Position Paper

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Embedding Biodiversity within One Health

in the Strategy for European Life Sciences

Joint Cross-Project Position Paper · 2026

BCOMING BE PREP RESTOREID zoe

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Executive Summary

This position paper was developed by four Horizon Europe projects working at the biodiversity–health interface to support the European Commission in implementing the Strategy for European Life Sciences[1] and to identify research gaps and priorities relevant to Horizon Europe for the next framework programme period 2028-2034.

It draws on evidence generated by four Horizon Europe projects: BCOMING (Grant agreement ID: 101059483[2]), BEPREP (Grant agreement ID: 101060568[3]), RESTOREID (Grant agreement identifier: 101134969[4]) and ZOE (Grant agreement ID: 101135094[5]). The evidence base includes project deliverables, scientific articles and contributions, BCOMING[6], BEPREP[7], RESTOREID[8] and ZOE policy briefs[10], as well as a cross-project questionnaire completed by partners across all four projects. The questionnaire was developed to identify shared scientific findings, implementation challenges, research gaps, infrastructure priorities, and policy needs related to biodiversity, One Health, and pandemic preparedness, and to support the development of joint recommendations for Horizon Europe 2028–2034.

The questionnaire responses brought together expertise from a wide range of disciplinary, institutional, and geographical backgrounds across the four projects, providing an interdisciplinary and internationally grounded perspective on biodiversity–health interactions, pandemic preparedness, surveillance, restoration, and One Health implementation.

This paper aligns directly with the Strategy for European Life Sciences, which defines life sciences as the study of living systems "from human beings, animals, plants, microorganisms to ecosystems and their interconnectedness" and emphasises coordinated approaches across the life sciences value chain. Evidence generated across BCOMING, BEPREP, RESTOREID, and ZOE demonstrates that biodiversity is not external to the life sciences agenda, but a foundational component of prevention-oriented, resilient, and integrated One Health approaches. Embedding biodiversity within life sciences therefore strengthens the Strategy's objectives on prevention, surveillance, data integration, public trust, innovation uptake, and cross-sector coordination.

The Strategy may not fully realise its ambitions if it addresses life sciences holistically in principle but leaves the biodiversity-health interface under resourced in practice. Findings from the RESTOREID expert elicitation[11], the global evidence synthesis on land-use change and zoonotic risks[12], and the RESTOREID policy brief[8] provide independent, practitioner-level evidence that this incoherence is already visible on the ground and in the data:

[1] https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/jobs-and-economy/strategy-european-life-sciences_en
[2] https://cordis.europa.eu/project/id/101059483; https://bcoming.eu/
[3] https://cordis.europa.eu/project/id/101060568; https://www.beprep-project.eu/
[4] https://cordis.europa.eu/project/id/101134969; https://restoreid.eu/
[5] https://cordis.europa.eu/project/id/101135094; https://www.zoe-project.eu
[6] Lovasz, G., Foldessy, A., Smajgl, A., Ward, J., Todd, A., Furey, N., Thi, S., Mak, S., & Moung, V. (2024). BCOMING Policy brief - Implementation of One Health initiatives for better surveillance and mitigating the risks of emerging zoonotic diseases – participatory processes and technological tools supporting successful results. Zenodo. https://doi.org/10.5281/zenodo.13149189
[7] Ecke, F., Semenza, J. C., Buzan, E., Costa, F., Giorgi, E., Guo, J., Kirkpatrick, L., Knauf, S., Meheretu, Y., Singh, N., Sjödin, H., Timperley, M., Treskova, M., Ulrich, R. G., Zeppelini, C. G. & Rocklöv, J. Adaptive ecosystem restoration to mitigate zoonotic risks. Nature Ecology & Evolution 9, 1979-1988 (2025). https://doi.org/10.1038/s41559-025-02869-3
[8] RESTOREID D6.6 Policy Brief 1
[9] Goffaux, R., Durieux, C., de Bouville, J., Kirkpatrick, L., Jagadesh, S., Kabisch, N., Ecke, F., & Bunnefeld, N. (2026). Reducing zoonotic risk through nature restoration. Biodiversa+. https://doi.org/10.5281/zenodo.20750160
[10] Kabisch N., Jo W.K., Dumitru A., Ambort M.A., Reperant L. (2026) Deliverable 6.6 Policy Brief I – Introducing ZOE and first policy recommendations. ZOE Project. GA Number: 101135094. https://doi.org/10.5281/zenodo.20450012
[11] RESTOREID D4.2 Expert elicitation
[12] Fell, A., Jagadesh, S., Duthie, A.B. et al. Global evidence synthesis on land-use change and zoonotic risks. Nat Sustain 9, 142–152 (2026). https://doi.org/10.1038/s41893-025-01750-2

people working in restoration and land-use change are not equipped with the tools, governance frameworks, or surveillance capacity that a genuinely integrated life sciences strategy would require. This represents an opportunity for the EU Life Sciences Strategy to close the distance between its stated ambitions and current practice on the ground by ensuring that the next Framework Programme provides the long-term infrastructure, governance mechanisms, and cross-sectoral coordination that practitioners, communities, and ecosystems urgently need. The recommendations in this paper identify the specific investments required to do so.

Biodiversity loss is increasingly recognised as a driver of emerging infectious diseases, ecosystem instability, and socio-economic risk.[13] [14] Evidence generated across BCOMING, BEPREP, RESTOREID and ZOE demonstrates that biodiversity and healthy ecosystems are not an optional contextual factor within One Health, but a core determinant of prevention, preparedness, resilience, and long-term health security.[15]

One Health threats do not stop at national or EU borders: biodiversity loss, ecosystem degradation, land-use change, and zoonotic emergence are shaped by interconnected ecological, trade, food and production systems within and beyond Europe.

Global biodiversity loss is accelerating ecosystem degradation, intensifying and modifying human–animal contact, and increasing the conditions that facilitate pathogen emergence and spillover.[14] [15] Ignoring the links between biodiversity loss, land-use change, ecosystem disruption, and disease emergence places Europe in a vulnerable position economically, environmentally, and strategically.[16] Embedding biodiversity more explicitly within One Health is therefore essential for strengthening European resilience, preparedness, and preventive capacity.

