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Integrated One Health Ecosystem: A Silo Connector

One Health is more than a concept; it is an integrated approach rooted in the unbreakable bond between humans, animals, plants, and our shared environment. Designed to break down silos, it serves as a frontline defense against global threats. At the heart of this **Integrated Ecosystem Framework** lies the Base: a foundation of multisectoral governance, science-policy dialogue, and innovative financing dedicated to primary prevention.

Supported by this base, the framework operates through four strategic pillars:

- **Emerging Infectious Diseases:** Halting zoonotic spillovers through integrated surveillance and increased prevention.
- **Antimicrobial Resistance (AMR):** Protecting our medical future through global solidarity and sustainable farming.
- **Pollution:** Mitigating chemical and plastic risks via 'Safe by Design' production.
- **Sustainable Food Systems:** Reimagining the link between agriculture and food to safeguard human, animal and environmental health.

To ensure this ecosystem thrives, **Data** acts as the essential 'enabler', driving deeper insights if shared and usable, while **Social Sciences and Humanities** serve as the 'tools to understand the social challenges of the One Health model' — ensuring that every policy remains ethical, equitable, locally grounded and shared/co-constructed by all stakeholders.

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Humanities and Social Sciences

Territorialization and social pluralism
Local adaptation to cultural and socio- economic contexts

Ethics and Equity
Environmental justice, protection of vulnerable populations

Co-construction
Implication of local communities

Infectious diseases emergence
Prevention
Integrated surveillance
Preparedness

Integrated prevention

AMR Antimicrobial Resistance
Global solidarity and sustainable farming

Pollutions / EID

Co selection

Biodiversity Preservation and decreased risk practices

Human Animal Plant Environment

AMR and water / soil management

Sustainable food systems
Agroecology, territory scale and healthy nutrition

Microbiome Loop

Safe water, soil and agriculture for a safer food

Exposome

Pollutions
Safe by design and real life exposure and impact

Data and Ai

Unlock | Sharing | Interoperability | Indicators | Pilot studies

Governance and transformative changes

Inter and trans-disciplinary, multi-sectorality, multi-actors, inclusiveness

Science-Policy-Society | Community engagement | Education and training | Funding

I. Governance as the foundation of the OH approach

Current governance structures and collaborative practices from local to global, remain insufficiently sustainably integrated across sectors hampering effective implementation of the OH approach**. The recommendations below aim to strengthen institutionalization and operationalization of One Health**, address multisectoral governance challenges, enhance evidence-informed decision-making and ensure equitable, sustainable and long-term outcomes in the face of escalating global risks and pressing global challenges.

Strengthening multisectorality and inter- and trans-disciplinarity is a prerequisite to efficient and meaningful implementation of the OH approach. It requires further institutionalization of OH frameworks across human, animal, plant, environmental and agri-food sectors, to maximize cross-sectoral co-benefits and a transdisciplinary OH research ecosystem with sustained funding and career support. **Knowledge pluralism, inclusiveness and equity are core values of OH** and integration of Indigenous, traditional, and local knowledge intertwined with scientific evidence and participation of underrepresented groups are essential to any OH decision-making process.

Develop OH science-policy interfaces, science-state-society dialogues and international standards at all scales to enhance OH decision-making efficiency:

- Engage communities in rural and urban OH initiatives to leverage local knowledge for prevention and preparedness and connect the existing networks of One Health Cities.
- Integrate OH platforms into national governance and coordinate them with expert committees.
- Strengthen OH as a cross-cutting principle in international policy frameworks and standards, and accelerate harmonization and interoperability between them.
- Strengthen and further operationalize the mandate of the Quadripartite and its scientific advisory body (OHHLEP), deepen synergies with IPCC and IPBES, and systematically leverage existing global fora (e.g., COPs) to embed dedicated One Health segments.
- Facilitate cross-border cooperation, research, surveillance, information and data sharing and risk management.
- Strengthen and adapt regulatory and legal frameworks to ensure timely, equitable, and accountable engagement of research and development industries supplying critical technologies during health emergencies.
- Adapt the regulatory and legal pressure on research and development industries supplying technologies in times of a health emergency, ensuring a high level of public-private collaboration.

