius i transversals de les substàncies perilloses.

Aquest article defensa la integració de l'enfocament "Una Sola Salut" (*One Health*) en la regulació de la contaminació, tot reconeixent la interconnexió entre la salut humana, animal, vegetal i dels ecosistemes. Centrant-se en la contaminació agrícola, examina la regulació dels agroquímics i l'evolució de la jurisprudència, i identifica oportunitats per elaborar normes holístiques que incorporin diversos objectius, estableixin mecanismes de coordinació intersectorial, promoguin l'ús responsable i sostenible d'aquestes substàncies i afavoreixin la participació de les parts interessades, elements clau de l'enfocament "Una sola salut". La incorporació d'aquest enfocament a la regulació de la contaminació pot contribuir a integrar la naturalesa complexa, acumulativa i transfronterera dels contaminants agrícoles, afavorint el desenvolupament de marcs jurídics que evolucionin de respostes reactives i sectorials a estratègies preventives i integrades dirigides a promoure la salut de totes les espècies i dels ecosistemes.

**KEY WORDS:** One health – pollution – pesticides – chemicals – plastics – legal frameworks – precautionary principle.

**PALABRAS CLAVE:** Una sola salud – contaminación – plaguicidas – productos químicos – plásticos – marcos jurídicos – principio de precaución.

**PARAULES CLAU:** Una sola salut – contaminació – plaguicides – productes químics – plàstics – marcs jurídics – principi de precaució.

**SUMMARY:** I. POLLUTION AS A GLOBAL ENVIRONMENTAL CRISIS DEMANDING A ONE HEALTH RESPONSE. II. FRAGMENTATION AND INTEGRATION IN POLLUTION GOVERNANCE. III. JUDICIAL AND INTERPRETATIVE DEVELOPMENTS IN INTEGRATED POLLUTION GOVERNANCE. IV. ONE HEALTH AS AN INTEGRATIVE AND INTERPRETATIVE FRAMEWORK FOR POLLUTION REGULATION. 1. Pesticides as a paradigm One Health regulatory framework. 2. Fertilisers and Agricultural plastics regulation and One Health. V. CONCLUSIONS. VI. BIBLIOGRAPHY.

## **I. POLLUTION AS A GLOBAL ENVIRONMENTAL CRISIS DEMANDING A ONE HEALTH RESPONSE**

Environmental pollution is among the three most critical crises threatening planetary stability (UNEP, 2020a; Persson et al, 2022). It is a major driver of biodiversity loss (UNEP, 2019a) and climate change (Campbell-Lendrum et al, 2019; Sutton et al, 2013: 1; UNHRC, 2025: 7-8) while also increasing disease burdens and contributing to premature mortality in humans and animals (UNEP, 2018a: 1). Its impacts fall disproportionately on vulnerable populations, thereby reinforcing social inequalities in exposure and harm (UNEMG, 2023: 4; Landrigan et al, 2018: 469, 487; Wang et al, 2024: 12). Beyond human health, pollution disrupts ecosystems on a large scale, affecting pollinators, birds, mammals, wildlife, and aquatic life (Hallmann et al, 2017; Ogada, 2014) with effects that breach recognised planetary limits (Virrarrubia-Gomez et al, 2024; Richardson et al, 2023).

The transboundary nature of anthropogenic pollution engages foundational principles of international environmental law, including the duty to prevent transboundary harm, which is a recognised rule of customary law (ICJ, 2025: 134). Pollution also undermines internationally-recognised human rights, including the rights to life, health, food, and a clean and sustainable environment (UNHRC, 2018; ECHR, 2025: 380). These harms fall heavily on children, women, Indigenous Peoples and other groups in situations of vulnerability, raising pressing questions of environmental justice and equity (UNGA, 2022a: 3; Landrigan et al, 2018: 465). Addressing pollution is also essential to achieving the Sustainable Development Goals (SDGs) (Brack et al, 2022: 2) particularly SDG 3 (target 3.9) on reducing deaths and illness from hazardous chemicals and pollution of air, water and soil, and SDG 12 (targets 12.4 and 12.5) on sound chemical and waste management and the transition to circular economy practices. Yet, pollution continues to escalate, driven by unsustainable development patterns that prioritise short-term economic growth (Wang et al, 2014: 18), with hazardous substances now found in remote environments such as polar regions and deep oceans (Schäffer et al, 2023).

Within this broader challenge, certain agriculture practices can contribute to pollution pressures. Rising global food demands and intensified production practices have increased the use of agrochemicals and agricultural plastics in agrifood systems (Shorette, 2012; Osumanu & Kosoe, 2023; Winkler et al, 2025). While these inputs have supported productivity and food availability, their mismanagement can lead to diffuse, cumulative and sometimes underregulated pollution, with direct and indirect impacts on ecosystems, human and animal health (Wang et al, 2024; Ogwu & Izah, 2023; Sutton, 2013; FAO, 2024b; Shi et al, 2024). Runoff from pesticides, fertilisers and plastics can contaminate soil, water, and air, affecting terrestrial and aquatic systems alike (Hussain et al, 2025).