Evidence from RESTOREID and BEPREP further strengthens the case for treating nature restoration as a proactive public health strategy.[7] [8] Well-designed restoration can reduce zoonotic risk by rebuilding ecological complexity, reducing the dominance of high-risk reservoir species, and stabilising host–pathogen dynamics. However, restoration must be 'safe by design', with zoonotic risk considered from the planning stage to manage localised, context-specific transition risks and maintain public trust.[7] [9] [12] Restoration efforts should also recognise that biodiversity recovery is not only about restoring ecosystems, but also about supporting healthier and more equitable livelihoods and socio-economic opportunities. Restoration planning and governance should therefore integrate local perspectives and understandings of wellbeing from the design stage onward, while recognising that actors involved in conservation and restoration shape changing human–wildlife interactions and risk landscapes in different ways.[7] Evidence from ZOE's community work highlights the necessity for enhanced public communication strategies and locally tailored policies to improve environmental education on zoonotic risks. These locally tailored education strategies should be coupled with communicating a broader understanding of biodiversity's essential role in ecosystem stability, while recognizing that cultural practices may need to adapt.[10]

[13] Carlson, C.J., Albery, G.F., Merow, C. et al. Climate change increases cross-species viral transmission risk. Nature 607, 555–562 (2022). https://doi.org/10.1038/s41586-022-04788-w

[14] IPBES (2020) Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services. Daszak, P., Amuasi, J., das Neves, C. G., Hayman, D., Kuiken, T., Roche, B., Zambrana-Torrelio, C., Buss, P., Dundarova, H., Feferholtz, Y., Földvári, G., Igbinosa, E., Junglen, S., Liu, Q., Suzan, G., Uhart, M., Wannous, C., Woolaston, K., Mosig Reidl, P., O'Brien, K., Pascual, U., Stoett, P., Li, H., Ngo, H. T., IPBES secretariat, Bonn, Germany, DOI:10.5281/zenodo.4147317.

[15] One Health High-Level Expert Panel (OHHLEP). 2022. One Health: A new definition for a sustainable and healthy future. PLoS Pathogens, 18(6): e1010537.

[16] National security assessment - global biodiversity loss ecosystem collapse and national security, HM Government

The European Commission has already invested in the biodiversity–One Health nexus through Horizon Europe 2021–2027. Together, the four contributing projects have generated evidence across key areas, including mechanistic understanding, monitoring, surveillance, predictive modelling, solution design, governance, and implementation.[17] [18] [19] However, without continuity and targeted investment in the next Framework Programme, much of this knowledge risks remaining fragmented and underutilised. Multiple projects also identify short-term funding cycles as a barrier to generating the long-term ecological, epidemiological, and biodiversity datasets needed for predictive One Health research and surveillance.[6] [20]

This position paper aims to support the implementation of the Strategy for European Life Sciences and inform priorities for Horizon Europe 2028–2034. It delivers:

- a citable scientific overview establishing biodiversity as a foundational component of One Health; and
- specific, fundable research and innovation recommendations to strengthen prevention, preparedness, surveillance, and biodiversity-based health resilience across Europe.

SHEILA HOLMES - BEPREP

[17] BCOMING D7.1 Stakeholder Case Study Site Description
[18] BCOMING D7.3 A priori testing of zoonotic mitigation solutions
[19] BCOMING D7.4 Report on One Health systems learning
[20] RESTOREID findings from the joint project questionnaire

01 | Introduction

Biodiversity loss sits at the intersection of environmental degradation, climate change, economic cost, security risk, and global fragmentation.[13] [21] Landscape degradation driven by food production, land-use change, and extractive practices increases competition for scarce resources, drives migration and political instability, intensifies human–animal contact, and accelerates disease emergence.

The threat of future pandemic spillover is inseparable from these dynamics, particularly for pathogens recognized within WHO and WOAH priority frameworks.

Evidence from the four projects contributing to this paper shows that disease emergence cannot be effectively addressed without understanding how biodiversity loss alters ecosystem functioning, host–pathogen dynamics, and human exposure pathways.

The biodiversity–health interface should therefore be understood not as a peripheral environmental issue, but as a specific contribution to the Strategy for European Life Sciences across its core implementation areas, including holistic One Health research and innovation, interoperable data and AI infrastructures, public trust and stakeholder engagement, and coordinated cross-sector governance.

RESTOREID and BEPREP further highlight that ecosystem simplification and habitat degradation can favour dominance of high-risk reservoir species, while ecologically complex and biodiverse systems may stabilise host–pathogen dynamics and reduce spillover risk through dilution effects.[7] [8] [9] One Health frameworks that do not structurally embed biodiversity therefore risk incoherency because the mechanisms that drive spillover risk operate at the ecosystem level.

The final Horizon Europe 2021–2027 calls on biodiversity and One Health show the Commission's continued commitment to this area. Together with the four projects contributing to this paper, they create a strong pathway from early evidence generation to policy-relevant synthesis. However, without stronger integration of biodiversity within One Health in the next Framework Programme, this pathway risks stopping before it leads to lasting policy and funding impact.

[21] Pfenning-Butterworth A, Buckley L, Drake J et al. Interconnecting global threats: climate change, biodiversity loss, and infectious diseases. The Lancet Planetary Health, 8, e270-e283

02 | Scope of the Paper

This document:

- focuses on embedding biodiversity within the One Health approach to research and innovation;
- builds on evidence generated by BCOMING, BEPREP, RESTOREID, and ZOE;
- provides forward-looking research and innovation recommendations aligned with the Strategy for European Life Sciences; and
- identifies research gaps and infrastructure needs relevant to Horizon Europe 2028–2034.

This document does not attempt to replicate existing policy strategies, nor does it provide exhaustive technical detail for each action. Detailed policy-action mappings and research gaps are provided in the annexes.

NADJA KABISCH AND FELIX DREXLER - ZOE

03 | Strategic Goals for Embedding Biodiversity in One Health

Goal 1

Strengthen the integration of biodiversity within One Health through improved causal understanding and implementation

Biodiversity loss is identified as a key driver of disease emergence and pandemic risk [6 9], particularly in high-risk ecological interfaces and biodiversity hotspots. At the same time, current research and policy frameworks remain largely constrained by correlation-based approaches, limiting the ability to identify causal mechanisms and feedback loops , and multi-scale processes linking biodiversity change to health outcomes.[22]

This limitation directly affects implementation. Despite increased recognition of the biodiversity–health nexus, the COVID-19 crisis exposed the structural weaknesses of existing One Health approaches[6], particularly their limited operationalization, predictive capacity, and translation into field-level action. Across projects, there is consistent evidence of a gap between knowledge generation and policy uptake, with insufficient integration into public health strategies, land-use planning, and governance frameworks.[11 20 23] To overcome this gap not only knowledge generation needs to improve but also participatory processes need to be introduced that effectively bridge the science-policy interface, as demonstrated with the ChaRL processes in BCOMING.[19] Otherwise, knowledge improvements may continue to have inconsistent policy impacts.

