



A case for intersectoral health-conservation collaboration

Barriers and opportunities



Supported by:



Federal Ministry
for the Environment, Nature Conservation,
Nuclear Safety and Consumer Protection



INTERNATIONAL
CLIMATE
INITIATIVE

based on a decision of
the German Bundestag

A case for intersectoral health-conservation collaboration

Barriers and opportunities



The designation of geographical entities in this book, and the presentation of the material, do not imply the expression of any opinion whatsoever on the part of IUCN concerning the legal status of any country, territory, or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The views expressed in this publication do not necessarily reflect those of IUCN or other participating organisations.

IUCN is pleased to acknowledge the support of its Framework Partners who provide core funding: Ministry of Foreign Affairs of Denmark; Ministry for Foreign Affairs of Finland; Government of France and the French Development Agency (AFD); the Ministry of Environment, Republic of Korea; Ministry of the Environment, Climate and Sustainable Development, Grand Duchy of Luxembourg; the Norwegian Agency for Development Cooperation (Norad); the Swedish International Development Cooperation Agency (Sida); the Swiss Agency for Development and Cooperation (SDC) and the United States Department of State.

This publication has been made possible by funding from the International Climate Initiative of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection of the Government of Germany for the Africa Stabilizing Land Use project.

Published by: IUCN, Gland, Switzerland

Produced by: IUCN Centre for Conservation Action – Forest and Grassland Team

Copyright: © 2024 IUCN, International Union for Conservation of Nature and Natural Resources

Reproduction of this publication for educational or other non-commercial purposes is authorised without prior written permission from the copyright holder provided the source is fully acknowledged.

Reproduction of this publication for resale or other commercial purposes is prohibited without prior written permission of the copyright holder.

Recommended citation: Kumar, K. & Pokhrel, P. R. (2024). *A case for intersectoral health-conservation collaboration: Barriers and opportunities*. IUCN.

Cover photo: Photo by Bridget Simpson

Layout by: Bridget Simpson

Contents

Key takeaways	iv
Acknowledgements	vii
List of acronyms	viii
Introduction	1
Chapter 1 The benefits of forest conservation and restoration to public health	2
Chapter 2 The benefits of collaboration with the health sector for the conservation sector	7
Chapter 3 One health approach	10
Chapter 4 Barriers to collaboration: shared evidence base linking forests to human health	14
Chapter 5 Barriers to collaboration: data-sharing, common metrics, and approaches	18
Chapter 6 Barriers to collaboration: funding	21
Chapter 7 Barriers to collaboration: capacity-building	25
Chapter 8 Barriers to collaboration: knowledge dissemination and dialogue	31
Conclusion	35
Appendix	36

Key takeaways

There is a close relationship between our health and that of animals, plants, and the environment. Forests have been proven to provide significant benefits to human health. One Health has been developed to acknowledge these interdependencies and promote an integrated approach that balances and optimises the health of humans, animals, plants, and ecosystems sustainably. As part of this approach, fostering collaboration between the forest conservation and restoration and public health sectors is essential.

Significant barriers to multi-sector collaboration include a lack of sufficient and specific evidence supporting the benefits of forest conservation and restoration to human health, ineffective mechanisms for sharing data across sectors, limited funding for collaborative activities, gaps in capacity, and poor inter-sectoral communication. This report draws upon a range of existing literature, including academic and grey literature and workshop proceedings, supplemented by interviews with experts in the conservation and health sectors. It overviews these barriers and highlights opportunities and global best practice case studies of collaboration between the (forest) conservation and human health sectors.

Below are some of the key recommendations to support collaboration:

Forest conservation sector recommendations

- **Investment in research and development:**
Most national laboratories fail to meet the accreditation standards of quality management systems. Public and private sector funds should invest in quality laboratory equipment to strengthen the evidence base and help us better understand the relationship between forests and health.
- **Improve the evidence base of research linking forest conservation and restoration and public health:**
Researchers should adopt longitudinal, intervention, and randomised controlled trial research designs used in human health research to understand the specifics of biodiversity-health linkages.
- **Expand research topics linking forest and health:**
The links between forests and nutrition and infectious diseases have received a more comprehensive understanding in research than others. Forest conservation and restoration research should explore other potential public health benefits of forest conservation.
- **Integrate health objectives into conservation concession models:**
Conservation project financiers should ensure that conservation concession models include health objectives to guarantee that the revenues generated from the concession area can be used to support health infrastructure.
- **Understand the language and culture of the health sector:**
The forest conservation and restoration sector should build an understanding of the health sectors key 'concerns, and funding priorities' to effectively build a case for long-term collaboration and highlight the need for preventative health solutions adopting nature based solutions over short-term goals.

Public health sector recommendations

- **Educate and empower health professionals to engage in forest conservation and restoration:**

Health stakeholders should educate themselves on the benefits of forest biodiversity for public health, the environmental determinants of health, and the role nature plays in disease prevention and management, among other things. Health stakeholders should strive to understand the language of forest conservation and identify shared objectives.

Joint recommendations

- **Co-create health and biodiversity Indicators:**

Public health and forest conservation sector researchers should establish a broader range of physiological health parameters and undertake epidemiological studies examining specific diseases impacted by forest conservation and restoration.

- **Leverage emerging technologies:**

Health and environmental scientists can employ emerging technologies to precisely measure exposure doses in studies examining the health benefits of exposure to nature.

- **Develop a centralised, accessible cross-sectoral data-sharing platform:**

Develop a platform to share data relevant to the health and conservation sectors with standardised key metrics and frameworks.

- **Integrate shared objectives in financing models between sectors and strengthen financial evidence:**

Financers should establish performance targets between the health and conservation sectors to encourage co-financing and pooling of resources to achieve common objectives. Projects linking forests and health should expand monitoring, evaluation, research and learning on the outcomes and benefits of co-financing, including its impacts on health and conservation outcomes, the achievement of programme and policy objectives, and the costs to sectoral payers.

- **Extend project timelines for collaboration:**

Policymakers and project implementers should allow for sufficient time to build relationships, buy-in from each sector, and a framework for joint action. Likewise, project funding must allow enough time for discussion and systematic thinking through the health and well-being implications of specific conservation and restoration policies and practices. Finding a shared common ground and synergies is only feasible after aligning conceptual understandings that can bridge the sectoral divides.

- **Dedicate departments to cross-sector collaboration and introduce accountability mechanisms:**

Governments should create specific departments and roles within them whose core purpose is pursuing cooperation. This team will possess the required skills to establish trust and momentum for cooperation between the forest conservation sector and health.

- **Add a capacity-building project component:**
One Health initiatives could include capacity-building as part of their core project objectives to promote the advancement of One Health at the national level. Collaboration between universities and projects can facilitate the integration of capacity-building by exchanging field experience with academic experience in One Health through seminars, workshops, and the development of training materials.

- **Create a platform for information exchange:**
Information exchange platforms are crucial for multi-sectoral communication between the public health and environment sectors. These platforms facilitate collaboration among professionals, policymakers, and stakeholders, promoting open dialogue to address complex issues of climate change, pollution and infectious disease.

Acknowledgements

This publication has been an effort of many people who have generously contributed their time, and expertise. We would like to thank all of them for their support and contributions to the production of this report.

This report was coordinated by the IUCN Forest and Grasslands team. The process was led by Chetan Kumar and Pragyan Raj Pokhrel from the IUCN Forest and Grasslands team with the support of Megan Simpson, Arimbi Wahono, Arielle Rosenthal, Sze Vei Leong, and Stephanie Lvovich from Shared Planet.

We would also like to acknowledge the experts who kindly took time to provide us with their insights on this critical topic. We would like to thank Ntungire Dickson (Ministry of Health, Uganda), Katharina Kreppel (Institute for Tropical Medicine in Antwerp, Frances Macguire, Serge Morand (CNRS), and Ssali Ronald Ogwal (Conservation through Public Health).