Despite a range of international agreements and national frameworks, pollution governance remains fragmented across sectors and jurisdictions, compromising coherence and accountability. Addressing agricultural pollution therefore requires legal and governance approaches that are integrated, cross-sectoral and inclusive. The One Health approach provides a systems-based framework for rethinking pollution regulation, promoting interdisciplinary collaboration, reinforcing prevention, and supporting resilience (Winkler et al, 2025; Machalaba et al, 2025). This paper argues that overcoming the current fragmented regulatory landscape calls for a One Health approach grounded in the principles of integration and precaution. Using pesticide regulation as a case study, it explores how this framework can inform more coherent legal responses to pollution and accelerate the transition towards sustainable agrifood systems.

## **II. FRAGMENTATION AND INTEGRATION IN POLLUTION GOVERNANCE**

The international regulatory framework for pollution control and chemical safety is highly fragmented, with no overarching binding instrument establishing generally applicable principles and rules (Sands et al, 2018, p.619; Dupuy and Viñuales, 2018: 253). Instead, numerous multilateral environmental agreements address discrete aspects of pollution: some target specific pollutants (Montreal, 1989; Stockholm, 2001; Minamata, 2023), others regulate particular stages of the chemical life cycle

(Rotterdam, 1998; Basel, 1989), while sectoral regimes govern areas such as maritime transport (MARPOL) and occupational health (ILO, 1977, 1990). Complementing these are a few predominantly trade-related soft-law instruments, such as UNEP's 1976 International Register of Potentially Toxic Chemicals (IRPTC) and the 1987 *London Guidelines for the Exchange of Information on Chemicals in International Trade*.<sup>1</sup> This multiplicity of instruments generates coordination challenges at global, regional and national levels, entrenches technical and institutional silos, and hampers effective responses to pollution control and chemical safety.

At the national level, similar fragmentation arises from the traditional division of responsibilities among authorities directly implicated in pollution management — including industry, health, agriculture and environment authorities— which often operate in parallel unless multisectoral collaboration is explicitly mandated and operationalised (Winkler et al, 2025: 35). Moreover, regulatory frameworks frequently assess individual chemicals in isolation, without accounting for the cumulative risks posed by mixtures across multiple exposure pathways (UNEP, 2019b: 39; Kortenkamp et al, 2009).

In contrast, several non-binding instruments have underscored the need for an integrated approach to pollution and chemical safety (Dupuy and Viñuales, 2018: 256). The 1972 Stockholm Declaration urged States to limit the release of toxic substances beyond the environment's capacity to neutralise them, thereby averting irreversible damage (UN, 1972). Two decades later, the Rio Declaration reaffirmed and deepened this commitment, urging States to cooperate in preventing the relocation or transfer of activities and substances that cause severe environmental degradation or are harmful to human health (Principle 14) and to preserve the integrity of Earth's ecosystems (Principle 7). Building on this momentum, the Agenda 21 translated these commitments into specific targets for hazardous waste management, explicitly acknowledging its direct impact on health and the environment (UNCED, 1993 Ch. 20). Subsequent inter-agency programs and

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<sup>1</sup>Most of these instruments were framed around the facilitation of trade and information exchange, with limited or only indirect reference to the protection of human health.

initiatives, such as the Inter-Organisation Program for the Sound Management of Chemicals (IOMC), the Bahia Declaration on Chemicals Safety (2000) by the International Forum of Chemical Safety, and the Johannesburg Summit on Sustainable Development (UN, 2002a, UN, 2002b), further advanced a shared understanding of the need for coordinated action in chemicals management.

The 2002 Globally Harmonised System of Classification and Labelling of Chemicals (GHS), as well as the 2006 Strategic Approach to International Chemicals Management (SAICM) - a voluntary, multi-stakeholder policy framework for the sound management of chemicals-, were adopted to promote chemical safety across sectors and regions, advancing a shared framework for minimising risk. More recently, the fifth International Conference on Chemicals Management (ICCM5) adopted the “Global Framework on Chemicals – For a planet free of harm from chemicals and waste” which made the case for integrated, life-cycle approaches to chemicals management addressing both, human and ecosystem health (UNEP, 2023).