In addition, implementation remains constrained by the lack of context-adapted, stakeholder-relevant solutions.[9] Effective interventions are often not designed for real-world conditions or lack alignment with local socio-economic, cultural and ecological contexts, reducing their uptake, scalability and long-term impact. [6 10 22]

Current investment also remains more strongly focused on documenting biodiversity degradation and disease risk rather than understanding and implementing how restoration, biodiversity recovery, and ecosystem-based approaches can reduce pathogen risk and strengthen long-term animal and human health resilience, particularly in high-risk regions outside Europe where sustainable research funding and long-term monitoring remain limited.[15]

[22] BEPREP findings from the joint project questionnaire
[23] BCOMING findings from the joint project questionnaire

Goal 2

Develop predictive and preventive capacity for biodiversity–health risks

Current approaches remain largely reactive, with limited ability to anticipate pathogen emergence, system-level instability, or effects of the environmental change on disease dynamics.[10 24 25] Recent outbreaks, including the ongoing (2026) Ebola Bundibugyo outbreak in Central Africa with still uncertain origins, further highlight the consequences of limited understanding of the ecological and environmental drivers of emergence. Preparedness should therefore not be understood only in terms of vaccines and therapeutics, but also in terms of understanding and anticipating the underlying drivers of disease emergence.

There is a need to shift toward predictive, mechanism-informed frameworks[25] that focus on the improved management of the human environment interface for effective surveillance and zoonosis prevention, which integrate biodiversity, ecosystem functioning, pathogen dynamics, and human health, including stronger integration of functional and mechanistic processes across a range of host–vector–environment systems.[24 25] The resulting Zoonosis Prevention Architecture (ZPA) would take an explicit whole-of-systems approach for managing zoonotic risks. These priorities are aligned with ongoing international prevention-oriented initiatives, including PREZODE, which emphasises predictive, integrated, and systems-based approaches to zoonotic risk prevention.

Across projects, reliance on case-specific correlations limits transferability and prevents scaling of findings across regions and systems.[22 25] Strengthening predictive capacity therefore requires integrating ecological, epidemiological, and evolutionary processes into unified analytical frameworks.[25]

VINCENT SLUYDTS - BCOMING

[24] ZOE findings from the joint project questionnaire
[25] BCOMING findings

Goal 3

Build integrated data, monitoring, and indicator infrastructures

Fragmentation across data systems, surveillance approaches, metrics, protocols and analytical frameworks limits comparability, synthesis and decision-making.[7 20 24 25] The evidence points to the need for interoperable One Health databases, standardised surveillance protocols, comparative analytical frameworks, and harmonised indicators for assessing emergence risks.[7 25] At the same time, these infrastructures must account for the highly context-dependent relationships between biodiversity change and host–pathogen dynamics across different environments.

There is a clear need to develop interoperable infrastructures that integrate ecological, genomic, epidemiological, and environmental data, including scalable biodiversity monitoring approaches such as eDNA, alongside harmonised indicators capable of supporting early warning and policy-relevant risk assessment.[20 24 25 26]

The profound funding gap in gathering integrated socio-economic data highlights a lack of financial support for monitoring the human and behavioural metrics necessary for interoperable infrastructures. There is a chronic lack of long-term funding to integrate health surveillance directly into environmental monitoring, highlighting a structural gap for cross-sector data sharing.

VINCENT SLUYDTS - BCOMING

[26] BCOMING D3.7 Biodiversity assessment

Goal 4

Design and implement context specific and participatory One Health solutions

Evidence from participatory and transdisciplinary work shows that effective One Health solutions must be context-specific, co-created with stakeholders,[10 7] and evaluated for both benefits and unintended consequences.[6 7 27] Implementation also requires commitment from governments, organisations, and communities, because current interventions do not sufficiently reflect One Health principles and therefore remain limited in preventing zoonotic disease emergence.[6]

Current interventions do not sufficiently reflect One Health principles, particularly in their limited integration of ecological, social, and governance dimensions, which constrains their effectiveness and scalability.[6 20 28] Implementation also depends on governance structures, stakeholder engagement, and long-term commitment across sectors, which remain unevenly developed across projects and regions.[6 7 9 27] Implementation is further constrained by limited support for ex ante zoonotic risk screening, transition-phase monitoring, and long-term capacity building within restoration and natural resource management programmes.[9] Current funding structures also rarely support the integration of public health and veterinary authorities from the initial design and planning stages of National Restoration Plans, particularly in vulnerable regions where long-term monitoring and health infrastructure remain limited. Emerging biodiversity financing mechanisms, including biodiversity credits, should also integrate One Health considerations to ensure that restoration and conservation investments support both ecosystem recovery and long-term health resilience.[9] In addition, evidence highlights the importance of aligning solutions with local incentives, behaviours, and socio-economic conditions, as well as systematically evaluating co-benefits and trade-offs of interventions, including nature-based solutions and restoration strategies.[18 19 25 28] Effective One Health solutions require the adoption of "incentive ecology" frameworks, which embed community-designed, multi-layered incentives in national programmes and One Health strategies.[19]

RESTOREID adds that ecosystem restoration should not be treated as automatically risk-free.[7 9] While ecological restoration is framed as a net positive for health, its benefits depend on design, implementation, and monitoring.[7 9] A 'safe-by-design' approach is therefore needed to anticipate potential localised risks, including changes in animal communities, vector abundance, human access patterns, and human–wildlife contact during the transition phase.[7 9]

Currently, natural resource conservation interventions do not reflect a One Health approach and as such do not prevent zoonotic disease emergence/spillover.

[27] BCOMING D7.2 Visions, beliefs and values
[28] BCOMING D6.6 Stakeholder risk perceptions V2

04 | Specific Research and Innovation Recommendations

To truly embed biodiversity as a foundational pillar of One Health, the EU must move beyond 'one-size-fits-all' ecological models. The impacts of landscape change and biodiversity loss and recovery on health outcomes are highly nonlinear and context-dependent, shaped by complex local variables that also dictate the success of restoration efforts. FP10 should therefore support mechanistic research examining how these dynamics shift across critical anthropogenic interfaces, such as the transitions between urban and agricultural zones, or agricultural and restored landscapes. Only by understanding these underlying drivers can we transition from reactive monitoring towards more predictive and site-specific One Health interventions.

> **"One-size-fits-all" ecological models are insufficient for understanding biodiversity–health dynamics across different socio-ecological contexts and anthropogenic interfaces.**

Taken together, the following recommendations identify priority areas for research and innovation support relevant to the implementation of the Strategy for European Life Sciences particularly across integrated One Health approaches, data and AI infrastructures, public trust, and cross-sector coordination.

Recommendation 1

Invest in mechanistic and causal biodiversity–health research

Primary DGs: DG RTD, DG SANTE
Secondary DGs: DG ENV, DG CLIMA, DG AGRI

Long-term interdisciplinary research programmes should prioritise the transition from correlation-based analyses toward mechanistic and causal understanding of biodiversity–health interactions across different ecological, anthropogenic and socio-economic contexts. This recommendation includes the request for integrating ecological, virological, epidemiological, and socio-environmental processes across scales in an inter- and transdisciplinary approach and examining not only how biodiversity loss increases disease risk, but also how and under which conditions restoration and landscape recovery may reduce risk across anthropogenic interfaces within nations, or may offset risks to different, more biodiverse but less secure regions globally. These claims directly support the Strategy for European Life Sciences by reinforcing European R&I excellence and advancing a holistic One Health approach that links life sciences from organisms to ecosystems. Restoration practitioners are not currently operating with an integrated human-animal-environment perspective — for instance, risky human contacts and pathogen spillover receive less monitoring attention in restoration projects than in land-use change projects[11], moving towards this should be a necessary focus of the EU Life Sciences Strategy, to be truly preventative.