Demonstrate evidence of One Health strategies' impact and added value:

- Boost the production of actionable data through the creation of science-society dialogue platforms or communities of practice.
- Integrate hidden costs and cost-of-inaction analyses in policy planning and regulatory frameworks, considering climate, biodiversity, health and socio-economic impacts.
- Support participatory research in ecological or societal vulnerable areas to increase evidence on OH impact, equity and ecosystem resilience.
- Ensure that scientific findings and Monitoring, evaluation and learning (MEL) reports inform international standards and public policies.

Promoting the One Health framework in education, training and outreach activities:

- Integrate OH across all educational levels and in workforce planning, emphasizing systems thinking, inter and transdisciplinarity, multisectorality and participatory engineering, and integrating various knowledge sources in line with the already mentioned principles of pluralism, inclusiveness and equity.
- Establish mandatory cross-faculty OH modules, connecting climate, biodiversity and health education, in medical, veterinary, ecological, urban planning, economics, political sciences, diplomacy and international relations curricula.
- Implement lifelong OH training for professionals and decision-makers, adapting content to local contexts and relying on collaborative platforms for sharing OH educational tools and competency frameworks.

Strengthening health systems through increased disease prevention and multisectoral strategies:

- Transform health systems to fully embed OH principles and address all determinants of health and provide clear metrics for impact evaluation.
- Foster integrated surveillance of communicable and non-communicable diseases, and strengthen associated primary prevention measures via multisectoral and multiscale action (agri-food systems, pollution…).
- Advance international research partnership to provide science-based strategies for health systems governance and functioning.

Investing and leveraging key economic drivers to strengthen global health security:

- Systematically integrate and prioritize primary prevention within all policy and budget frameworks, recognizing it as a strategic and cost-effective investment.
- Deploy innovative financing mechanisms that de-risk investment, such as blended finance and public–private partnerships, to mobilize private capital for One Health, and develop business models that prioritize cross-sectoral co-benefits and upstream risk reduction.
- Ensure flexible funding during emergencies to support prevention, preparedness and integrated responses.
- Promote Horizon scan emerging technologies (eg. AI, blockchain for traceability) for transparent and accountable implementation of OH interventions.

II. Operational Pillars:

Emerging Infectious Diseases (EID)

The prevention and control of EID require a fundamental shift toward **primary prevention** at the high-risk interfaces between humans, animals, and their shared environment. By integrating territorial surveillance and multisectoral coordination, this approach aims to halt zoonotic spillovers and mitigate the global spread of pathogens before they escalate into systemic crises. A group of national and international experts has worked to develop a list of recommendations to guide the future initiatives needed to develop an adapted One Health approach to be better prepared to anticipate or face any epidemic or pandemic associated to emerging and re-emerging infectious diseases. These recommendations are expected to be discussed and endorsed at the political level.

These recommendations globally concern the fields of prevention, surveillance, monitoring and control of outbreaks and highlight the need to develop territorial and land use approaches.

- In this frame, the need to position at the heart ***of public policy primary prevention at high-risk human-animal-environment interfaces*** including terrestrial and marine socio-ecosystems to reduce zoonotic spillover, disease emergence and spread has been unanimously identified.
- In the same field, supporting ***One health surveillance and prevention systems through a science-state-society dialogue*** seems key. There is a clear need to develop integrated health surveillance and prevention systems using the One Health approach, linking local, subnational, national, regional, and international levels. This requires promoting One Health literacy at all levels, from grassroots communities and frontline workers to local authorities and national policymakers, to ensure shared understanding, timely reporting, and effective use of surveillance information. It also calls for ensuring engagement of private-sector actors, integrating social sciences, anthropology and economics, establishing interoperable platforms for sharing and analyzing One Health data, establishing dialogue between science, decision-makers, and society, and developing international communication.
- The need to implement and ***integrate territorial approach to prioritize One Health interventions*** has also been identified as a priority. The objective is to develop an integrated characterization of territories based on the probability of emergence and the severity of the impact to anticipate the risks of emergence/re-emergence.
- Of main importance, the development of ***integrated strategies for monitoring, preventing and controlling outbreaks of emerging infectious diseases*** and eliminating/eradicating invasive alien species at ecosystem-animal-wildlife-human interface. It is based on the assessment that strategies focusing solely on one compartment (humans, animals, plants, or ecosystems) would lead to inefficient response to and prevention and control of outbreaks.
- Finally, it looks crucial to strengthen ***land and water use planning and urbanization strategies*** by systematically integrating the One Health dimension in order to limit the establishment, transmission, and circulation of EIMs in urban and rural areas. This approach aims to promote healthy urban planning and rural land use, integrating human, animal, plant, and environmental dimensions in a coordinated manner.