Notably, many of these instruments refer to both human health and the environment as joint protection goals. However, they rarely address broader impacts on non-target species or microbial diversity. This omission reflects structural limitations in chemicals regulation: regulatory requirements for risk assessment are typically framed to evaluate the effects of single substances on humans and a limited set of environmental endpoints. As a result, critical issues — such as the combined effects of chemical mixtures, impacts on non-target species (including pollinators), and effects on soil microbial diversity — are only partially addressed (Backhaus & Faust, 2012; Kortenkamp et al., 2009; Vázquez, Periago, & Sánchez-Bayo, 2020). These gaps inevitably carry over into risk management processes, which typically balance identified risks against the perceived benefits of a product, while recognising that unforeseen risks may emerge as science advances (Dupuy and Viñuales, 2018: 46-47). Expanding the scope of risk assessments to include objectives such as the protection of non-target species or microbial diversity increases both the complexity of assessments and the uncertainty that regulators must resolve. This underlines the need for adaptive legal frameworks and robust application of the precautionary

principle to ensure protective outcomes under scientific uncertainty (Bullón Caro, 2024).

The precautionary principle applies across the chemical life cycle—from pre-market authorisation and classification/labelling to use-restrictions, substitution, and waste-phase controls—with particular attention to cumulative and cross-species exposures (Wang et al., 2014). Applied as a legal principle and regulatory approach, precaution requires a reasoned risk appraisal using the best available evidence, proportionality (suitability and necessity), selection of the least-restrictive means capable of achieving the protective aim, and periodic review and recalibration as evidence improves (European Commission, 2000). In practice, this translates into risk-based regulatory measures—for example, conditions on authorisation, targeted use-restrictions, substitution requirements, and time-limited approvals—together with operator information-generation and surveillance duties to reduce uncertainty (EFSA, 2023; European Commission, 2000).

Precaution is reflected in chemical-governance instruments such as the World Summit on Sustainable Development (2002), the Stockholm Convention (2001) and the Global Framework on Chemicals (2023), and is incorporated in domestic regimes including the EU's REACH Regulation (Article 1(3)) and several national pesticide laws (e.g., Egypt 2017; Malta 2011; Gibraltar 2012; North Macedonia 2020). Courts have also recognised precaution's role in managing scientific indeterminacy while preserving proportionality and review. The ICJ in *Pulp Mills* (2010) acknowledged a “precautionary approach” but declined to treat it as a burden-shifting rule; ITLOS has required States to act with “prudence and caution” in cases of uncertainty; and EU courts have consolidated precaution as a general principle of EU law, conditioning precautionary measures on a structured risk assessment and ongoing review (e.g., *Pfizer T-13/99*; *Artogodan*, Joined Cases T-74/00 et al.).

Within a One Health architecture, precaution operates as an optimisation mandate: decision-makers balance competing interests across human, animal, plant and ecosystem health when evidence is incomplete, avoiding both regulatory paralysis and over-broad prohibitions and advancing integrated pollution governance.

### III. JUDICIAL AND INTERPRETATIVE DEVELOPMENTS IN INTEGRATED POLLUTION GOVERNANCE

Beyond legislative and policy initiatives, judicial decisions and interpretative guidance have progressively clarified the interdependence of environmental protection, public health and human rights, and the importance of considering obligations from different instruments in an integrated manner.

The International Court of Justice (ICJ) in its Advisory Opinion of 23 July 2025, concluded that the obligations to prevent significant environmental harm and to cooperate in environmental protection form part of customary international law, and apply *erga omnes* (para. 439). It clarified that State responsibility arises not only from failure to achieve environmental outcomes, but also from failure to take all available preventive measures (para 135). It further affirmed that a clean, healthy and sustainable environment is a prerequisite for the enjoyment of fundamental human rights, including the rights to life, health, food, water, and housing. The Court called for a multidisciplinary, integrated approach—explicitly acknowledging the limits of legal action in isolation and, in doing so, it aligned with the cross-sectoral dimension of One Health (ICJ, 2025: 456). This Advisory Opinion confirms some of the statements of the Inter-American Court of Human Rights Advisory Opinion OC-32/25 (2025) in relation to the impact of climate change on human rights. It also aligns with the International Tribunal for the Law of the Sea (ITLOS) Advisory Opinion on Climate Change and the Law of the Sea, which reaffirmed States' obligations to prevent, reduce, and control marine pollution associated with climate change, including through the ecosystem approach (ITLOS, 2024:197-243, 418).

In the same vein, the European Court of Human Rights (ECtHR) in *Cannavacciuolo and others vs. Italy* (2025) held that a State's failure to act against environmental pollution may violate the right to life (ECHR, 2025: 377), and affirmed States' positive obligations to adopt preventive measures, ensure access to information, and provide effective deterrence against threats from both public and private actors (ECHR, 2025: 380).