IUCN acknowledges the generous financial support of the International Climate Initiative of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection of the Government of Germany for the Africa AStabilizing Land Use project.

List of acronyms

AFROHUN - Africa One Health University Network
BBP - Belgian Biodiversity Platform
CBD - Convention on Biological Diversity
CDC - Centers for Disease Control and Prevention
COP28 - 28th Conference of the Parties of the United Nations
DALYs - Disability-Adjusted Life Years
DGS - Portuguese Directorate-General of Health
DHRU - Development and Health Research Unit
DRC - Democratic Republic of Congo
EDHS - European Health Data Space
EAC - East African Community
FAIR - Findable, Accessible, Interoperable, and Reusable
FAO - Food and Agriculture Organization
GDP - Gross Domestic Product
GBF - Global Biodiversity Framework
DGS - Portuguese Directorate-General of Health
GPs - General Practitioners
HiAP - Health in All Policies
IPE & IPC - Interprofessional Education & Interprofessional Collaboration
IDEEAL - Infectious Disease Emergence and Economics of Altered Landscapes
IPBES - Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN - International Union for Conservation of Nature
IUFRO - International Union of Forest Research Organizations
LDDV - Laboratory of Diversity and Viral Diseases
MWE - Ministry of Water and Environment
NAPHS - National Action Plan for Health Security
NBSAPs - National Biodiversity Strategies and Action Plans
NCD - Non-Communicable Diseases
NEMA - National Environment Management Authority
NFA - National Forestry Authority
NHS - National Health Service
NOHP - National One Health Platform
OECD - Organisation of Economic Co-operation and Development
OHTWG - One Health Technical Working Group
OHCEA - One Health Central and Eastern Africa
OHW - One Health Workforce
PPP - Public-Private Partnerships
PPOH - Pandemic Prevention and One Health
SDH - Social Determinants of Health
SOPs - Standard Operating Procedures
UN - United Nations
USAID - United States Agency for International Development
WHO - World Health Organization
WOAH - World Organisation for Animal Health
WWF - World Wide Fund for Nature

Introduction

The COVID-19 pandemic revealed the close links between human health and biodiversity. Research shows that many viruses that cause pandemics originate from wildlife and are transmitted directly or indirectly to humans. Deforestation is a significant driver of pandemics as it increases the interactions between humans and wildlife.¹ The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) links deforestation to more than 30% of new diseases reported since 1960.² Consequently, there is a growing acknowledgement among international, national, regional, and local policymakers of the critical role that forest conservation and restoration play in safeguarding human health.

Given the links between biodiversity and human health, there is a corresponding global push for cross-sectoral cooperation, partly by removing collaborative barriers between the conservation and public health sectors. This is evident in recent environmental and biodiversity multilateral agreements. For example, the Kunming-Montreal Global Biodiversity Framework (GBF) acknowledges the interlinkages between biodiversity and health and recommends the framework to be implemented through the One Health Approach, mobilising multiple sectors, disciplines and communities to sustainably balance and optimise the health of people, animals, plants, and ecosystems. Likewise, the recent 28th Conference of the Parties to the UN Framework Convention on Climate Change (COP28) featured the first-ever Health Day to showcase the clear impact pathways between climate change and human health.³ More than 40 million health professionals worldwide joined a call to action by the World Health Organization (WHO) and civil society organisations at COP28 to prioritise health in climate negotiations.⁴ This call

to action highlights the willingness of the health community to collaborate with the environmental sector, including the conservation sector.

Critically, in 2022, the UN General Assembly declared access to a clean, sustainable, and healthy environment a human right. This decision will require governments to scale up their efforts to address the triple planetary crisis: climate change, pollution and biodiversity loss - all mentioned in the resolution's text. National collaboration between the health and conservation sectors is paramount to fulfilling this human rights obligation.

However, despite the growing attention and apparent willingness from conservation and health communities to collaborate, significant challenges remain in achieving effective cross-sector collaboration. Barriers include a lack of sufficient and specific evidence supporting the benefits of forest conservation and restoration to human health, ineffective mechanisms for sharing data across sectors, limited funding for collaborative activities, gaps in capacity, and poor inter-sectoral communication. This report provides an overview of these barriers and highlights opportunities and global best practice case studies of collaboration between the (forest) conservation and human health sectors.

This report draws upon a range of existing literature, including academic and grey literature and workshop proceedings, supplemented by interviews with experts in the conservation and health sectors. It is aimed at members of both sectors to help them understand the need for collaboration and the key actions required to facilitate this collaboration.

1. The benefits of forest conservation and restoration to public health

Why should the public health sector collaborate with the conservation sector?

Human health, defined by the WHO as a state of complete physical, mental, and social well-being, is intricately linked to the health of our ecosystems.⁵ Research demonstrates the positive impact of proximity to nature and biodiversity on human health and well-being.⁶ Biodiversity is a crucial determinant of human health, with forests constituting a critical component of this link as forests encompass at least two-thirds of terrestrial biodiversity.⁷ Forest ecosystems and their services, including food, clean air, fresh water, medicines, climate regulation, pest and disease control, and disaster risk reduction, are essential to our health and well-being.⁸ Governments should consider investing healthcare spending towards protecting, managing, and conserving forests for potential long-term savings in health expenditure. These forest management strategies must uphold the rights of Indigenous peoples, especially given that approximately 36% of remaining intact forests are on Indigenous peoples' lands.⁹