> **Only 39 restoration-focused studies examining infectious disease outcomes were identified across a 24-year period.**

Evidence from projects

BCOMING identifies the need to move beyond correlation-based approaches toward mechanistic understanding.[25]

BEPREP questionnaire responses identified "limited causal evidence linking biodiversity and disease risk (context specific)"[22] and emphasised the need for long-term data collection to address current evidence gaps.

RESTOREID points to a "persistent lack of quantitative, policy-ready evidence linking specific restoration interventions to infectious disease outcomes."[20], while also highlighting that restoration-focused research remains drastically underfunded compared to research on landscape degradation and disease emergence. RESTOREID policy evidence further shows that only 39 restoration-focused studies examining infectious disease outcomes were identified across a 24-year period, despite growing recognition that restoration may help reduce zoonotic risk and support healthier landscapes.[9] RESTOREID expert elicitation[11] reflects that land-use change and restoration practitioners view the effects of restoration on zoonotic risk spillover as "context dependent" and uncertain, with the effects differing across ecological contexts and vectors/pathogens.

ZOE highlights that ecosystem degradation, biodiversity loss, and land-use change influence infectious disease emergence, while also identifying the persistent "limited understanding of how biodiversity, social behavioural factors and land-use changes translate into disease emergence risk."[24]

Implementation needs

- Development of mechanistic and multi-scale approaches to biodiversity–health interactions across key ecological contexts and anthropogenic interfaces.
- Standardisation of metrics, surveillance protocols, and analytical frameworks to improve comparability, including development of indicators that are meaningful for policymakers and public engagement.
- Coordination across disciplines, including ecology, virology, epidemiology, veterinary science, modelling, land-use ecology, and social sciences, particularly across high-risk anthropogenic interfaces such as agricultural, restored, rewilding landscapes and peri-urban areas.
- FP10 research priorities should also address how agricultural extensification, urbanisation, rewilding, habitat recovery, and landscape transitions alter wildlife–livestock–human interfaces and associated zoonotic risks both within regions and due to risks leaking to more biodiverse but insecure regions.

Long-term research efforts to support sustained and integrated investigation of biodiversity–health interactions.

DG Mapping

This recommendation mainly belongs to **DG RTD** because the evidence calls for new research frameworks, mechanistic science, interdisciplinary networks, and FP10 investment. **DG SANTE** is primary because the purpose is emergence risk assessment, preparedness, and health security. **DG ENV, DG CLIMA and DG AGRI** are secondary because the evidence links disease emergence to biodiversity alteration, land-use change, climate perturbation, agriculture, and ecosystem functioning, particularly across key contexts and anthropogenic interfaces where wildlife, livestock, and human systems interact.

Recommendation 2

Establish long - term One Health observatories

Primary DGs: DG RTD, DG SANTE, DG ENV, DG AGRI
Secondary DGs: DG CLIMA, DG REGIO

Longitudinal One Health observatories should be established to monitor biodiversity, host ecology, pathogen circulation, human activities, and health outcomes over extended timeframes and across different anthropogenic interfaces both within and outside of Europe. This establishment requires long-term interdisciplinary investment across (landscape) ecology, veterinary science, virology, epidemiology, and social sciences to better understand how biodiversity, land-use change, agriculture, and human activities interact across high-risk interfaces, including wildlife–livestock systems. The observatories can partly be linked to existing monitoring of wildlife, vectors, air, water and soil that currently do not include a pathogen component. The interdisciplinary collaboration would strengthen implementation of the Strategy for European Life Sciences by building the long-term evidence capacity needed for a holistic and prevention-oriented life sciences agenda.

> **Long-term One Health observatories are needed across different anthropogenic interfaces to understand how biodiversity, land-use change, restoration, and human activity influence disease emergence over time.**

Evidence from projects

BCOMING highlights insufficient long-term surveillance capacity noting that “Long-term, multi-host ecological surveillance systems… remain severely underfunded”.

RESTOREID identifies the absence of integrated long-term datasets including “lack of long-term and integrated datasets that combine ecological, environmental and epidemiological information” and a “temporal mismatch between ecological processes and funding cycles”. RESTOREID expert elicitation[11] showed that “around half of restoration experts reported feeling unprepared to cope with zoonotic disease transmission, with weak governance, insufficient funding, and poor surveillance capacity as key barriers”. ZOE reports similar fragmentation and short duration of datasets referring to a “lack of long-term and integrated datasets” and “fragmented datasets collected at different spatial and temporal scales”.

BEPREP likewise emphasises limitations associated with short term project durations, noting that the "project is too short to make final conclusions" and "long-term data are required".[7]

ZOE also noted the general limitations toward "... a fully covered one-health approach" due to "...the too short time frames and budget constraints of the single projects." ZOE highlights that "Clear and transparent sampling protocols, ...long term research with established case studies of up to at least 6-10 years [with] interdisciplinary teams are needed that cover the full One Health spectrum with landscape ecologists, geographers, geobotanists, sociologists, virologists, epidemiologists, veterinarians, etc."[24]

Implementation needs

- Dedicated long-term infrastructure funding beyond standard 3–5 year project cycles.
- Establishment of longitudinal One Health observatories across diverse ecological and socio-economic contexts.
- Harmonised monitoring protocols for biodiversity, pathogens, human activities, and socio-ecological systems.
- Integration of ecological, epidemiological, and socio-economic data within shared, interoperable infrastructures.
- Cross-border and cross-DG coordination to ensure continuity, integration, and comparability beyond individual projects.

DG Mapping

This recommendation sits with **DG RTD** because it requires long-term research infrastructure and funding. **DG SANTE** is primary because observatories monitor pathogen circulation, health outcomes and preparedness signals. **DG ENV** is primary because biodiversity and ecosystem monitoring are central. **DG AGRI** is also primary because agriculture, food production systems, and wildlife-livestock interfaces are central components of spillover risk and disease emergence processes. **DG CLIMA** is relevant where climate variability and perturbations affect disease spread and dynamics. **DG REGIO** where observatories are place-based across regions.