These developments build upon earlier international case law articulating core principles of international pollution law. The *Trail Smelter Arbitration* (UN, 2006) established that no State may use its territory in a manner that causes injury to another State's territory, persons or property. In *Pulp Mills on the River Uruguay* (ICJ, 2010), the ICJ reaffirmed States' obligations to prevent transboundary harm, conduct environmental impact assessments (EIAs) for activities posing significant cross-border risks, and ensure notification and consultation with potentially affected States. Similarly, in *Ecuador v. Colombia* (Aerial Herbicide Spraying), Ecuador argued that Colombia's aerial fumigation near the border violated the principles of prevention and precaution under international law, causing harm to human health and the environment (ICJ, 2009: 276 – 8.7).

Taken together, these decisions and interpretative statements have progressively strengthened international and regional case law on pollution, reaffirming States' duties to prevent environmental harm, conduct environmental impact assessments, and guarantee public access to information. More broadly, they illustrate a convergence between environmental protection, human rights, and public health in international law, reinforcing calls for integrated, systemic approaches to pollution regulation that align with the One Health approach.

Complementing these judicial developments, UN Special Rapporteurs John Knox (human rights and the environment) and Baskut Tuncak (toxics and human rights) have elaborated both procedural and substantive obligations relevant to pollution. These include duties to prevent exposure to hazardous substances and wastes, and to guarantee the rights to information, access to justice, and effective remedy (UNHRC, 2018; UNGA, 2019). They have also underscored heightened obligations towards Indigenous Peoples (UNGA, 2022a). In *The imperative of defossilizing our economies*, the Special Rapporteur on human rights and climate change, Elisa Morgera, further clarifies States' obligations to phase out fossil fuels and to address life-cycle toxic harms, with particular attention to vulnerable populations (UNHRC, 2025).

#### **IV. ONE HEALTH AS AN INTEGRATIVE AND INTERPRETATIVE FRAMEWORK FOR POLLUTION REGULATION**

As we discussed in Section 2, the fragmented legal landscape of pollution regulation and its insufficient integration with human and animal health and ecosystems integrity poses significant governance and regulatory challenges (Sousa et al, 2022) and would benefit from a holistic systems-based approach (EFSA, 2022). One Health provides a legally relevant, system-based framework for addressing these challenges (Morrison et al, 2022; Machalaba et al, 2025; Winkler et al, 2025: 6). It enables legal reasoning by recognising the interconnected nature of human, animal, plant, and ecosystem health, and requiring legal frameworks to reflect these connections (Bullon Caro, 2025a). This section examines how One Health can operate as an interpretative lens for regulators, policy-makers, and courts, breaking regulatory silos and fostering systemic reasoning in pollution governance and regulation.

The One Health High-Level Expert Panel (OHHLEP), which advises the Quadripartite comprising the Food and Agricultural Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the World Health Organization and the World Animal Health Organisation (WOAH) on matters related to One Health, defines One Health as:

*“an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent. The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on*

*climate change, and contributing to sustainable development” (OHHLEP, 2022).<sup>2</sup>*

This definition provides a robust conceptual and operational mandate for addressing complex global health and ecological challenges in an integrated and inclusive manner.

Initially focused on zoonotic diseases, One Health has evolved to place ecosystems at the core of global health (Laign et al, 2023; Machalaba et al, 2025; Winkler et al, 2025). It aligns with other integrative frameworks such as Ecohealth and Planetary Health, placing a renewed emphasis on the intrinsic value of all living species beyond their utility to humans, together with the imperative of safeguarding life on Earth (Zinsstag, 2013, Ruiz de Castañeda et al, 2023).

Applied to pollution governance – with its complex sources, exposure pathways, and effects on health and ecosystems— One Health supports coherent, cross-sectoral regulatory responses (Mc Alister et al, 2022). Such responses extend beyond human health and the environment to address broader ecological impacts, including effects on non-target species and ecosystem integrity. Addressing these challenges demands multi-level governance, diverse stakeholder engagement, and shared responsibility for environmental stewardship (Steiner, 202; Wang et al, 2024; Machalaba et al, 2025). In legal terms, One Health can be seen as extending the principle of environmental integration to explicitly incorporate public, animal and ecosystem health as core interpretative and operational considerations (Bullon Caro, 2025a). It is also a concrete application of the principle of sustainable development.

Legislation can support the incorporation of a One Health approach into pollution management in ways that promote integration with other sector-specific regimes. Four elements have been proposed to articulate the normative content of One Health and facilitate its cross-sectoral implementation (Bullon Caro, 2025b): (1) normative integration, including a connection to legal objectives and mechanisms in other areas relevant to human, animal or environmental health (ILA, 2006, p.13). An example is

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<sup>2</sup> While not the only existing definition of One Health, it has gained broad recognition by international organisations and the scientific community (FAO et al, 2021).

the inclusion of explicit references to human or animal health in pollution legislation. (2) Multisectoral governance mechanisms, such as inter-agency bodies, joint planning processes, integrated data collection, and shared surveillance systems. (3) Stewardship and sustainability, promoting prudent use of pollutant substances and recognising their detrimental effects on all living species and ecosystems; and (4) inclusive stakeholder participation and the recognition of diverse knowledge systems under a human rights-based approach. Embedding the rights to information, consultation and participation enables affected communities, Indigenous Peoples, and other underrepresented groups to meaningfully shape the design, implementation and oversight of policy and regulation. This is particularly critical in pollution control, where legal measures often impose restrictions and burdens (Moreno Molina, 2010: 29). Embedding these elements into pollution legislation can enhance the capacity of regulatory systems to address complex, cross-cutting harms while affirming the value of integrating traditional and local knowledge into regulatory frameworks.