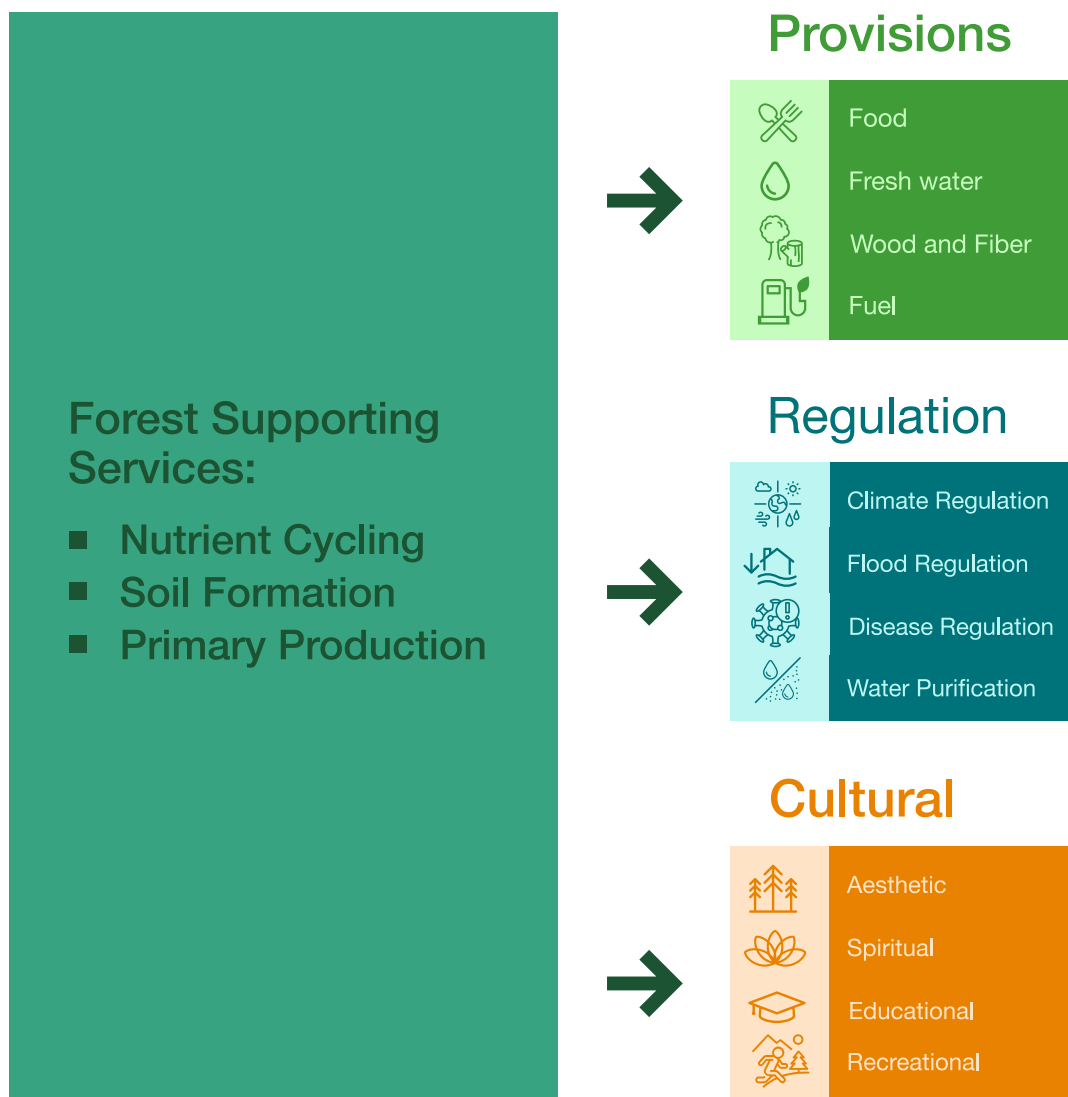


Figure 1. Forest Ecosystem Services. Source: Millenium Ecosystem Assessment (2005)

Improved social determinants of health and food security

Globally, governments increasingly recognise the importance of addressing the environmental and social determinants of health (SDHs) that negatively impact human health, focusing on preventive measures rather than reactively treating illness. This holistic approach reduces long-term healthcare costs and supports health equity. According to the WHO, SDHs encompass poverty, food insecurity, and quality air and water, accounting for 30-55% of health outcomes.¹⁰

Forest ecosystem services positively impact many SDHs by offering cost-effective solutions and robust mechanisms to improve health.¹¹ For instance, forests act as natural filters, removing pollutants from both air and water, which helps reduce the risk of pollution-related diseases such as diarrhoea, cancer, respiratory illnesses, and many others. Diarrhoea is the fifth leading cause of death in children under five. Two-thirds of diarrheal diseases are caused by unsafe water, sanitation, and hygiene.¹² One study found that a 30% increase in tree cover in upstream areas is linked to a 4% decline in the probability of diarrhoea, similar to the effect of improved sanitation facilities.¹³ Forests are also direct sources of nutritious foods and medicinal plants and support water sterilisation, all of which are critical determinants of health.¹⁴

Advance Indigenous peoples' health

Indigenous peoples tend to suffer from poorer health than non-Indigenous populations worldwide primarily because Indigenous peoples' are disproportionately subject to (among other things) poverty, inadequate housing, violence (including gender-based violence), racism, and a lack of access to medical services, water and sanitation.¹⁵ For example, Indigenous peoples experience disproportionately high levels of maternal and infant mortality, malnutrition, cardiovascular illnesses, HIV/AIDS, and other infectious diseases

SDHs encompass poverty, food insecurity, and quality air and water, accounting for 30-55% of health outcomes.¹⁰

such as malaria and tuberculosis.¹⁶ The disparity in health outcomes is apparent in the gap in life expectancy between Indigenous and non-Indigenous peoples in many countries; in Canada, for example, this gap stands at 17 years.¹⁷ Evidence suggests that environmental stewardship programmes, including forest conservation and restoration, that uphold Indigenous rights and reconnect Indigenous peoples with their lands can address the social determinants of Indigenous health and enhance Indigenous health outcomes.¹⁸ Conservation and restoration outcomes also improve through Indigenous land stewardship. Currently, Indigenous peoples protect 80% of the world's remaining biodiversity despite making up around 19% of the world's extremely poor and just 6% of the global

Conservation and restoration outcomes also improve through Indigenous land stewardship. Currently, Indigenous peoples protect 80% of the world's remaining biodiversity despite making up around 19% of the world's extremely poor and just 6% of the global population.¹⁹

Forest ecosystems and their services, including food, clean air, fresh water, medicines, climate regulation, pest and disease control, and disaster risk reduction, are essential to our health and well-being.²²



Forest Valley, Berend Leupen, Unsplash.

Delivery of essential medicines

Forests provide essential medicines, with some studies suggesting that the total number of plant species used for medicinal purposes is as high as 50,000.²⁰ Much of these forest medicines are critical to traditional health care systems, which are particularly abundant, and essential, in areas with restricted state or government health care. Over 80% of the global population depends on traditional medicine for their primary healthcare needs.²¹ Forests are critical to the health of an estimated four billion people globally who rely on traditional knowledge of medicinal plants and animal products, particularly women, Indigenous peoples, and rural communities.²²

One example of forest-derived medicine is using naturally occurring substances to treat and prevent cardiovascular diseases. For example, the white willow tree, found in the forests of Europe and Western and Central Asia, produces salicin, converted to salicylic acid, an active component that helps prevent myocardial infarction and strokes. This substance is used in the production of aspirin.²³

Reduced health impacts associated with climate change

Forests can improve a country's resilience to climate change by offering nature-based solutions to reduce the risks of natural disasters, improving health outcomes. Preserved and intact forests shield individuals and communities from the adverse impacts of various natural hazards, such as floods, landslides, and hurricanes, reducing the number of fatalities and injuries associated with these events.²⁴ For example, in Niger, planting nitrogen-fixing trees among crops enhanced community resilience to drought.²⁵

Climate change induces heat waves and higher temperatures, which are associated with adverse health outcomes, including premature death and cardiorespiratory failure. Forests can reduce heat-related mortality by reducing heat through evaporation and transpiration.²⁶ A study found that continued deforestation in the Amazon would expose over 11 million people in Brazil to lethal heat stress by 2100.²⁷ Forests also act as natural air purifiers, improving air quality and reducing respiratory issues caused by pollution - playing a critical role given the upsurge in wildfires due to a changing climate.²⁸ Forests also mitigate climate change by absorbing carbon dioxide, a greenhouse gas

responsible for global warming. By capturing and storing carbon dioxide, forests help reduce the rate at which the gas builds up in the atmosphere, slowing climate change.²⁹

Lowered risks of non-communicable diseases (NCDs) and improved mental health

The primary NCDs (cardiovascular disease, cancers, respiratory diseases, and diabetes) share common risk factors like air pollution and physical inactivity. Forests address these risk factors by improving environmental quality and providing accessible spaces for physical activity. In Indonesia, for instance, high levels of greenspaces (including forests) were associated with 0.3% to 9.4% lower NCD rates.³⁰ Research suggests forests also positively impact mental health by enabling physical activity and connection to nature.³¹ During the COVID-19 pandemic, green spaces and forests proved vital for supporting people's well-being as they dealt with lockdown restrictions, with several countries in Europe, the United States, Canada, New Zealand, and Brazil implementing social prescription programmes.³² For example, the UK's National Health Service (NHS) extended green social prescribing to improve public mental and physical health. The mental health benefits associated with visits to woodland in the UK are estimated to save the NHS £185 million each year in treatment costs.³³ In the 2023 Environmental Improvement Plan, the UK Government seeks to increase the scale of green social prescribing, aiming to refer 900,000 people in 2023/24.³⁴

Mitigated infectious and zoonotic diseases

Tropical forests are a rich source of pandemic-causing viruses; deforestation and habitat fragmentation increase human-wildlife contact, heightening the risk of virus spillover.³⁵ The evidence also points to a higher incidence of infectious diseases in species associated with disturbed habitats.³⁶ This heightened risk is exemplified by a 2019 study revealing that a 1% decline in primary forest cover can result in a 10% increase in malarial incidence.³⁷ The reasons for increased disease transmission include deforestation, habitat reduction, and heightened interactions between disease pathogens, carriers, and hosts.³⁸ The risks of infectious disease outbreaks escalate significantly in rapidly deforested tropical regions, where nearly 50% of zoonotic diseases in humans are linked to agricultural drivers.³⁹ Consequently, safeguarding forests from deforestation is a crucial measure to mitigate the incidence of infectious diseases.