Together, these recommendations form an integrated framework to better prevent, detect and respond to emerging infectious disease threats through coordinated One Health action at all levels.

Antimicrobial Resistance (AMR)

AMR has been listed one of the top ten global health threats by the World Health Organization (WHO). Each year, an estimated 7·7 million deaths are attributed to bacterial infections, of which 4.95 million are associated with drug-resistant pathogens, and 1·27 million are caused by bacterial pathogens resistant to the antibiotics available. In all, AMR jeopardizes global health security by undermining the effectiveness of essential medicines, leading to untreatable infections, increased mortality and overwhelmed health systems. Forecasts show that if we do not act now, AMR will cause 39.1 million deaths cumulatively between 2025 and 2050, with an additional 169 million people dying from illnesses associated with AMR.

Despite numerous efforts, AMR continues to expand. In 2024, the United Nations General Assembly (UNGA) adopted key targets and recommendations to mitigate AMR, including increasing financing for National Actions Plans (NAPs) from 20-60%, reducing AMR-related human deaths by 10% by 2030 and significantly reducing antibiotic use in agrifood systems. To achieve these goals, preventing infections, improving hygiene and biosecurity, using antibiotics and other antimicrobials in a better way, expanding appropriate access to life-saving medicines to populations in need and finding new antibiotics or alternatives are key areas to consider.

In addition to human health, AMR has been framed a quintessential One Health issue. AMR in humans is interlinked with AMR in animal populations and in the wider environment. Antimicrobials are used in livestock to maintain health and productivity, also contributing to the spread of drug-resistant bacteria. Antimicrobial use (AMU) in crops is on the increase. AMR threatens food security and economic development, and also exacerbates the impact of global changes such as climate change, loss of biodiversity, global pollution, pandemics, armed conflicts or population displacements.

As highlighted by the UN, the One Health approach needs strengthening actions at local, national and global levels and requires a transdisciplinary and multisectoral response across humans, animals, plants and the environment, that considers socio-economic determinants, the geopolitical context (including international aid constraints), strengthened research and evidence generation. The group under the name "Quadripartite" of four international organizations, including the WHO, the Food and Agriculture Organization of the United Nations (FAO), the World Organisation for Animal Health (WOAH), and the United Nations Environment Programme (UNEP), is an undeniable asset in the fight against AMR for the benefit of humanity, animals, plants, ecosystems, and livelihood. However to date, the Quadripartite reports that less than a third of countries currently finance their NAPs against AMR.

As an AMR One Health working group fully aligned with the objective to meet the UNGA 2024 targets, we call for greater cooperation across countries through One Health actions tailored in a burden-adjusted approach against AMR. Not all countries face the same needs and difficulties in addressing AMR challenges. Of the estimated 1·27 million deaths attributed to AMR in 2019, 1·12 million were in low-income and middle-income countries (LMICs). The burden of AMR also accelerated during the COVID-19 pandemic because of inappropriate treatments. In many places, antimicrobials are a substitute for infection control, water, hygiene and sanitation (WASH) rather than as a corollary to these. Access to existing antimicrobials, vaccination coverage, development of new medicines and use of diagnostics to inform treatment refer to different situations worldwide. Implementation of science-based and country-tailored policies is therefore urgently needed.