Despite its potential, the main challenge for One Health implementation is overcoming entrenched institutional silos. Regulatory and policy domains often remain segmented, with separate mandates, data systems, and decision-making processes. This fragmentation hinders coordination and information-sharing, and risks leaving One Health a rhetorical commitment rather than an operational reality. Its adoption also carries risks if poorly framed. The broad scope of the approach can blur responsibilities, duplicate mandates, or—when one sector dominates—discourage meaningful engagement from others. These factors may slow decision-making or weaken accountability. Clear legal frameworks, adequate resourcing, and monitoring mechanisms are therefore essential to translate One Health into enforceable practice rather than leaving it aspirational.

Case studies illustrate the legal and practical need for an integrated approach to pollution across sectors. One prominent example is the collapse of vulture populations in India and Pakistan in the mid-1990s due to the drug Diclofenac (Oaks et al, 2004). Following a patent expiration, the drug was broadly used on livestock, but its residues caused fatal kidney failure in vultures feeding on contaminated

carcasses (Balmford, 2013). Vulture populations declined by nearly 90% in some species with cascading effects on sanitation and rabies incidence (Government of India, 2015). A recent study estimates an increase of 4% in human mortality and economic costs of USD 70 billion per year (Franck and Sudarshan, 2024). The risk assessment for this pharmaceutical did not consider non-target raptors or downstream ecological effects, leading to dire public health consequences.

Similarly, Becker et al (2020) documented how pesticide uses close to water sources in Lake Victoria increased schistosomiasis among human populations exposed to unsanitary water. The pesticide authorization process did not account for its impact on aquatic species leading to the proliferation of pesticide-resistant snails due to the toxic effects on their predators. Together, these examples support a One Health-aligned duty to assess multi-species and ecosystem-level effects, not just human endpoints.

While various international instruments reference the need for integrated responses to pollution –including the Stockholm and the Rio Declarations— explicit references to One Health remain rare. A notable exception is the UN Common Approach to Pollution (UNEMG, 2023), which identifies One Health as one of its ten guiding principles and approaches, urging countries to adopt multisectoral and multi-stakeholder strategies. Similarly, the Kunming-Montreal Global Biodiversity Framework highlights the relevance of the One Health approach for its cross-sectoral implementation (CBD, 2022: Section C(r)) and the 2023 World Health Assembly Resolution on the impact of chemicals, waste and pollution on human health, calls for further work on the interface between human health and pollution under a One Health approach (WHA, 2023). At the regional level, The EU Zero Pollution for Air, Water and Soil Action Plan and the EU Scientific report on One Health Governance reference the role of One Health in supporting pollution regulation and cross-sectoral coherence (European Commission, 2021, 2024). Other key pollution instruments, such as the 2018 UNEA Ministerial Declaration “Towards a Pollution-Free Planet” and the 2023 Global Framework on Chemicals, emphasise integration and stakeholder engagement in ways that align with the One Health approach, even if the term is not explicitly used.

This emerging recognition provides a foundation for embedding One Health more systematically into international and domestic pollution legislation, enabling decision-makers, regulators and courts to adopt integrative reasoning that explicitly considers the effects of pollution on all forms of life and the ecosystems on which they depend, provided that institutional silos are addressed and governance frameworks ensure clarity, accountability, and cross-sectoral commitment.

## **V. STRENGTHENING REGULATORY RESPONSES TO AGRICULTURAL POLLUTION THROUGH A ONE HEALTH APPROACH**

Building on the integrative and interpretative functions of One Health outlined in Section 4, the agricultural sector offers a critical testing ground for applying this approach. Target 7 of the Global Biodiversity Framework addresses three forms of pollution directly relevant to agriculture: nutrient runoff from fertilisers, pesticide contamination, and plastic waste (CBD, 2022, Decision 15/4, Target 7). These three categories of agriculture pollution exemplify “wicked problems” at the nexus of health, agriculture and the environment: challenges marked by scientific uncertainty, fragmented institutional mandates and diverging stakeholder values (Allen, 2013; Batie, 2008).