The link between deforestation and infectious diseases suggests that significant and globally coordinated efforts to retain forests would have a substantial return on investment. At an annual cost of \$9.6 billion, direct forest-protection payments to outcompete deforestation investment can potentially achieve a 40% reduction in areas at the highest risk of virus spillover.⁴⁰ The COVID-19 pandemic had and continues to have a severe cost; for example, the estimated overall cost of COVID-19 to the US economy is \$14 trillion by the end of 2023.⁴¹ In addition to the socio-economic costs, the pandemic continues to burden the health sector worldwide. This burden has been particularly pronounced in low- and middle-income countries. The costs of reducing deforestation are far less than the costs of dealing with pandemics and should be considered a critical public health measure.



Deforestation, by gryffyn m on Unsplash.

A study found that continued deforestation in the Amazon would expose over 11 million people in Brazil to lethal heat stress by 2100.²⁷

2. The benefits of collaboration with the health sector for the conservation sector

Why should the conservation sector collaborate with the public health sector?

Integrating forest conservation and human health benefits both human health outcomes and forest biodiversity conservation. The health sector is one of the largest in the world and has the necessary capabilities and training to make meaningful contributions to biodiversity conservation.⁴² Healthcare practitioners can become key advocates of forest conservation. Collaboration can also encourage the conservation community to adopt health-based decision-making models informed by the best available data.⁴³ The public health community has been actively promoting preventative healthcare by developing evidence-based policies that consider the role of forests in mitigating the impact of zoonotic infectious diseases, natural disasters, extreme heat, and other health effects associated with climate change. The forest conservation sector is critical to unlocking preventative health care through forests.

Draw on the skillset of the Health Sector to support forest conservation and restoration

The healthcare industry is one of the largest sectors globally, with an estimated 12 million doctors and over 50 million other healthcare workers worldwide; this means there is approximately one healthcare professional for every 125 people on Earth.⁴⁴ Additionally, healthcare community members tend to be highly skilled, trusted, connected, and resourced, making them essential partners for the conservation sector.⁴⁵ Medical doctors and nurses, for example, have the training and capabilities to upskill and acquire new knowledge rapidly. They also have strong communication skills and are positioned as trusted public servants. They could promote public health messages that stress changing our relationship with nature and promoting forest conservation and restoration. The Convention on Biological Diversity (CBD) has repeatedly called for more effective mainstreaming of biodiversity across sectors. Health is

a critical partner in mainstreaming the conservation of biodiversity.

Access health resources for forests

According to the OECD, the world currently spends about US\$78-91 billion annually to support global biodiversity, while harmful financial flows that damage biodiversity are estimated to be over 500 billion.⁴⁶ In comparison, global spending on healthcare reached US\$9 trillion in 2020 during a worldwide pandemic, accounting for 10.8% of the global GDP.⁴⁷ The conservation and restoration of forests can be a cost-effective preventive healthcare solution that mitigates the spread of zoonotic diseases. Governments should consider investing healthcare spending towards protecting, managing, and conserving forests, which can lead to long-term savings in health expenditure. For instance, a study conducted in Cambodia found that increased protected area coverage decreased incidences of diarrhoea and acute respiratory infections, a critical healthcare issue.⁴⁸

The healthcare industry is one of the largest sectors globally, with an estimated 12 million doctors and over 50 million other healthcare workers worldwide; this means there is approximately one healthcare professional for every 125 people on Earth.⁴³



Tree Root, by Fiona McCluney.

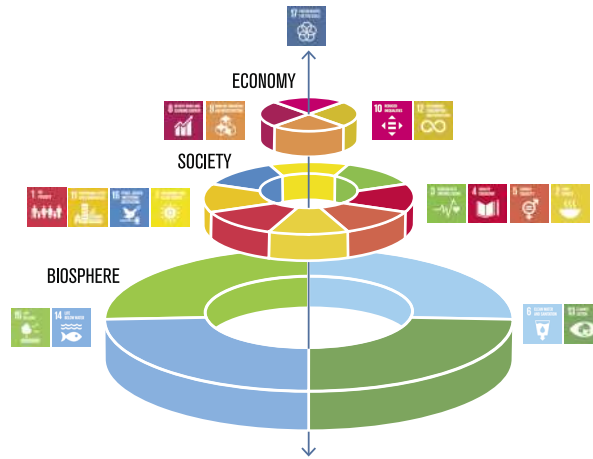


Figure 2: Biodiversity and Ecosystem Services are linked across key public health and development goals including the Sustainable Development Goals. Source: Stockholm Resilience Centre (2016).

Synergies in workstreams and objectives

As highlighted in Chapter 2, forest conservation and restoration can realise many public health benefits. The forest conservation sector can likewise strengthen its policies and programming through collaboration with the public sector in many key areas. Redesigning the food production system, for example, is an area in which both sectors are invested, given food and nutrition are essential for human well-being and that the food system is currently one of the most significant contributors to biodiversity loss. As of 2018, agriculture expansion drives almost 90% of global deforestation. Animal agriculture, including livestock and animal feed, is responsible for nearly 40% of deforestation.⁴⁹

intensification. These alternatives include agroforestry and integrated landscape management, which also positively impact human health. Agroforestry, for example, can increase the production and availability of micronutrient-rich fruits, leafy vegetables, and nuts. This can have a significant effect in reducing malnutrition. Fruit consumption, for example, has been linked to substantial reductions in undernutrition (nearly 2%).⁵⁰ Since more than 70% of fruit produced for human consumption globally is harvested from trees, agroforestry is a pivotal opportunity to improve nutritional outcomes.⁵¹ The health sector can support the food system's transition towards agroforestry through its dietary recommendations and food security strategies, prioritising plant-based food that lends itself to more sustainable farming.⁵²

As of 2018, agriculture expansion drives almost 90% of global deforestation. Animal agriculture, including livestock and animal feed, is responsible for nearly 40% of deforestation.⁴⁸

The forest conservation sector advocates for less environmentally harmful alternatives to agricultural land conversion and chemical-based

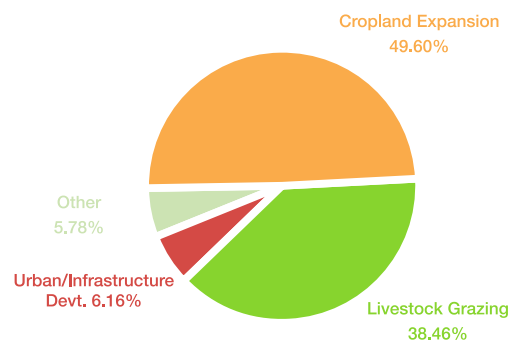


Figure 3: Global Causes of Deforestation 2000-2018, Source: FAO (2021)

3. One health approach



One Health Diagram, by Shutterstock

The connection between biodiversity and human health is increasingly recognised in global policy development. The WHO has collaborated with the CBD since 2015 to promote research on the health impacts of biodiversity. Likewise, IPBES is working on evaluating the interdependent relationships between biodiversity, water, food, and human health. International environmental organisations increasingly consider health in their research and decision-making and call for increased collaboration between health and environmental sectors. In forest conservation, organisations including the International Union of Forest Research Organizations (IUFRO), the International Union for Conservation of Nature (IUCN), the World Wide Fund for Nature (WWF), and the Food and Agriculture Organization (FAO) of the United Nations (UN) have produced publications and introduced specific workstreams considering the human health outcomes linked to forests. **See Annex 1 and 2 for existing literature on the links between forests and health and a sample of projects connecting the two sectors.**

One Health

Three broad global approaches link the ecological environment and human health: Planetary Health, One Health, and EcoHealth. These frameworks show a commitment to working holistically across sectors. One Health is the most widely used and is defined as an integrated, unifying approach to balance and optimise the health of people, animals, and the environment.⁵³ The One Health approach brings together various sectors, disciplines, and communities, such as veterinary, public health and environmental sectors, to work collaboratively at different levels of society. It addresses multiple issues, including land use change, forest degradation, climate change, and zoonosis. The Tripartite organisations – FAO, the World Organisation for Animal Health (WOAH), and the WHO – are leading the way towards a multisectoral One Health approach through mandated inter-agency collaboration on an international level. Many countries have also developed their own One Health Strategic Action Plans.