- **Declare antimicrobials and their effectiveness a global public good.**
    - Establish a Global Antimicrobial Solidarity Agreement modelled on elements of the Pandemic Treaty to safeguard the effectiveness of essential antimicrobials as global public goods. The framework would introduce the Global Antibiotic Access Index to monitor progress and support coordinated international action on sustainable production, equitable availability and access, and harmonised antimicrobial stewardship framework, and an agreement not to use antimicrobials for growth promotion in non-human sectors.
- **Accelerate country-tailored implementation of One Health National Action Plans informed by an international meta-network**
    - Strengthen international implementation support mechanisms to accelerate the operationalization of One Health National Action Plans on AMR, particularly in LMICs, through sustained financing, technical assistance, and implementation research to identify cost-effective interventions and support evidence-based policymaking.
    - Strengthen global coordination and interoperability among existing One Health AMR initiatives, building on mechanisms such as the Quadripartite's AMR Multi-Stakeholder Partnership Platform, and systematic sharing of national AMR and antimicrobial use data with global surveillance platforms and align research priorities. This includes accelerating research and innovation from early R&D stages to clinics towards new antimicrobials, vaccines and alternatives; developing common One Health indicators for AMR surveillance, increasing accurate, representative and interoperable data; and supporting cross-sector antimicrobial stewardship frameworks across human, animal, and environmental sectors.
- **Strengthen the science-policy-society interface on AMR in the One Health and sustainable context.**
    - Promote public awareness and engagement on AMR through evidence-based communication campaigns and evaluation of their impact. Strengthen education and training on AMR/OH programs among young people (primary and secondary schools) and healthcare professionals (physicians, veterinarians, nurses, pharmacists, IDE, SF…). At the same time, strengthen interdisciplinary research coordination among social, biological, and medical sciences at the national and international levels to promote and sustain the One Health approach.
- **Address AMR within the context of global environmental and societal challenges**
    - Establish a Climate and Territory Observatory to monitor the impact of environmental and territorial drivers on the emergence and spread of AMR, and develop AI-based predictive models using integrated global data sources.
- **Promote OH innovations for prevention, diagnostics and treatment**
    - Launch an international sustainable bioeconomy AMR program integrating the One Health approach and linking innovation, ecotoxicology, and industrial development to support therapeutic innovations with a low ecological footprint, with remuneration mechanisms disconnected from sales volumes.
- **Integrate agricultural systems (livestock, aquaculture, crop production) and value chains into AMR strategies**
    - Determine the national, regional, international contributions of agricultural systems (livestock, aquaculture, crop production) and associated value chains to the global AMR burden and use this evidence to better integrate an AMR lens into agricultural development policies

Addressing Pollution through a One Health (OH) Approach

Chemical, plastic and biological pollution represent a major global OH challenge. More than 100,000 chemicals are currently on the global market, yet only a small fraction have been comprehensively assessed for exposure and toxicity. This pollution has interconnected effects on humans, animals, plants, ecosystems, food systems and therefore requires integrated action spanning design, production, environmental exposure and health impacts. The framework proposed here brings together 9 recommendations (annexes) organized into 3 strategic pillars.

Pillar 1: Safe and Sustainable by Design (SSbD), Production and Governance

Preventing pollution begin before substances and materials enter markets and supply chains (including food chains). Key actions should include:

- Embedding OH principles across international agreements and science & policy platforms (UN Plastics Treaty, Stockholm Convention, ISP-CWP and related frameworks)
- Strengthening upstream regulatory requirements to ensure transparency on the chemical composition of products
- Assessing chemicals as mixtures and full formulations (e.g. pesticides), not only individual substances
- Integrating SSbD principles into chemical and material innovation
- Establishing a Global OH Chemicals and Products Data Commons to share information on chemical composition, product uses and environmental & health effects, a database which will be built on coordinated monitoring schemes, harmonized sampling and analytical methods, common metadata standards, quality assurance/quality control procedures, and interoperable reporting formats.