Traditional regulatory models have often failed to address the dynamic, interconnected nature of these problems (Allen, 2013). For example, in pesticide regulation, fragmented environmental risk assessments that overlook chemical synergies may create regulatory blind spots and increase cumulative exposure risks (Axelman et al, 2024). Overcoming these shortcomings requires systemic, multisectoral, and multidisciplinary regulatory strategies consistent with the One Health approach (Allen, 2013; Axelman et al, 2024).

This section introduces the global regulatory framework for pesticide management as a case study of pollution regulation closely aligned with One Health and the four legal elements identified in Section 4 —normative integration, multisectoral coordination, stewardship and sustainability and participation—. The section

continues by examining the alignment of the regulatory frameworks for fertilisers and agricultural plastics with the One Health approach.

### **1. Pesticides as a paradigm One Health regulatory framework**

As developed above, One Health offers a framework for addressing complex, cross-sectoral regulatory challenges. The international regulatory regime for pesticide management provides a particularly compelling case study of how this approach can be operationalised. At the global level, pesticide governance is shaped by a range of international instruments, including multilateral environmental agreements regulating chemicals and waste, such as the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention), the Rotterdam Convention on the prior informed consent procedure for certain hazardous chemicals and pesticides in international trade (Rotterdam Convention), and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The only instrument dedicated specifically to pesticides, however, is the International Code of Conduct on Pesticide Management (CoCPM), a voluntary non-binding instrument approved by FAO and endorsed by WHO. The CoCPM provides comprehensive guidance for managing pesticides across their entire life cycle — from production and distribution to use and disposal—adopting a preventive “cradle to grave” integrated approach that aligns closely with One Health.

Initially approved by the FAO Conference in 1985 with a focus on pesticides used in agriculture (FAO, 1985), the Code underwent a major revision in 2013 to broaden its scope to public health pesticides used for vector control —such as malaria—. This revision led to its approval by the FAO Conference and endorsement by the WHO in 2014, thereby reinforcing its cross-sectoral relevance. The CoCPM addresses the responsibilities of all actors in the pesticide chain —governments, industry and users— and seeks to balance competing interests — including the need for pesticides to support vector control, food security and agricultural productivity against the risks they pose to human health, non-target animal species and ecosystems.<sup>3</sup>

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<sup>3</sup> CoCPM, 2013: 1.4, 1.7.3, 1.7.4., 3.10, 3.11, 6.1.11 and 8.2.5).

Implementation of the CoCPM is supported by a suite of technical guidance documents developed by the FAO/WHO Joint Meeting on Pesticide Management (JMPPM) is an advisory body to FAO and WHO on the lifecycle management of pesticides in agriculture and public health. These include the Guidance on Pesticide Legislation (FAO and WHO, 2020), which identifies the core elements of a robust pesticide legal framework. Although the CoCPM and its supporting guidance documents do not explicitly refer to One Health, they embody the foundational One Health legal elements enunciated in section 4. Through their broad implementation at the national level (FAO and WHO, 2019), these elements have been incorporated into pesticide legislation and regulatory practice worldwide, thereby embedding One Health considerations within national legal frameworks, as we can see in the following sections.

The Code promotes normative integration, recognising the interconnected risks pesticides pose to human, animal and environmental health.<sup>4</sup> This integrated framing is increasingly reflected in national pesticide legislation. For instance, laws in Afghanistan (2016), Ethiopia (2010), Honduras (2023), and the United Arab Emirates (2010) explicitly include the protection of the health of humans, animals and the environment as key legislative objectives.

The CoCPM also reinforces multisectoral collaboration throughout the pesticide life cycle,<sup>5</sup> supporting shared responsibilities and coordination mechanisms, such as information sharing.<sup>6</sup> The Guidance on pesticide legislation specifically calls for independent, multisectoral decision-making in pesticide registration,<sup>7</sup> typically involving ministries of agriculture (evaluating agronomic value and animal health risks), environment (assessing biodiversity and ecosystem impacts), and human health (determining vector control value, human toxicity and public health risks). These collaborative structures,<sup>8</sup> aligned with the One Health approach, are institutionalised in several countries. For example, Buthan's Pesticides Rules and

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<sup>4</sup> CoCPM Article 1.7.4. Guidance on Pesticide Legislation point 4.1.1. p. 9.

<sup>5</sup> CoCPM Article 6.1.1, 6.1.13. and, to a lesser extent Article 3.7.

<sup>6</sup> CoCPM Articles 5.1.6, 5.1.10, 6.1.10, 6.1.11, 6.1.13, 6.2.1, 9.

<sup>7</sup> Guidance on Pesticide legislation. Point 4.2.2. p. 12.

<sup>8</sup> Guidance on Pesticide legislation. Point 4.2.2. p. 13.

Regulations (2019) establish a multisectoral pesticide registration board composed of members from the ministries in charge of agriculture, health, environment, economic affairs, and food. Similar mechanisms are found in the legislation of Eswatini (2017), Liberia (2019), Tanzania (2020) and Tonga (2002), reflecting the importance of multisectoral collaboration in pesticide governance.