However, implementing the One Health approach can be challenging because it requires interdisciplinary thinking against the traditional culture of silo-based operations prevalent within academic and governmental bureaucracies. Health and environment ministers frequently develop policies independently, with little or no coordination. Health officials are often excluded from policy discussions about the environment, even though the environment is crucial in determining health outcomes. Similarly, many countries have failed to involve the health sector in developing their National Biodiversity Strategies and Action Plans (NBSAPs), suggesting severe barriers to collaboration internationally and nationally. In international forums, significant participation by environmental or health actors in each other's decision-making forums is lacking.⁵⁴ This is why, even after more than 17 years since the term One Health was coined, its implementation remains a challenge, and there is still a strong demand to put this approach into action.⁵⁵

Uganda

Uganda One Health strategic plan

Uganda is facing several critical health issues that span multiple sectors, including zoonotic diseases, antimicrobial resistance, and biosecurity issues in both human and animal health. Due to a unique biological diversity and rising population density, Uganda is particularly vulnerable to zoonotic diseases that arise from increased contact between humans and animals. Over 80% of the Ugandan population is engaged in agriculture, with 58% involved in livestock farming. The Government of Uganda launched a National One Health Platform (NOHP) on November 3, 2016. The purpose of the platform is to promote collaborative efforts among four government sectors to prevent, detect, and respond to existing zoonotic diseases and emerging pandemic threats. The four government sectors involved in this initiative are the Ministry of Health, the Ministry of Agriculture, Animal Industries, and Fisheries, the Ministry of Water and the Environment, and the Uganda Wildlife Authority. Key actors from across these authorities have committed to mainstream One Health plans and activities into their policies, budgets, and work plans to respond to these threats and improve human, animal, and environmental health.

Key successes to the One Health approach in Uganda

Improved multisectoral communication:

The platform has created a space for dialogue between various government sectors and disciplines including veterinary, human health, and environment, among others. The platform holds quarterly meetings to discuss pressing issues like public health surveillance, biosecurity, and antimicrobial resistance. In January 2020, Uganda introduced its national One Health Risk communication strategy, where four line ministries have officially nominated national focal persons to support disease reporting and monitor the implementation of the National Action Plan for Health Security (NAPHS).

Increased One Health capacity and education:

The One Health Central and Eastern Africa (OHCEA) is an international university network of 16 universities spread across the Eastern, Central and Western African regions. Their mission is to build a



Uganda, by Random Institute, Unsplash.

“One Health often prioritises the links between human and animal health, with the importance of ecosystems being overlooked at community, regional, and national levels”

Interview with Health and Conservation Officer, Conservation through Public Health

multidisciplinary health workforce through their One Health Workforce (OHW) project, which focuses on promoting the One Health approach through university training. Makerere University, Uganda is in this network and has incorporated One Health concepts in the curricula, and developed the One Health Institute, which offers field placements, fellowships, and small grants.

Outstanding challenges to the One Health approach

Defining One Health:

An interview with a health and conservation officer at Ugandan non-profit organisation Conservation through Public Health revealed that there is still a lack of understanding around the concept of One Health, especially at the community level. The interview also highlighted that One Health often prioritises the links between human and animal health, with the importance of ecosystems being overlooked at community, regional, and national levels.

Funding:

A lack of dedicated government funding for One Health activities remains. Instead, different ministries fund these activities, leading to competition, hindering collaboration. This ultimately slows down progress towards a multi-sectoral approach to One Health.

Conservation sector side-lined:

According to the interview, key government actors, including the National Environment Management Authority (NEMA) and National Forestry Authority (NFA) that fall under the Ministry of Water and Environment (MWE), are being left out of One Health decision-making. Instead, the Minister of Health tends to lead the decision-making.

A lack of dedicated government funding for One Health activities slows progress towards a multi-sectoral approach.

Lack of One Health legal or policy instrument:

There are challenges in taking action due to the lack of a unifying policy or legal instrument. While the platform allows for discussions, the absence of a formal framework for decision-making makes it difficult to put these discussions into practice. There needs to be political will to establish a national policy, and politicians must be convinced of the economic benefits of adopting a One Health approach.

Case study sources

Bakiika, H., Obuku, E.A., Bukirwa, J. et al. (2023). Contribution of the one health approach to strengthening health security in Uganda: a case study. *BMC Public Health* 23:1498.

Atusingwize, E., Ndejjo, R., Tumukunde, G. et al. (2020). Application of one health approach in training at Makerere University: experiences from the one health workforce project in Uganda. *One Health Outlook* 2: 23.

Interviews with Ntungire Dickson, One Health Officer, National One Health Platform (Ministry of Health) and Ssali Ronald Ogwal, Health and Conservation Officer, Conservation through Public Health, Uganda

4. Barriers to collaboration: shared evidence base linking forests to human health

4.1 Barriers

There is a large body of research considering the links between biodiversity, specifically forests, and human health. Many studies stress that a loss of biodiversity in a forest ecosystem will likely weaken the provision of forest ecosystem services, many of which are associated with health. However, there is less robust evidence for the specific causal pathways linking biodiversity to human health, and there remains conflicting evidence regarding the association between biodiversity and infectious diseases.⁵⁶ The lack of a specific understanding of how biodiversity impacts human health limits the use of nature-based solutions in public health and its impact on health policy. The key informant interviews confirmed this by revealing that some healthcare professionals do not consider the evidence linking nature, particularly forests, to human health outcomes strong enough to justify policy recommendations and budget decisions. It is still unclear how the presence, contact with, or changes in different forms of biodiversity affect human health.

A significant issue in existing research is the lack of focus on the intricate aspects of biodiversity, like species richness, abundance, functional traits, and their genetic, structural, and ecosystem diversity, and how these specifically impact human health.⁵⁷ For example, according to Marselle et al., the studies that investigate the health benefits of being in nature tend to focus on people's proximity to green spaces or the duration of time spent in nature without considering the ecological characteristics of these spaces. Similarly, studies examining the ways in which nature benefits human health and well-being through indirect pathways, such as the provision of ecosystem services or regulation of natural systems, often fail to specify the biodiversity involved.⁵⁸

There are also concerns related to the rigour of the research design of some studies reporting data on biodiversity and associated positive health outcomes. Aerts et al. found that most evidence for

the health benefits of being in nature was self-reported psychological well-being rather than well-defined clinical outcomes. The study findings suggest that the impact of biodiversity on mental and general health varies depending on the definition and method used to measure perceived biodiversity and health status.⁵⁹ The Aerts et al. review also revealed that many studies have focused on the short-term effects of exposure to biodiversity and take a cross-sectional experimental design, stressing the need for longitudinal studies, such as birth cohort studies, that could validate the long-term benefits of biodiversity on human health. Longitudinal, intervention, and randomised controlled trial research designs used in human health research should be adopted to understand the specifics of biodiversity-health linkages.⁶⁰

The literature on the effects of biodiversity on the 'risk and burden of vector-borne diseases' creates further challenges in building consensus for collaboration between the health and conservation communities. Some research endorses the dilution effect hypothesis, in which biodiversity (for example, species richness) reduces the transmission of pathogens.⁶¹ Other studies have revealed a positive association between host diversity and infectious agent prevalence and infection rates of infectious agents. Wood et al. investigated spatial and temporal relationships between per-person disability-adjusted life years (DALYs) lost to infectious disease and potential drivers, including biodiversity.⁶² The study found that forest expansion is associated with higher burdens of infectious disease.⁶³ The contradictions in the data could mean that the health sector is still not convinced of the benefits of forest conservation and restoration in reducing infectious diseases.