Recommendation 3

Develop integrated forecasting and surveillance systems

Primary DGs: DG RTD, DG SANTE
Secondary DGs: DG CONNECT, DG ENV, DG CLIMA, DG AGRI

Mechanism-informed forecasting and integrated surveillance systems should be developed to anticipate pathogen emergence across hosts, vectors, and environments. This aligns with the Strategy for European Life Sciences by contributing to its priorities on unlocking the power of data and AI, strengthening interoperable infrastructures, and improving cross-sector preparedness. Findings from the RESTOREID expert elicitation[11] indicate that while biodiversity is commonly monitored in restoration initiatives, pathogen spillover, human-animal interaction types, and socio-economic factors remain systematically under monitored. Addressing these gaps will require integrated and interoperable monitoring systems capable of linking ecological, epidemiological, behavioural, and socio-economic data.[12] The effective use of AI and forecasting tools will also depend on adequate governance, coordination, representative training data, and investment in trained personnel capable of interpreting risk outputs and translating them into decision-making and action.[12] Institutional coordination is further needed to ensure that surveillance outputs can effectively inform decision-making across environment, health, and agricultural sectors.

Evidence from projects

BCOMING calls for predictive and integrated approaches through the "development of predictive, mechanism-informed frameworks capable of explaining and anticipating viral emergence" and the deployment of "integrated surveillance systems combining 1) eDNA and metagenomics,[26] 2) remote sensing, and 3) AI-based early detection tools". BCOMING D3.7 demonstrates the value of multi-marker eDNA metabarcoding and complementary terrestrial methods for scalable biodiversity monitoring across anthropogenic gradients.[26]

BEPREP highlights the need for improved early warning and integrated monitoring by "Providing data for... early-warning frameworks for zoonotic diseases" and supporting the "incorporation of ecological indicators into surveillance systems".

RESTOREID identifies fragmentation and lack of operational tools noting that "evidence remains fragmented across disciplines, leading to weak translation into decision-support tools", while also proposing practical One Health indicators, related to vectors, reservoir hosts and human exposure.[8 19]

ZOE supports interdisciplinary, integrated One Health analysis by linking ecosystem degradation, biodiversity loss, land-use change, and infectious disease emergence, while also identifying "lack of long-term and integrated datasets that combine ecological, environmental and epidemiological information".[10]

Implementation needs

- Development of interoperable data platforms integrating ecological, genomic, epidemiological, and environmental data, alongside standardised surveillance pipelines and early-warning indicators across systems. This includes common standards, ontologies and interoperability frameworks that allow AI tools to function across national and sectoral boundaries as well as financial support for cross-sector data sharing and joint governance.
- Investment in advanced monitoring tools, including eDNA, metagenomics, remote sensing and AI-based detection, while combining complementary biodiversity monitoring methods rather than relying on a single sampling approach.[26]
- Support for interdisciplinary expertise bridging modelling, ecology, virology, epidemiology, and data integration.
- Translation of research outputs into operational decision-support tools for policymakers.
- Integration of behavioural, socio-economic, participatory, and risk-perception dimensions into surveillance system design and implementation,[28] including human-wildlife interactions relevant to forecasting and early warning systems.
- Invest in AI-driven predictive models that integrate ecological, epidemiological, genomic and environmental data streams to anticipate pathogen emergence across hosts and vectors and incorporating missing critical components such as pathogen spillover and human-animal interaction data.
- Financial support for cross-sector data sharing, joint governance approaches, and interoperable monitoring systems linking environmental, public health, and veterinary sectors.

DG Mapping

This recommendation maps to **DG RTD** because it requires predictive models, surveillance research and technological development. **DG SANTE** is primary because the outputs support disease preparedness, early warning and public health risk assessment. **DG CONNECT** is primary because the evidence repeatedly calls for interoperable platforms, AI tools, data infrastructures and dashboards. Any AI tools need to be paired with human infrastructure requirements, to ensure that capacity building and governance frameworks are usable in practice. These should connect across DG RTD, DG SANTE and DG CONNECT. **DG ENV, DG CLIMA and DG AGRI** are relevant because environmental change, climate, land-use and agriculture are part of the risk system.

Recommendation 4

Support solution design, implementation, and evaluation

Primary DGs: DG ENV, DG SANTE, DG RTD
Secondary DGs: DG AGRI, DG REGIO

Nature-based, restoration-based, and incentive-based solutions should be co-designed with communities[7 18 19 27] and assessed through a 'safe-by-design' One Health approach. Evidence suggests that restoration-related zoonotic risks are generally perceived as manageable rather than severe, reinforcing the value of proactive risk assessment and mitigation measures from the design stage onward.[11] This requires moving beyond fear-based risk communication toward context-specific incentives, stakeholder engagement, and adaptive management that reduce zoonotic risks while supporting biodiversity recovery and public trust. Given uncertainties around the duration and reversibility of restoration-related risks, transition-phase monitoring should be incorporated into restoration planning and evaluation.[11] This strengthens the Strategy for European Life Sciences by linking holistic One Health implementation with public trust, outreach, and place-based uptake of innovation.

Evidence also highlights that "one-size-fits-all" approaches to restoration and One Health implementation can backfire if local ecological, socio-economic, and governance conditions are not adequately considered. While restoration is generally associated with manageable rather than severe zoonotic risks, outcomes remain context dependent and may temporarily increase risks for specific diseases, including Lyme disease.[11] Current evidence further shows that socio-economic dimensions and human–wildlife interactions are still poorly integrated into biodiversity–health research and implementation, reinforcing the need for more transdisciplinary and participatory approaches adapted to local contexts. Emerging biodiversity financing mechanisms, including biodiversity credits, should also embed One Health considerations to support both ecosystem recovery and long-term health resilience.[9]

> **Nature restoration can either reduce or amplify zoonotic risks, depending on the design and implementation of the restoration project, as well as how people interact with restored environments and associated exposure pathways.**

Evidence from projects

BCOMING emphasises participatory, incentive-based, and risk-perception-informed approaches through a "shift from Fear appeal… to incentive ecology, multi-layered schemes… aligned with cultural identity" and the need to "use participatory approaches to identify the context-relevant incentives".[19 23] BCOMING deliverables further show that community uptake depends on trust, livelihood impacts, and whether surveillance strategies are co-constructed rather than externally imposed.[17 18 19 28]

RESTOREID highlights governance and social barriers to implementation noting that "links between restoration, biodiversity and disease are not easily perceived by local communities" and that "new governance frameworks that engage local communities… are needed". It also stresses that zoonotic risk should be integrated into restoration from the design stage rather than treated as an afterthought, arguing that "The One Health approach, when integrated from the design stage of National Restoration Plans, enables policymakers to anticipate,

reduce and manage zoonotic risks without compromising ecological or health benefits", while warning that "Nature restoration can either reduce or amplify these risks, depending on the design and implementation of the restoration project".[9] RESTOREID further proposes context-based decision pathways outlining practical approaches for screening, assessing, and monitoring risks across different restoration environments, including wetlands, forests, urban areas, and agricultural mosaics. It also warns that restoration outcomes depend on implementation.

BEPREP stresses the need to move beyond reactive approaches, noting that "tick-borne diseases... have been managed through a reactive, medical perspective rather than as manifestations of ecological alterations".