Beyond registration, the CoCPM promotes the stewardship and sustainable use of pesticides, encouraging a life-cycle approach. Legal mechanisms such as licensing and permitting<sup>9</sup> are used to regulate actors involved in production (Nepal, 2024; China, 2022), sale (Portugal, 2013; Maldives, 2019), commercial application (Australia, 2018), and other activities necessitating regulatory oversight. Additionally, pesticide laws encourage good agricultural practices that reduce pesticide reliance, such as Integrated Pest Management (IPM) (Lao, 2017; Croatia, 2025).

Stakeholder participation is promoted through both the CoCPM and the Guidelines on pesticide legislation.<sup>10</sup> These documents call for transparency, access to information, and inclusion of relevant stakeholders in pesticide decision-making. In practice, countries such as Ethiopia (2010: 27-28) and Cabo Verde (2017: 3) have established pesticide advisory boards composed of government officials, industry representatives, farmers, and other stakeholders. A particularly important mechanism for stakeholders' direct involvement in pesticide management is the inclusion of Extended Producer Responsibility (EPR) schemes, which hold manufacturers and distributors accountable for the collection and safe disposal of pesticide containers, obsolete pesticides, and leftovers (South Africa, 2023; Zambia, 2018).

Taken together, these legal and institutional mechanisms demonstrate how pesticide legislation can operationalise a One Health approach. By integrating normative alignment across sectors, multisectoral collaboration, preventive stewardship, and stakeholder participation, pesticide law serves as a regulatory model for One Health

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<sup>9</sup> CoCPM Articles 6.1.3, 6.1.4, 8.1.1, 8.2.7, 8.3, 10.3.2. Guidance on Pesticide legislation. Point 4.4, 4.5, 4.10.1, 4.13.

<sup>10</sup> CoCPM Articles 3.8, 5.2.4.6, 6.1.2, 9.2.211.1, 11.2.12. Guidance on Pesticide legislation. Points 3.1, 4.2.4, Points 4.3.3, 4.8, 4.9, 5.3.3 and 5.3.4.

governance. Strengthening and scaling these mechanisms under a One Health approach could enhance the sustainability, safety, and resilience of agrifood systems in the face of evolving health and environmental challenges.

## **2. Fertilisers and Agricultural plastics regulation and One Health**

While pesticides offer perhaps the clearest example of an established international governance framework aligned with One Health, the approach is equally relevant to other forms of agricultural pollution. Fertilisers and plastics differ in their regulatory histories and in the scientific knowledge underpinning risk management, but they share similar challenges of diffuse impacts, scientific uncertainty, and the need for integrated, cross-sectoral governance.

Excessive use of nitrogen and phosphorous-based fertilisers contributes to eutrophication and the degradation of aquatic ecosystems, potentially infringing obligations under legal norms on water quality, biodiversity, and public health. Over time, nutrient overload also diminishes the resilience of soils and crops to pathogens, environmental stressors, and climate change (Wang et al, 2024). Regulatory frameworks exist to promote the safe use of fertilisers and to support alternative crop production practices. The FAO International Code of Conduct for the Sustainable Use and Management of Fertilizers (FAO, 2019) offers a global voluntary instrument that implicitly applies an integrated approach consistent with One Health. It promotes a cross-sectoral governance model that integrates considerations across human, animal, soil and environmental health.<sup>11</sup> The Code emphasises transparency, stakeholder participation, and information-sharing,<sup>12</sup> as well as practices such as nutrient recycling, including the safe use of animal manure.<sup>13</sup> These elements reflect a broader regulatory vision that reconciles agricultural productivity with environmental and health objectives —hallmarks of a One Health approach.

Agricultural plastics are another significant source of pollution. Microplastics, additives and chemicals found in plastic films, containers and other agricultural

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<sup>11</sup> Code of Conduct for the sustainable use and management of fertilizers Points 1.5.6, 15.7, 1.6.7, 5.3.3., 6.3.2.

<sup>12</sup> Idem. point 1.6.3.

<sup>13</sup> Idem points 3.6.1, 3.8.6, 5.3.2.

inputs contribute to long-term contamination of soils, waterways and the food chain (UNEP, 2020b; FAO, 2021). Beyond chemical pollution, plastic surfaces and microplastics, when spread in the environment, can act as reservoirs for pathogenic bacteria and create favourable conditions for the development of antimicrobial resistance (Ormsby et al, 2024; Milani et al, 2024; Gross et al, 2025). Once in the soil, plastic particles may inhibit plant growth, alter nutritional content, and disrupt microbial communities. Growing evidence indicates that they can even migrate to edible plant tissues, raising concerns for both plant health and food safety (Nizzetto et al, 2025). Plastic production is predominantly fossil fuel-based, significantly contributing to greenhouse gas emissions and thereby to climate change (UNHRC, 2025: 26). It also frequently incorporates chemical additives that may pose risks to health and the environment (UNEP, 2023c).