Pillar 2: Characterizing Real-Life Exposures and the OH chemical and biological Exposome

Pollution already present in the environment requires better characterization of exposures across interconnected systems. Key actions should include:

- Developing a OH exposome framework capturing real-life exposures to chemical, plastics and biological pollutants, including pathogens and antimicrobial resistance across humans, animals and ecosystems.
- Harmonizing global analytical methods to measure pollutants and plastics across environmental compartments, including wastewater surveillance as an early-warning component of the One Health exposome (pathogens, AMR and public health indicators).
- Implementing high-throughput analytical infrastructures and hazard-based grouping approaches
- Strengthening monitoring of products, supply chains, occupational settings and frontline communities
- Integrating monitoring data within life-cycle frameworks and shared databases to support upstream prevention, regulatory action, and comparable signals on chemicals, plastics and biological pollutants across regions and over time.

These efforts should improve the capacity to detect emerging risks linked to pollution and guide evidence-based interventions.

Pillar 3: Understanding Impacts and Enabling Mitigation across OH Systems

There is clear evidence that chemical, plastic and biological pollution, already affects multiple interconnected systems and generates cascading impacts on ecosystems, biodiversity, food systems and human health. This evidence necessitates the actions outlined in Pillars 1 and 2. Further research is also needed, especially on chronic effects, to ensure ecosystems, biodiversity, food systems and human health is fully safeguarded for the benefit of future generations:

- Advancing research on the OH impacts of chemical, plastic and biological pollutants, including mixture effects, chemical–biological interactions (e.g. pathogens and AMR), and the effectiveness of wastewater treatment and reuse systems.
- Improving understanding of mixture effects, long-term exposures and cumulative risks
- Assessing impacts on critical systems such as soil, water resources, biodiversity and food safety
- Developing mitigation strategies that reduce pollution at source while avoiding unintended consequences
- Supporting socio-economic transitions including agroecological practices, assessment of safer more sustainable materials and production systems, and reduced reliance on hazardous chemicals (including pesticides) and products

These actions identify effective mitigation strategies to protect ecosystems, biodiversity, food systems and human health. while supporting trade in safer and more sustainable chemicals and products (see also pillar 1).

We call for an international scientific initiative to address pollution from a One Health perspective, recognizing the interconnected health of ecosystems, biodiversity, food systems and human populations. Similar to the global effort on genomes, a flagship international project could transform our capacity to map and interpret real-world exposures to chemicals and plastics, including micro- and nanoplastics, while also tracking pathogen circulation and antimicrobial resistance across wastewater and environmental systems. By integrating chemical, plastic and biological signals within a shared One Health evidence base, such an initiative would strengthen the capacity to understand, mitigate and ultimately prevent pollution impacts. It would support safer design of chemicals and materials; stronger regulations and evidence-based public policies aimed at preventing the production and diffusion of harmful substances.

Sustainable Food Systems

Effective prevention of health crises cannot be achieved in isolation; it requires a structural transformation of our food systems to ensure they safeguard ecological foundations rather than serving as drivers of disease and environmental degradation.

Current food systems face interconnected crises: environmental degradation, biodiversity loss, rising diet-related chronic diseases, chemical and biological contamination, and deepening food inequalities that cannot be addressed through siloed policies. This document presents ten integrated policy recommendations grounded in the One Health approach, which recognizes the indivisible links between human, animal (domestic and wildlife), plant, and environmental health. These recommendations call for a structural transformation of food systems at all levels: from production practices and food quality to territorial governance and the protection of vulnerable populations, prioritizing scientific evidence, interdisciplinary

collaboration, and participatory governance. The recommendations are organized into four thematic pillars:

Pillar 1: Production Systems and Ecological Foundations

- Sustainable Food Systems and Microbiomes: Develop a global One Health microbiome observatory. Leverage microbiomes as a strategic tool for sustainability across agriculture, aquaculture, livestock, and food processing, reducing chemical inputs and antimicrobial use while strengthening ecosystem and human health.
- Promoting Agroecological Systems: Support the transition to agroecological agricultural, livestock, and aquatic systems founded on biological diversity, system autonomy, and ecosystem interaction. Value Indigenous and local knowledge and develop frameworks for ecosystem services payment.
- Preserving Biodiversity in Food Systems: Strengthen research on genetic, species, ecosystem, and landscape biodiversity to enhance socio-ecosystem resilience. Counter the standardization of production systems and diets. Conserve and valorize local and aquatic resources as levers for ecological and food resilience.