ZOE underlines the importance of integrated One Health governance and community engagement, including "integrated policy frameworks that explicitly link biodiversity, human, and animal health"... and recognition that "community engagement... is critical for successful implementation." ZOE also notes the need for locally adapted public communication strategies explaining how human behaviour in the environment impacts health and leads to ecological consequences for humans, pets, and wildlife. When designing such strategies, regional asymmetries and diverse local dynamics should be considered.

Implementation needs

- Sustainable funding for transdisciplinary, participatory, and context-specific One Health approaches involving local communities and stakeholders and long term implementation capacity.
- Co-design of nature-based, restoration-based, and incentive-based interventions adapted to local socio-ecological conditions and developed together with communities, public health authorities, veterinary practitioners, land managers, restoration specialists, and local governance actors. [18] [19]
- Development of evaluation and adaptive monitoring frameworks capturing biodiversity, health, and socio-economic co-benefits, including early detection of zoonotic emergence signals and transition-phase risks.[9] [29] [7]
- Development of standardised "safe-by-design" protocols that integrate zoonotic risk assessment into National Restoration Plans, through adaptive management, ex-ante screening and context-specific transition monitoring.[9]
- Support the development of sustainable alternatives to harmful practices, including biocides.
- Integration of social sciences, behavioural insights, and risk communication strategies to strengthen policy uptake, social acceptance, and long-term sustainability.[19]
- Involvement of public health and veterinary authorities in restoration planning and governance from the design stage onward.[9] [29]

[29] BCOMING D6.4 New Design of OH Surveillance System

- Development of scientific, monitoring, and indicator frameworks for assessing disease regulation as a biodiversity-related ecosystem service relevant to restoration, land management, and One Health decision-making.

- Exploration of biodiversity financing mechanisms, including biodiversity credits, that embed One Health considerations within restoration and ecosystem recovery investments.

DG Mapping

This recommendation is primary for **DG ENV** because it concerns restoration, nature-based solutions, biodiversity conservation and alternatives to harmful practices. It would also strengthen the scientific basis for integrating biodiversity-related disease regulation into restoration governance and environmental decision-making. **DG SANTE** is primary because the interventions aim to reduce zoonotic and vector-borne disease risks. **DG RTD** is primary because the evidence calls for evaluation, experimentation and transdisciplinary research. **DG AGRI** is relevant where land-use, agroecology, pesticides and food systems are involved. **DG REGIO** is relevant for place-based implementation.

05 | Governance and Institutional Embedding

While the recommendations above outline priority actions for strengthening the biodiversity–health nexus, their effective implementation depends on how responsibilities are structured and coordinated within the European Commission. Current fragmentation across policy domains risks limiting their impact unless supported by appropriate governance mechanisms and institutional alignment.

The implementation of the Strategy for European Life Sciences is currently distributed across multiple Commission services without clear ownership of the biodiversity–health interface. This creates structural fragmentation, where biodiversity remains inconsistently integrated across health, research, and environmental policy domains.

Evidence across projects points to persistent fragmentation of targets, monitoring and data systems, with environmental, agricultural, and public health data 'still largely collected within separate frameworks' (BCOMING), 'fragmented data systems across environment and health sectors' (RESTOREID), and 'fragmented datasets collected at different spatial and temporal scales' (ZOE), alongside 'missing coordinated surveillance activities' and limited data availability across systems (BEPREP).

BCOMING emphasises the need to take a dynamic, whole-of-system perspective that mitigates zoonotic risks by effectively managing the human-ecosystem interface. This new paradigm shifts the focus from a species-focused risk assessment and management perspective to a holistic Zoonosis Prevention Architecture (ZPA) framework for effective ecosystem interface governance leveraging community-derived incentives.

RESTOREID provides direct evidence that this governance gap is already visible in restoration policy. A review of 30 national and international policies on landscape restoration, zoonoses, and related health frameworks found that although most policies highlight ecological and socio-economic benefits, only a small minority address unintended health or social consequences. This indicates that biodiversity and restoration policy still insufficiently integrate health risk anticipation, monitoring, and cross-sector responsibility.[9]

As a result, biodiversity considerations are often treated as complementary rather than foundational within One Health, limiting their uptake in surveillance systems, risk assessment frameworks, and policy design. This fragmentation weakens the EU's capacity to translate scientific evidence into coordinated, cross-sectoral action. BCOMING deliverables 7.2, 7.3, 7.4 and 6.6 further demonstrate that implementation effectiveness depends on participatory governance and co-construction with local communities, as externally imposed approaches may fail when they do not incorporate local knowledge and risk perceptions.[18 19 27 28] Similarly, ZOE Policy Brief[10] highlights the need for locally adapted public health campaigns that not only focus on specific diseases (e.g., dengue or borreliosis), which may hinder recognition of other zoonoses with similar symptoms. Preventive strategies should thus adopt a One Health approach, emphasizing ecological understanding of vectors, reducing human–vector contact, and improving public knowledge of disease transmission.

Embedding biodiversity structurally within One Health therefore requires clearly defined institutional responsibility, strengthened cross-DG coordination, and the formal integration of biodiversity expertise into Life Sciences governance structures. This should include alignment between research, policy, and implementation functions, ensuring that biodiversity is systematically incorporated into health preparedness, environmental management, and innovation strategies.

The convergence of biodiversity loss and emerging infectious diseases creates a critical moment for Europe. Evidence generated by BCOMING, BEPREP, RESTOREID, and ZOE demonstrates both the feasibility and the necessity of embedding biodiversity within One Health.

With the next Horizon Europe Framework Programme under preparation, there is a limited window to ensure continuity, scale, and impact. Failing to act risks losing the value of existing investments; acting decisively would position Europe as a leader in preventive, biodiversity-based health governance.

Annex I – Policy Briefs Aligned with the Strategy for European Life Sciences

Policy Brief 1

DG RTD (Research & Innovation)

Relevant recommendations	Invest in mechanistic and causal biodiversity–health research; Establish long-term One Health observatories; Develop integrated forecasting and surveillance systems.
Key message	Strengthen FP10 to support mechanistic, interdisciplinary, and long-term One Health research integrating biodiversity, with a shift from descriptive to predictive approaches.
Alignment	Strengthens European R&I excellence and leadership in life sciences; Supports integration of disciplines and data across sectors; Advances predictive and preventive health approaches.

Actions backed by projects

- Prioritise funding for mechanistic and predictive biodiversity–health research across different contexts and anthropogenic interfaces.[23]
- Support long-term research programmes and observatories beyond short project cycles.[20 23]
- Fund interdisciplinary networks integrating virology, geography, ecology, sociology and modelling.[23]
- Invest in integrated data infrastructures and predictive modelling frameworks.[23]
- Support development of early warning and predictive tools.[25]

Evidence base: BCOMING identifies the need to move from descriptive to mechanistic and predictive research frameworks. RESTOREID highlights the need for long-term, phased research programmes. ZOE and BEPREP identify limitations linked to short-term, fragmented datasets and lack of integration.