Logging, by Dineo Motau, Unsplash.

There is less robust evidence for the specific causal pathways linking biodiversity to human health, and there remains conflicting evidence regarding the association between biodiversity and infectious diseases.¹

4.2. Opportunities and successes

Some research studies have taken a cross-sector approach, effectively expanding the research base linking forest conservation and restoration to human health. EcoHealth Alliance's Infectious Disease Emergence and Economics of Altered Landscapes (IDEEAL) project examined the impact of ecological and land use change on the number of malaria cases in locations across Southeast Asia. The underpinning rationale for the project was that if land use change is associated with increased impact from endemic and emerging infectious diseases, then the economic damages from these diseases should be considered in the cost of land use change.⁶⁴ The project involved analysing the links between land use change and health, developing models that assess the economic impact of land use change on malaria and emerging infectious diseases, and implementing capacity-building and community engagement activities.

The project successfully developed and communicated an evidence base for the economic impact of malaria incidences associated with land use change. As part of their project, EcoHealth Alliance made it a priority to collaborate with all stakeholders to develop mutually beneficial solutions. To achieve this, they established a multi-stakeholder working group and held quarterly meetings with university partners. The purpose of these meetings was to discuss data sources, modelling methods, policy approaches, and community engagement and outreach. EcoHealth Alliance shared preliminary results with stakeholders and encouraged partners to provide critical analysis of modelling approaches and plans. They also discussed best practices for creating wide-reaching policy deliverables and shared research and ideas on land-use change and health across Southeast Asia.⁶⁵

The project established the Development and Health Research Unit (DHRU) at Universiti Malaysia Sabah as a centre for researching and educating about the intersection of health, economics, and land use change. The IDEEAL project prioritised developing future research talent in the fields of public health, environmental science, and economics, providing students with multidisciplinary research projects. This project, among others, highlights the transformative potential of collaborative research delineating pathways for linking human health and forests in broader policy interventions.⁶⁶

4.3 Recommendations

Quick wins

Health and biodiversity indicators:

A streamlined approach using more carefully selected health and biodiversity indicators is needed to understand the causal connections between biodiversity and human health factors.⁶⁷ These indicators should establish the extent and duration of the health effects (e.g. long-term vs. transitory) and explore whether multiple short-term exposures can either sustain, enhance, or diminish specific health outcomes. To deepen understanding, researchers should establish a broader range of physiological health parameters and undertake epidemiological studies examining specific diseases impacted by forest conservation and restoration.

Emerging technologies:

Health and environmental scientists can employ emerging technologies to precisely measure exposure doses in studies examining the health benefits of exposure to nature. One promising method involves using mobile health applications on smartphones, which leverages GPS technology and internet connectivity.⁶⁸ These applications can track individuals' locations while simultaneously gathering personal data (i.e., activity, heart rate, and stress), environmental data (i.e., air quality, temperature, and humidity), and medical data. Likewise, recent advancements in high-resolution hyperspectral imaging technology allow for detailed functional characterisation of vegetation and spatiotemporal biodiversity mapping.⁶⁹ Combining these technologies facilitates a better understanding of the intricate interactions between human health and forest biodiversity.

Mid- and long-term actions

Long-term research studies:

Most studies on biodiversity and human health have examined the short-term effects of exposure to the natural environment, often lacking proper experimental design. Aert et al. suggest updated studies adopt randomised

controlled trial designs.⁷⁰ Potential replication studies should take into consideration the potential time lags between exposure to biodiversity and its subsequent impacts on health, as this timing does not necessarily align. Longitudinal studies, such as birth cohort studies, could be more suitable for validating the enduring benefits of biodiversity on human health.

Specific and collaborative research:

Certain causal pathways, such as those involving nutrition, infectious diseases, and microbiota, have received a more comprehensive understanding in research than others.⁷¹ Likewise, there is a lack of mechanistic insight into the connections between biodiversity and human health, limiting collaboration and the application of nature-based solutions in public health.⁷² In the long term, developing a framework delineating the causal pathways could contribute to informing public health interventions. Given the intricate nature of multidisciplinary research, research necessitates increased collaboration. This will involve close engagement between ecologists, landscape and environmental scientists, biomedical scientists, public health specialists, and social scientists.⁷³

Longitudinal and randomised controlled trial research designs used in human health research should be adopted to understand the specifics of biodiversity-health linkages.

5. Barriers to collaboration: data-sharing, common metrics, and approaches

5.1. Barriers

The health and conservation sectors require access to good quality data on the interplay between human health and ecosystems to mobilise resources to facilitate intersectoral collaboration. In this respect, the existence of data silos is a significant barrier to effective collaboration. Data silos mean data relevant to human health and environmental conservation are collected, stored, and analysed in isolation. These silos impede the sharing and pooling of data between sectors.⁷⁴ EcoHealth Alliance's IDEEAL project referenced challenges in obtaining the necessary data for modelling.⁷⁵ The project found that receiving approvals and data was more time-consuming than planned due to data formatting, availability, missing metadata, data storage, and permission issues. The team subsequently created a detailed list of datasets required and simplified the minimum data needed to clarify data usage for partners. The project's final report recommends starting the data-sharing process early in future projects.

There is also a lack of shared metrics and frameworks for facilitating intersectoral collaboration. For instance, conventional health indicators like DALYs and the burden of disease often fail to capture the diverse health benefits derived from biodiversity and instead have a narrow focus on morbidity, mortality, and disability.⁷⁶ There are, however, existing tools which promote a holistic approach to evaluating biodiversity-health linkages. For instance, on the conservation side, there are vulnerability and adaptation assessments, integrated health and environmental assessments, and ecosystem services analyses. There are also valuation approaches for assessing the trade-offs between policy scenarios, including environmental hazard or risk factor analyses or a greater identification of the socio-economic determinants of health and disease. Such approaches can be further strengthened by developing a common evidence base across the conservation and health sectors are placing greater emphasis on “translating” the meaning of key metrics to promote mutual relevance across the health and biodiversity sectors.⁷⁷

Traditional knowledge from local and Indigenous communities is also often inadequately recorded, constituting a significant gap in data necessary to address forest-related health risks in a manner that includes traditional approaches to health in forest communities. This is particularly important to address, given the importance of forest products as a source of traditional medicines, which Indigenous peoples and local communities rely on, and the general lack of targeted health interventions for traditional forest communities.

5.2. Opportunities and successes

An integrated approach to data sharing based on FAIR (findable, accessible, interoperable, and reusable) data is key to successful collaboration between the health and conservation sectors. One solution is to promote data spaces where disparate data sets can be securely and efficiently integrated, managed, and analysed. The EU, for instance, has been promoting a common European data space to facilitate data pooling and sharing by bringing together relevant data infrastructures and governance frameworks.⁷⁸ The first data space to emerge relating to a specific area as part of the European strategy for data is the European Health Data Space (EDHS), which will likely pave the way for other data spaces to emerge and connect data from various ecosystems.⁷⁹

The conservation and health sectors are placing greater emphasis on “translating” the meaning of key metrics to promote mutual relevance across the health and biodiversity sectors.⁷⁷

Another example of a data-sharing project that is used to overcome the limitations of data silos is the Belgian Biodiversity Platform (BBP). The BBP receives funding from the federal government to cater to the biodiversity-related needs of Belgium's scientific community, specifically by fostering collaborative networks and supporting the Belgian government to engage with global biodiversity initiatives. This involves sharing data on biodiversity with policy and scientific sectors. One focus area of the BBP is Biodiversity and Health. The BBP works with stakeholders, including scientific experts, policy experts, practitioners, NGOs, and citizens, to understand their perspectives and inform them of practical links between their work and biodiversity. This initiative is an example of a way to build bridges between different sectors to improve data and knowledge-sharing on the biodiversity-health nexus.⁸⁰

The BBP initiative is an example of a way to build bridges between different sectors to improve data and knowledge-sharing on the biodiversity-health nexus.⁸¹



Aerial forest, USGS on Unsplash.