Pillar 2: Territorial Governance and Place-Based Action

- Promoting Sustainable Territorial Food Systems: Recognize the territory as the privileged scale for food system transformation. Coordinate local actors, shorten supply chains, preserve local biodiversity, and integrate aquaculture and fisheries in coastal and island area and lakes.
- Implementing Food Policies at the Territorial Level: Deploy integrated territorial food policies that articulate health, environment, and social objectives through shared governance. Develop One Health indicators at the local level to inform decision-making and adapt strategies to local realities.
- Linking Food Systems and Health in Island Territories: Establish integrated One Health observatories in island territories as sentinel systems. Characterize land-sea continuum flows, study cumulative global change impacts, and strengthen international cooperation among island regions (Caribbean, Pacific, Indian Ocean).

Pillar 3: Food Quality, Nutrition, and Health

- Integrating Sanitary and Nutritional Quality: Break down the silos between food safety and nutrition. Adopt integrated risk/benefit assessment approaches that preserve food diversity while preventing biological, chemical, and physical contamination across the food chain.
- Preventing Diet-Related Chronic Diseases: Explicitly integrate non-communicable diseases into One Health frameworks. Promote front-of-pack labelling, regulate ultra-processed products, and support food environments that enable healthy choices particularly for vulnerable populations and in school settings.

Pillar 4: Cross-Cutting Challenges: Contamination, Equity, and Transitions

- Addressing Food Pollution through an Exposome Approach: Apply an integrated exposome/eco-exposome/socio-exposome framework to understand cumulative chemical, biological, and physical contamination across food chains. Maintain ambitious regulatory standards, reject the export of banned substances, and prioritize source-level prevention.
- Addressing Food Vulnerabilities for Global Health: Fully integrate food vulnerabilities: economic, nutritional, environmental, and social into the One Health approach. Address intersecting inequalities, develop localized strategies for rural, coastal, island, and urban areas, and include fisheries and aquaculture in the analysis of food insecurity.

III. Cross-Cutting Integration:

The operational success of these thematic pillars ultimately rests upon a unified foundation of multisectoral governance, interoperable data systems, and the ethical integration of social sciences and humanities to ensure local relevance.

DATA to enable OH implementation

Data convergence is the "catalyst" that allows information to circulate between sectors.

- Unlock the value of existing data for prevention and global health security
- Across the world, vast amounts of data relevant to human, animal, environmental and ecosystem health are already collected by research institutions, public agencies and monitoring systems. However, these data remain largely fragmented across sectors and institutions, limiting their capacity to inform prevention and early detection of emerging risks.
- Strengthening One Health data convergence offers a major opportunity to transform existing datasets into actionable knowledge. By enabling integrated analyses across sectors, countries and disciplines, such convergence can significantly improve the capacity of governments and institutions to anticipate health threats, better understand the drivers of disease emergence, and support evidence-based policy decisions.
- International experience also shows that successful data collaboration depends on trust and perceived fairness among partners, including recognition of data contributions and consideration of how resulting benefits may be shared.
- Build interoperability while respecting data sovereignty
- A central principle of the proposed approach is to promote progressive interoperability between existing data systems, while fully respecting national sovereignty over data, legal frameworks, privacy requirements and ethical standards.
- This can be achieved by strengthening the technical foundations that enable different datasets to interact and be interpreted together, including shared metadata standards, common identifiers and interoperable vocabularies. Federated data architectures can play a key role in this process, allowing institutions to maintain stewardship of their data while improving discoverability and analytical use across sectors.
- Such an approach avoids the need for centralized databases and instead focuses on connecting existing systems, making them more visible and usable while maintaining trust among stakeholders and encouraging equitable collaboration between data contributors.
- Demonstrate impact through practical cooperation and pilot initiatives
- For One Health data convergence to move beyond a conceptual ambition, it must deliver concrete operational benefits. Pilot initiatives at national and regional levels can play a crucial role in demonstrating how interoperable data ecosystems can support prevention, risk monitoring and public decision-making.
- These initiatives could focus on developing cross-sector indicators, strengthening metadata catalogues, and testing analytical tools capable of integrating environmental, animal and human health data. Over time, such demonstrators would provide practical guidance for scaling up interoperable data ecosystems and facilitate the sharing of knowledge, results and lessons learned.
- Ultimately, strengthening One Health data convergence is not only a technical exercise. It represents a strategic investment in global preparedness, prevention and resilience,

enabling governments and institutions to better anticipate complex health risks in an increasingly interconnected world.