Policy Brief 2

DG SANTE (Health & Food Safety)

Relevant recommendations	Develop integrated forecasting and surveillance systems; Establish long-term One Health observatories; Invest in mechanistic and causal biodiversity–health research.
Key message	Embed biodiversity within One Health surveillance and risk assessment systems to strengthen prevention, early warning, and preparedness for emerging health threats.
Alignment	Supports disease prevention strategies, preparedness objectives and education programmes; Strengthens One Health integration in health systems; Contributes to early warning and risk assessment capacity.

Actions backed by projects

- Integrate biodiversity indicators into surveillance and early warning systems.[24]
- Shift from reactive to continuous and integrated surveillance systems.[23]
- Strengthen early warning systems at high-risk interfaces.[23]
- Incorporate serological, ecological, and exposure data into routine monitoring.[23]
- Develop indicators linking biodiversity, exposure, and health outcomes.[22]
- Involve public health and veterinary authorities in education campaigns and policies on human behaviour-nature-disease relationships and restoration planning.[9 10 29]

Evidence base: BCOMING highlights the need to move toward continuous, integrated surveillance systems. ZOE emphasises multi-scale, integrated monitoring combining ecological and epidemiological data. RESTOREID identifies the need to integrate environmental, biodiversity, and health data systems and highlights gaps in operational, interoperable surveillance tools. BEPREP supports the inclusion of ecological indicators and early warning approaches within surveillance frameworks.

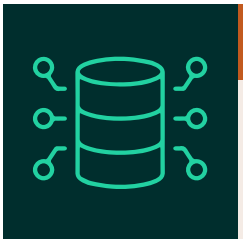
Policy Brief 3

DG ENV (Environment)

Relevant recommendations	Support solution design, implementation, and evaluation; Develop integrated forecasting and surveillance systems; Invest in mechanistic biodiversity–health research.
Key message	Embed biodiversity–health linkages into environmental policy, restoration, and land-use from the outset to support resilient ecosystems, adaptive management and reduce unintended disease risks.
Alignment	Supports biodiversity protection and ecosystem resilience objectives; Contributes to nature-based and preventive approaches to health; Aligns environmental policy with One Health frameworks.

Actions backed by projects

- Integrate disease risk into restoration and biodiversity policy.[7 20]
- Support nature-based solutions with health co-benefits.[7 22]
- Promote ecosystem protection as a primary prevention strategy.[7 22]
- Incorporate ecological indicators into environmental monitoring frameworks.[22]
- Align biodiversity conservation with health risk mitigation.[22]
- Apply ‘safe-by-design’ restoration in National Restoration Plans.[9]
- Integrate public health and veterinary authorities into National Restoration Plan governance and monitoring processes.[9]
- Develop locally tailored education campaigns and policies on human behaviour-nature-disease relationships.[10]



Policy Brief 4

DG CONNECT (Digital, Data & AI)

Relevant recommendations	Develop integrated forecasting and surveillance systems; Establish long-term One Health observatories; Invest in mechanistic biodiversity–health research.
Key message	Develop interoperable digital infrastructures, AI tools, and integrated data systems to support One Health surveillance, modelling, and decision-making.
Alignment	Supports data integration and digital infrastructure development; Advances AI and data-driven innovation in life sciences; Enables interoperability and cross-sector data use.

Actions backed by projects

- Develop interoperable data platforms integrating multi-source data.[23]
- Support AI-based early detection and modelling tools.[25]
- Establish standardised data collection to enable transboundary coordination for shared ecosystems.[20]
- Invest in digital tools for early warning and decision support.[23]
- Support data standardisation and interoperability frameworks.[25]
- Use existing data platforms to connect biodiversity and health monitoring.[9 29]

Annex II – Research Gaps and Recommended R&I Actions (Horizon Europe 2028–2034)

Strategic investment is needed to move beyond predominantly correlative evidence and strengthen the scientific basis for prevention-oriented One Health policy.

The following tables synthesise key research and knowledge gaps identified across BCOMING, BEPREP, RESTOREID, and ZOE, together with corresponding research and innovation actions relevant to Horizon Europe 2028–2034. The aim is to translate the evidence generated by the projects into operational priorities for future European research, surveillance, monitoring, restoration, and One Health implementation frameworks.

II.1 Understanding and Knowledge Gaps

Strengthening causal and mechanistic understanding of biodiversity–health interactions

Future R&I support should prioritise the generation of causal, multi-scale evidence on how biodiversity loss, ecosystem degradation, restoration, and land-use change influence disease emergence, transmission dynamics, and health outcomes. Strategic investment is needed to move beyond predominantly correlative evidence and improve the scientific basis for prevention-oriented One Health policy. This call for improvement in the scientific basis also requires stronger integration across ecology, veterinary science, virology, and social sciences to better understand how these processes interact across high-risk interfaces, including wildlife–livestock systems and changing agricultural production contexts within and beyond Europe.

Research & Knowledge Gaps	Recommended R&I Actions
Lack of mechanistic and causal understanding of biodiversity–health interactions.[22 24 25]	Develop mechanistic, multi-scale models linking biodiversity, ecosystem functioning, and health outcomes.[25]
Predominance of correlative approaches with limited causal inference.[22 25]	Conduct experimental and longitudinal studies to establish causal relationships.[6 25]
Limited understanding of multi-host transmission systems and spillover dynamics.[24 25]	Advance research on transmission ecology across multi-host systems and interfaces.[25]
Insufficient integration across biological scales (microbiomes → ecosystems → health outcomes).[25]	Integrate microbiome, ecological, and epidemiological processes within One Health frameworks.[25]
Limited evidence linking biodiversity interventions to measurable health outcomes.[20 22]	Evaluate biodiversity interventions (restoration, nature-based solutions) for health impacts.[20 22]
Weak understanding of landscape-scale and socio-ecological drivers of disease risk, including underrepresentation of high-risk regions, anthropogenic interfaces and restoration contexts in biodiversity–health research.[23 24]	Strengthen research in high-risk regions, across high-risk contexts such as anthropogenic interfaces and socio-ecological contexts.[6 24]
Limited mechanistic understanding of how restoration and biodiversity recovery reduce zoonotic risk and support disease regulation across different ecological and socio-economic contexts.[20]	Support mechanistic, longitudinal, and interdisciplinary research on how restoration, biodiversity recovery, and landscape transitions influence zoonotic risk, disease regulation, and health outcomes.[20]

II.2 Data Collection and Integration

Building long-term biodiversity–health observation and evidence capacity

Targeted support is needed for long-term, integrated observation capacities able to capture biodiversity–health dynamics over time and across ecological and socio-economic contexts. Future funding should address the current mismatch between short funding cycles and the longer temporal scales required to understand emergence risk, intervention effects, and environmental change.