5.3 Recommendations

Quick wins

Data-sharing:

In the short term, it may be feasible to develop centralised, accessible cross-sectoral data sharing – i.e. one modelled after the European Health Data Space – for sharing data relevant to health and conservation sectors. Short-term projects to standardise key metrics and frameworks may involve adapting health metrics such as DALYs to include biodiversity-related factors. Similar to the BBP, other countries can begin implementing initiatives where one sector (e.g., the conservation sector) works with other stakeholders to inform them of how biodiversity-related data has practical links to their work – in this case, working with the health sector.

Mid- and long-term actions

Evidence base and capacity-building

In the long-run, it is necessary to establish a comprehensive evidence base integrating data from the health and conservation sectors involving long-term data collection, analysis, and synthesis. Capacity-building programmes should be developed for professionals in both sectors to understand and work with integrated data and tools.

Community forest concession models can address social determinants of health and conserve forest biodiversity.



Rainforest, Cassie Smart, Unsplash.

6.1 Barriers

Despite the increasing thematic recognition of the links between health and biodiversity, there is a limited effort to scale funding correspondingly. This lack of financing at the health-biodiversity nexus demonstrates that the funding needs of the health and conservation sectors continue to be seen as siloed efforts. The WHO notes that biodiversity-health linkages fail to be integrated into relevant policies because individual countries' institutional and financial capacities are often lacking, and competing demands from health and environment agencies with limited resources curb intersectoral collaboration.⁸²

In the health sector, for instance, financing is typically focused on the proximal determinants of health rather than the social determinants of health. This is partly due to the narrow approaches used to evaluate investment value, which focus exclusively on direct health costs and, therefore, systematically undervalue long-term preventive health benefits. In other sectors, similar investment valuations tend to undervalue health co-benefits in non-health sector investments.⁸³

Co-financing models can encourage intersectoral funding efforts for projects bridging the health and conservation sectors. Co-financing involves the joint commitment by at least two budget holders with dissimilar programming objectives towards an intervention or set of interventions. However, the health sector typically does not adopt co-financing due to a lack of evidence of co-financing's impact on sectoral payers, funding flows, health outcomes, or the maximisation of programme and policy impacts. There is also a lack of literature on the financing intersectoral action, which limits public understanding of how to undertake co-financing arrangements, such as how to negotiate and implement budgeting and accounting arrangements. More broadly, a legacy of intersectoral competition in the public sector and safeguarding resources in the face of constrained budgets also constitute challenges to collaborative financing. When different sectors have differential organisational capacity, resources, regulatory requirements, and operational processes, proceeding with co-financing can be considered too complex. Some barriers to public co-financing are more external, such as the lack of budgetary autonomy when government ministries have mandates to provide certain services. These problems may be more pronounced in low-income countries, given that the majority of co-financing cases tend to come from high-income countries.⁸⁴

6.2 Opportunities and successes

Despite barriers preventing the implementation of co-financing approaches for intersectoral collaboration, co-financing remains a critical opportunity to drive increased financing for intersectoral health and biodiversity action and overcome the inefficiencies of siloed budgeting. Though the health sector tends to co-finance initiatives with the social care or education sectors, partnerships with the conservation sector should also be encouraged, given nature protection and restoration constitute a long-term investment in preventive healthcare.⁸⁵

To make the case for co-financing, it is critical to leverage the argument that pooling resources and sharing risk will better enable individual sectors to reach their goals. Other enablers of co-financing include the creation of interagency performance targets. In New Zealand, for instance, governments were able to incentivise intersectoral partnerships by holding several agencies collectively responsible for reaching specific government-mandated targets. It has been noted that co-financing is more common in high-income countries. Still, across developing countries in Africa and South America, there are opportunities for co-financing with financing support from international donors and development agencies (with cases including the World Bank, UNDP, the Japanese International Cooperation Agency, and the Gates Foundation). Between different types of co-financing, developing countries are more prone to using promotion models that fund programmes which address upstream factors to promote downstream sectoral objectives. Promotion models use aligned budgets or grant modalities, rather than sub-national pooled budgets, to fund intersectoral projects.⁸⁶

Conservation concessions provide another entry point for financing health and conservation outcomes. Conservation concessions are contractual agreements where rights to exploit resources (like logging, mining, or agriculture) in a particular area are relinquished in exchange for conservation activities.

These concessions are often granted by a government or landowner to a conservation organization or NGO. The concessions can, in turn, generate revenue for local communities or governments through mechanisms like eco-tourism. For instance, the Annapurna Conservation Area in Nepal, established in 1992, saw the area levying visitor fees, which have been used for local development. Community health and sanitation benefits financed by the conservation area include health clinics, mobile vaccinations, health education, latrines and rubbish pits construction, and improved water supply.⁸⁷ Community forest concession models, in general, have a high potential for lifting local people out of poverty—therefore addressing several social determinants of health—whilst simultaneously conserving forests and their inherent biodiversity.⁸⁸



Tegallalang Rice Terrace, Indonesia,
Paolo Nicoletto, Unsplash

In New Zealand, governments were able to incentivise intersectoral partnerships by holding several agencies collectively responsible for reaching specific government-mandated targets.



Annapurna, Narchyang, Nepal, by Giuseppe Mondì, Unsplash.

6.3 Recommendations

Quick wins

Integrated objectives:

Existing conservation concession models should integrate health objectives so that revenues derived from the concession area can be channelled towards health infrastructure, as in the example of the Annapurna Conservation Area. Governments could also create interagency performance targets (i.e., specifically the health and conservation sectors) to incentivise co-financing and pooling resources to support shared objectives.

Mid- and long-term actions

Evidence base:

Though co-financing represents a significant opportunity for collaborative financing between the health and conservation sectors, several long-term barriers must be addressed. Given that an oft-cited barrier is the lack of evidence demonstrating the benefits of co-financing, there is a need for greater research on the outcomes and benefits of co-financing, including the impacts on health and conservation outcomes, the achievement of programme and policy objectives and the costs to sectoral payers.

Annapurna conservation area in Nepal used visitor fees for local public health initiatives including health clinics, mobile vaccinations, and health education.

7. Barriers to collaboration: capacity-building



Pharmacy, by Tbel Abuseridze, Unsplash.

7.1 Barriers

Capacity refers to the individual, organisational, and enabling environment of the health and conservation sector to collaborate effectively. Despite frameworks like One Health, technical and institutional capacity barriers can hamper collaboration. This indicates a need to improve cross-sectoral competencies and capacities, including joint workforce training and governance based on multi-sectoral principles. On a national level, the capacity for intersectoral collaboration is particularly obstructed due to the differences in organisational structures between the health and environment sectors. The healthcare industry is known for having a hierarchical organisational culture that relies on strict, evidence-based decision-making processes, which can limit cross-sectoral collaboration.