Social sciences and humanities to understand the social challenges of the One Health model

The social sciences and humanities (SSH) are not a separate field, but rather a tool for understanding the social issues related to the "One Health" approach, which encompasses the entire ecosystem and ensures social acceptability and ethical justice.

Challenges: The implementation of One Health faces several major challenges. A persistent gap exists between global conceptual frameworks and heterogeneous territorial realities. Local stakeholders and vulnerable populations remain insufficiently involved, while behavioral and social determinants are still poorly integrated into policies. Ethical foundations guiding public decision-making remain insufficiently formalized. Furthermore, evaluation of One Health policies often remains fragmented and sectoral, limiting their legitimacy, social appropriation, and operational effectiveness.

- Recognize place-based socio-ecological contexts (including rural areas, peri-urban zones, and disadvantaged neighborhoods) as strategic levels for the evaluation, design, experimentation, and governance of One Health policies, by developing intersectoral and multi-level (from individual to collective) governance mechanisms with clear mandates.
- Systematically integrate the reduction of social, territorial, and gender inequalities into the design and implementation of One Health policies, particularly in multi-crisis contexts. This requires institutionalizing co-construction with local stakeholders, including vulnerable and marginalized communities, and ensure sustainable funding for intermediary functions between research, public decision-making, and society.
- Develop a range of decision-support tools tailored to different end-users — including policy-makers, territorial governance bodies, health professionals, community organizations, and the public — integrating scientific data, local knowledge, behavioral determinants, and social practices, particularly in prevention and vaccination strategies, and ensuring these tools are accessible, adaptable, and grounded in diverse local contexts and capacities.
- Clarify and formalize the ethical foundations of One Health by integrating social, environmental, and epistemic justice issues into governance, legal frameworks, and crisis management.

Conclusion: The Integrated One Health Ecosystem

The **Integrated One Health Ecosystem** represents a fundamental shift from fragmented, reactive interventions to a proactive, unified defense against the complex health threats of the 21st century. By breaking down traditional silos, this framework ensures that the health of humans, animals, plants, and the environment is addressed as a single, indivisible entity.

The success of the four **Operational Pillars** — Emerging Infectious Diseases, Antimicrobial Resistance (AMR), Pollution, and Sustainable Food Systems — depends on the strength of the **three Cross-Cutting Foundations**:

- **Governance as the Base:** Effective action within the pillars requires the institutionalization of One Health frameworks. Governance provides the multisectoral coordination, science-policy interfaces, and sustainable financing necessary to transition from theory to effective primary prevention.
- **Data as the Enabler:** Data convergence acts as the "catalyst" that enables information to flow between sectors. Interoperable data systems allow the pillars to move beyond isolated monitoring to integrated, predictive analysis, transforming fragmented datasets into actionable knowledge for global health security.
- **Social Sciences and Humanities as the "go-between" tool:** Social sciences (SSH) and ethics wrap around the entire ecosystem to ensure that technical solutions are socially acceptable, ethically grounded, and equitable. By involving local communities and addressing social determinants, SSH ensures that policies are not just scientifically sound but also "place-based" and just.

A Unified Approach for Present and Future Challenges: The pressing challenges of our time—ranging from zoonotic spillovers and the "silent pandemic" of AMR to pervasive chemical pollution and failing food systems—are deeply interconnected. A "siloed" approach that focuses on only one compartment of the ecosystem is inherently inefficient and often leads to unintended consequences. Implementing **the One Health approach** is no longer a conceptual choice but a practical necessity for global resilience. By fostering transdisciplinary research, inclusive decision-making, and technological innovation today, we can safeguard the ecological foundations required to support the health of future generations. Only through this integrated, collective effort and transformative change can we effectively anticipate, prevent, and respond to the evolving health crises of an increasingly interconnected world.