Research & Knowledge Gaps	Recommended R&I Actions
Lack of long-term, longitudinal datasets capturing biodiversity–health dynamics.[6 20 24]	Establish long-term One Health observatories including one-site data monitoring schemes across ecosystems and regions[6 20] combine with open-source long-term remote sensing-based data. Wherever possible link to already existing monitoring of wildlife, vectors, air, water and soil that currently do not include a pathogen component (e.g., various LTER sites).
Fragmented monitoring systems and lack of harmonised indicators, protocols, and integration frameworks across biodiversity, environmental, health, behavioural, and socio-economic domains.[20 24 25]	Develop harmonised indicators and standardised monitoring protocols.[7 25] Build interoperable data infrastructures integrating biodiversity, health, and environmental data.[20 25]
Limited integration of ecological, epidemiological, genomic, socio-economic and behavioural data.[20 25]	Enable cross-sector data integration linking ecological, epidemiological, genomic, socio-economic, behavioural, and governance-related datasets across environmental, public health and veterinary sectors.[7 20 25]
Underutilisation of emerging technologies (eDNA, metagenomics, AI, remote sensing).[25 26]	Scale up deployment of emerging monitoring technologies (eDNA, metagenomics, AI-based tools).[25 26]
Limited development of indicators and monitoring frameworks for disease regulation as a biodiversity-related ecosystem service.	Develop scientific, monitoring, valuation, and indicator frameworks for integrating disease regulation into restoration planning, land management, and One Health decision-making.

II.3 Integrated Forecasting and Surveillance

Advancing interoperable biodiversity–health data, indicators, and forecasting capacities

Future R&I investment should strengthen interoperability across biodiversity, environmental, veterinary, and public-health data systems, and support the development of shared indicators, analytical frameworks, and predictive capacities. This is essential for improving early warning, preparedness, and risk-informed decision-making at the biodiversity–health interface.

Research & Knowledge Gaps	Recommended R&I Actions
Surveillance systems remain fragmented, reactive, and insufficiently integrated.[24] [25]	Develop predictive biodiversity–health models integrating ecological, epidemiological, and evolutionary dynamics.
Limited predictive modelling capacity linking biodiversity change to disease emergence.	Build integrated early-warning systems combining biodiversity, environmental, site-based monitoring[26] and remote sensing-based health, behavioural and socio-economic data, including actionable indicators for decision-making and restoration planning.
Weak early-warning systems for emerging health risks.	Incorporate evolutionary and functional virology into emergence risk modelling.
Insufficient integration of ecological, epidemiological, and evolutionary data.	Develop interoperable platforms for real-time data integration and forecasting.
Limited development of operational indicators for emergence risk and system instability.	Design decision-support tools (risk maps, scenario models, dashboards) for policymakers.
Limited operationalisation of cross-sector governance and data-sharing infrastructures for integrated One Health surveillance.	Support interoperable monitoring systems, joint governance models, and cross-sector data-sharing infrastructures linking biodiversity, environmental, veterinary, and public-health monitoring.

II.4 Solution Design, Implementation, and Evaluation

Improving the design, implementation, and evaluation of biodiversity-based One Health responses

Strategic support is needed for research that improves how biodiversity-related interventions are designed, implemented, assessed, and translated into practice. This includes stronger attention to context-specificity, co-benefits and trade-offs, stakeholder engagement, governance conditions, and the social and behavioural dimensions that shape uptake and long-term effectiveness.

Research & Knowledge Gaps	Recommended R&I Actions
Limited evidence on the health impacts of restoration and nature-based solutions.[24 25]	Evaluate health impacts and co-benefits of nature-based solutions and restoration.[20 22]
Risk of unintended health outcomes and context-dependent effects of restoration and biodiversity interventions during transition phases.[9 22]	Integrate disease risk assessment, ex ante screening, and transition phase monitoring into restoration and land-use planning through context-specific “safe by design” approaches.[9 20]
Weak integration of health considerations into biodiversity and restoration policy.[9 20]	Develop participatory and context-specific intervention models including locally tailored education programmes.[6 7 9 18 19 27]
Limited evaluation of One Health interventions under real-world conditions.[7 22]	Quantify co-benefits across biodiversity, health, and socio-economic dimensions.[7 9 18] Provide required funding for monitoring pre-implementation.
Insufficient stakeholder engagement, uptake and practical indicators for biodiversity–health interventions.[9 22]	Support development of sustainable alternatives to harmful practices (e.g. biocides).[25] Explore alternative financing mechanisms such as biodiversity credits.
Continued reliance on environmentally harmful practices (e.g. biocides) with limited alternatives.[25]	Evaluate how participatory and co-constructed approaches influence surveillance effectiveness.[19 27]

National and international restoration policies rarely address unintended health or social consequences.[9]	Develop 'safe-by-design' restoration frameworks based on interdisciplinary knowledge, integrating zoonotic risk from the planning stage.[9]
Health sectors are insufficiently involved in restoration governance and monitoring.[9]	Strengthen stakeholder engagement, cross-sector coordination, and involvement of public health and veterinary authorities in restoration planning and monitoring[9], provide sufficient financial support (funding) to do so.
Limited understanding of how community risk perceptions influence surveillance uptake.[28 29]	Develop monitoring indicators for restoration-linked zoonotic risk.[9]
Limited integration of socio-cultural, behavioural, and local knowledge dimensions into One Health surveillance and restoration planning.[27]	Integrate social science, behavioural research, and local knowledge into One Health surveillance and restoration planning.
Limited understanding of how stakeholder participation, governance arrangements, and community engagement influence implementation effectiveness.	Evaluate how stakeholder participation, governance arrangements, and community engagement influence implementation effectiveness.
Insufficient integration of socio-cultural, behavioural, and economic factors into intervention design.[28 30]	Evaluate transition-phase risks and adaptive access management in restored areas[9] and focus on inter- and transdisciplinary approaches that require the involvement of social scientists and local community representatives.
Limited incorporation of local knowledge and participatory approaches in governance.[9 27 29 30]	Support participatory risk-perception research to identify barriers affecting surveillance uptake.[28] Develop enhanced public communication strategies and locally tailored policies to improve environmental education on zoonotic risks.[10]

[30] BCOMING D6.3 Report On Stakeholder Risk Perceptions

Centralised or externally imposed surveillance approaches may be ineffective without local knowledge.[27 30]	Co-design surveillance, restoration, and intervention strategies with communities, public health actors, veterinary authorities, and biodiversity stakeholders.[9 18 19 27]
Limited understanding of how restoration financing, governance structures, and long-term implementation capacity influence One Health outcomes.	Evaluate financing, governance, and implementation models supporting long-term, participatory, and context-specific biodiversity restoration and One Health interventions.[20]

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LUCINDA KIRKPATRICK - RESTOREID