UNEA Resolution 5/14: “End plastic pollution: towards an international legally binding instrument” (UNEP, 2022) mandates negotiations for a binding instrument to end plastic pollution, including in agrifood systems. Several stakeholders have called for this agreement to address the impact of plastic pollution on the health of all species under a One Health approach (International Science Council, 2024; Geneva Environment Network, 2025; FAO, 2025a). Health has consistently featured, though unevenly, across successive drafts of the agreement. It is included as a core objective in the Zero draft for INC-3, (UNEP, 2023b) and retained in the INC-4 and later drafts, but increasingly relegated to bracketed options, signalling a lack of consensus among States (UNEP, 2024a). In the INC-5.2 working text of August 2025, Article 19 introduced “One Health” as a non-consensual bracketed option (UNEP, 2025a). INC-5.2 concluded without consensus on a final instrument, and a decision to reconvene negotiations (UNEP, 2025b).

Complementing this, the provisional FAO Voluntary Code of Conduct on the Sustainable Use and Management of Plastics in Agriculture (2024a) provides guidance aligned with UNEA objectives, encouraging co-regulation and greater private-sector accountability (FAO, 2024a). Notably, the Code explicitly targets the protection of human and animal health, food safety and environmental quality from

plastic-related harm, and while One Health is not explicitly mentioned, its objectives are aligned with this approach.

Ultimately, aligning fertiliser and plastic regulation with One Health demands legal provisions that integrate human, animal, plant, and ecosystem health considerations, mandate cross-sectoral decision-making, and ensure prudent use and inclusive participation. Introducing these elements into binding instruments at the global and national levels would move the regulation of these pollutants from fragmented sectoral oversight towards the systemic, preventive governance envisioned by One Health.

## **V. CONCLUSIONS**

Pollution is a global environmental crisis with deeply interconnected impacts on the health of all living species. In the agrifood sector, it arises from multiple sources, including agricultural inputs such as chemical pesticides, fertilisers and plastics. While these inputs contribute to productivity, food security and economic development, their mismanagement and overuse cause environmental degradation, soil depletion, water contamination, biodiversity loss, and threats to food safety and the health of humans, animals, plants and ecosystems. Regulatory frameworks must therefore balance their benefits with the imperative to prevent and mitigate adverse impacts.

The One Health approach offers a legally relevant yet underutilised framework for strengthening the governance of agricultural pollution. While various pollution-related international instruments already reflect elements aligned with One Health, explicit recognition remains rare, and the absence of binding mandates for cross-sectoral collaboration perpetuates siloed approaches. Embedding One Health more explicitly into legal and policy instruments would promote coherence, strengthen institutional coordination, and foster participatory governance that integrates scientific, local and Indigenous knowledge systems—all essential for socially legitimate and legally effective regulation.

Legislation is central to operationalising One Health in pollution governance. It can codify enforceable obligations, establish coordinated mandates across health, agriculture and environment authorities, and promote risk-based, life cycle-based mechanisms. More fundamentally, it can formalise One Health institutional frameworks that provide the normative and procedural basis for integrated responses to pollution. Explicit legislative recognition of One Health at national, regional and international levels would enhance regulatory coherence and provide legal certainty for implementation and enforcement.

Critically, legislation should incorporate the precautionary principle, providing a legal basis for early protective and preventive action. The complexity of pollution's impacts on all living species often entails scientific uncertainty that must be addressed before product authorisation. This is especially relevant where pollutants cause diffuse, cumulative, or delayed effects across species and ecosystems, or where chemical interactions create risks not foreseen in single-substance assessments. In such contexts, precaution provides a legal basis for early, protective action, shifting the burden from reaction to prevention.

Judicial and interpretative developments increasingly reflect this integrated thinking, reinforcing precautionary measures, affirming duties to prevent harm and protect ecological integrity. Even without explicitly referencing One Health, this trend supports its underlying values and illustrates how precaution can bridge fragmented regimes and fosters systemic, cross-sectoral responses to complex problems. This evolving body of case law provides fertile ground for recognising One Health as a principle with normative weight, rather than merely a policy framework.

Although this paper focuses on agricultural sources of pollution, its findings are broadly applicable to other sources. One Health provides a scalable legal and governance model for addressing complex, cross-sectoral risks across all forms of pollution as well as other environmental health challenges, such as biodiversity loss and climate change. By embedding One Health more firmly in law, policymakers and regulators can establish inclusive, integrated, and forward-looking regulatory

frameworks capable of supporting resilient agrifood systems and advancing the environmental and health dimensions of sustainable development.

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