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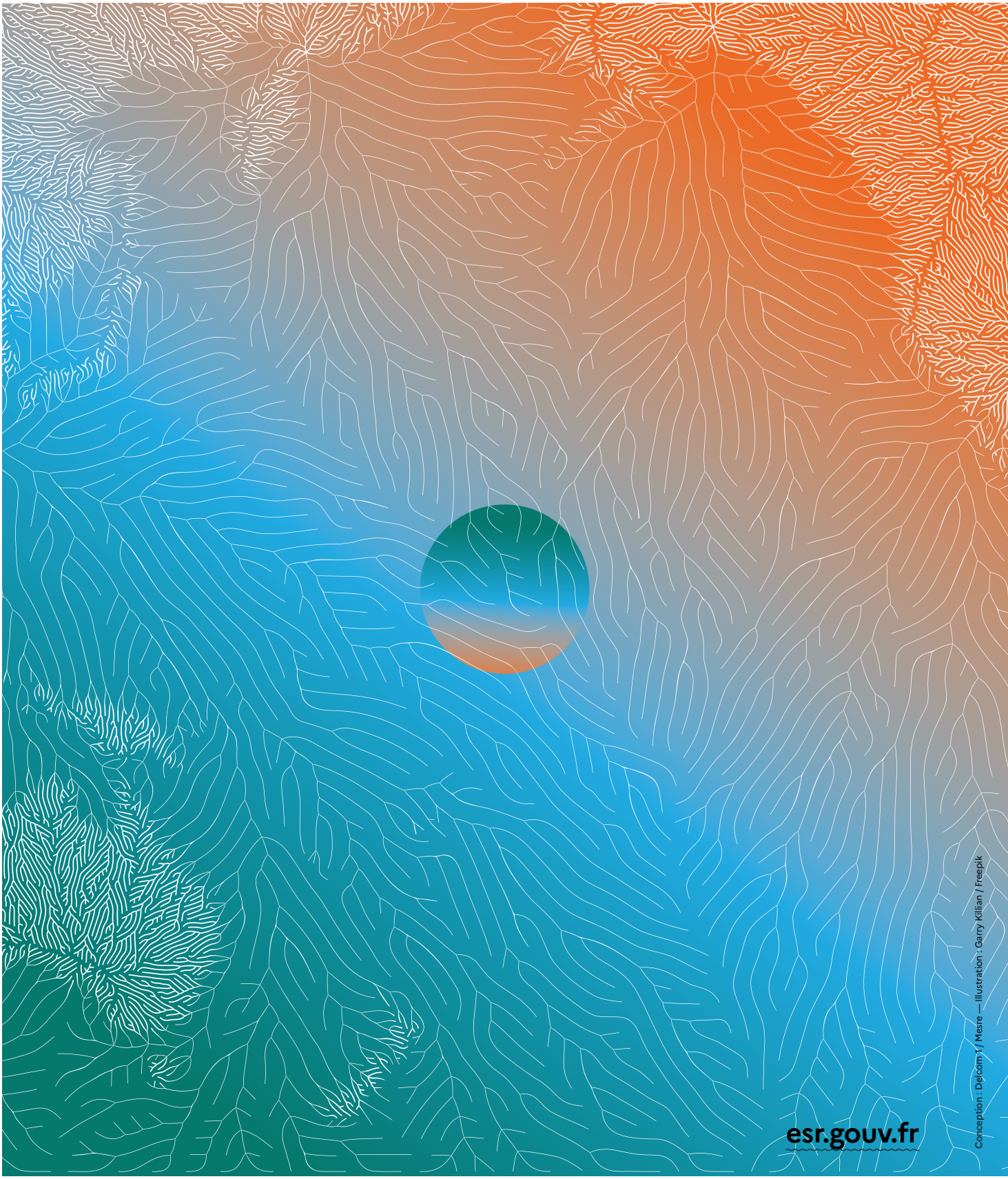

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