As an example of capacity impacting national-level cross-sectoral collaboration, one study examining the Health in all Policies framework (HiAP) in local public health agencies in Colorado identified the challenges to cross-sector collaboration due to limited state support or resources to create opportunities to build relationships. Some local public health agencies said they cannot do

this because they must fulfil agency responsibilities and duties first before having enough time to talk to other potential partners, suggesting there is a need for a mandate or better incentives for collaboration.⁸⁹ However, a mandate or directive strategy for collaboration should also be exercised with caution. A study conducted in Quebec found that a public health bill, which required health considerations to be considered during policy development across government, resulted in a slower cross-sector policy-making process. The study's informants suggested that intersectoral action is better facilitated by understanding the primary interests between sectors. A directive approach to facilitate agenda setting seemed to create tension about roles, responsibilities, and accountability in the case settings of the study, which may have ultimately slowed down the policy-making process.⁹⁰

Collaboration can also be difficult to achieve due to constraints in the time and resources of both sectors. A study in the Netherlands examining the collaboration between the public health sector and other sectors (including the environment) found that the focus of collaboration tended to be an exchange of information or on projects rather than integrated policy or decision-making. The interviews revealed that public health policy officers found that it was time-consuming to get other sectors involved, with different priorities and mindsets.⁹¹ The time and human resources needed to create formal mechanisms for collaboration and frameworks for joint decision-making meant most cross-sector collaboration relies on existing good (individual) relationships between sectors, previous positive experiences in collaboration, and a common interest in working together.

The health sector, particularly public health, is facing a severe shortage of staff in many contexts, which makes it challenging to collaborate across sectors. The WHO predicts that there will be a shortage of 10 million health workers by 2030, mainly in low- and lower-middle-income countries. However, countries at all levels of socioeconomic development are facing difficulties in educating,

employing, deploying, retaining, and managing their workforce to varying degrees.⁹² Lack of time and human resource constraints mean many members of national health sectors do not prioritise engagement with the environment sector.

7.2 Opportunities and successes

Opportunities to improve the capacity for intersectoral collaboration can include greater access to educational resources and the establishment of cross-cutting principles for action. The One Health Joint Programme (OH JP) is one example of establishing such principles. The Programme principles include adopting systems thinking, fostering advocacy and communication through public-private partnerships (PPP), enhancing governance, institutional and legal frameworks, and using the traditional knowledge of Indigenous peoples and local communities, as appropriate. This work includes creating stakeholder guidelines to design joint processes for One Health operationalisation and collaborative work plans. These plans include vision integration, prioritisation, negotiation, the definition of agreed outcomes and shared values, evidence needs, and collective actions. The OH JP focuses on generating an enabling environment for the effective implementation of One Health. Actions span several activities, from monitoring the implementation and enforcement of regulatory frameworks to the availability of sustainable financing, from information systems to technologies, and from transparency to communication.

Demonstrating the successes in improving capacity for intersectoral collaboration, One Health has increasingly been integrated into national curricula and academic research centres. In the United States, for instance, several universities offer degree courses in One Health. In Europe, the EU-funded One Health European Joint Programme has 37 partner institutions and runs 16 doctoral projects. Universities in Africa also provide One Health training opportunities.

One Health has increasingly been integrated in national curricula and academic research centres, demonstrating a push to improve capacity for intersectoral collaboration.

7.3 Recommendations

Quick wins

Gap assessments:

Conduct gap assessments to identify core barriers to cross-sector collaboration and One Health initiatives. Capacity-building and training can then be tailored to address identified gaps.

Capacity building project component:

One Health initiatives could include capacity-building as part of their core project objectives to promote the advancement of One Health at the national level. Collaboration between universities and projects can facilitate the integration of capacity building by exchanging field experience with academic experience in One Health through seminars, workshops, and the development of training materials.

Financial incentives:

Several studies have shown that offering financial incentives can encourage cross-sector collaboration. For instance, a study conducted in Sweden, Canada, and Australia found that economic incentives can facilitate intersectoral work. In Quebec, Canada, where the government promotes health initiatives through intersectoral cooperation, the study's key informant emphasised the importance of having funds available to incentivise participation. This can lead to continued partnership and awareness of the shared benefits, even after the financial incentives have ended.⁹³

Mid- to long-term actions

Dedicated departments:

The literature suggests ensuring role clarity to facilitate identifying the actors to collaborate with on the conservation and health sides. Alternatively, sectors should create specific departments and roles within them whose core purpose is pursuing collaboration. This team will possess the required skills to establish trust and momentum for collaboration between the forest conservation sector and health. This will ultimately increase the feasibility of cross-sector collaboration.

Investment in research and development:

Many nations, predominantly low-income and conflict-affected countries, lack access to quality laboratory services and essential research equipment necessary to establish the link between forest conservation, restoration, and health. Most national laboratories fail to meet the accreditation standards of quality management systems. Investing in quality laboratory equipment will strengthen the evidence base to understand the relationship between forests and health better.

Sufficient time:

Sufficient time to build relationships, buy-in from each sector, and a framework for joint action is critical to enabling effective cross-sector collaboration between forest conservation and health. Project funding must allow sufficient time for discussion and systematic thinking through the health and well-being implications of specific conservation and restoration policies and practices. Finding a shared common ground and synergies is only feasible after aligning conceptual understandings that can bridge the sectoral divides. This time must be considered valuable across the sector's hierarchies to withstand pressures from senior leadership.

AFROHUN

Africa One Health University Network (AFROHUN)

AFROHUN emerged from the former One Health Central and Eastern Africa network (OHCEA), which aimed to strengthen a One Health workforce by bringing together the Public Health and Veterinary faculties of six countries. In 2019, the network's leadership recognised the growing interest from other countries and expanded the mandate. The AFROHUN member countries include Cameroon, Cote D' Ivoire, the Democratic Republic of Congo (DRC), Ethiopia, Kenya, Rwanda, Senegal, Tanzania, and Uganda. As of 2023, within these AFROHUN member countries, there are 18 member universities, with 26 member institutions.

This network aims to transform the training environments and methods of universities to create a One Health Workforce that can respond to the growing number of outbreaks of epidemics, pandemics, and other complex health challenges connected to the environment. The network goes beyond the conventional One Health disciplines and institutions of public health and veterinary medicine, and includes professionals from agriculture, forestry, wildlife, veterinary and public health para-professions, allied health, business, and anthropology, as well as technical and vocational training organisations.

Key successes

Supports multi-disciplinary learning:

AFROHUN facilitates networking between the different partner universities and supports the development of training programmes and academic offerings that promote multi-disciplinary learning.

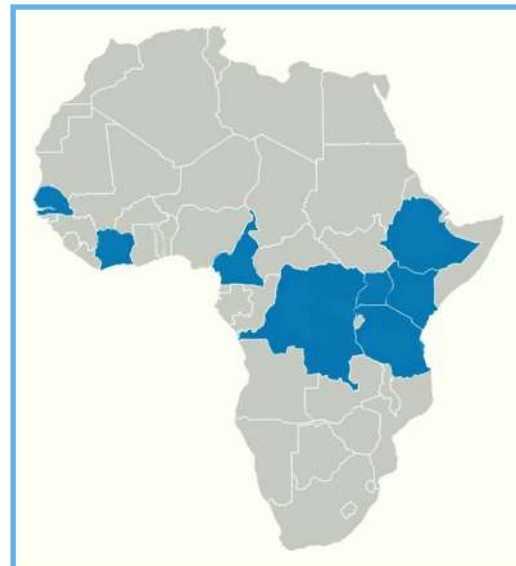
Accessible and widely used resources:

AFROHUN provides various training programmes, including online short courses that cover specific topics within all One Health sectors and subjects. This training material is publicly available, expanding the target audience to external universities.

Community-level fieldwork:

AFROHUN works together with various government institutions and NGOs to provide One Health training to fieldworkers at the community level. For instance, the network has collaborated with organisations such as the Red Cross in Uganda, Bread through Action in DRC, and government units responsible for risk communication and community engagement in Cameroon, Uganda,

AFROHUN member countries



Rwanda and DRC. These collaborations have resulted in effective risk communication for COVID-19 and AMR in these countries.

Outstanding challenges

Incentives needed to encourage participation

Individuals who are considering participating in One Health education and training may encounter obstacles such as financial constraints and lack of time to access the opportunities provided by AFROHUN. This highlights the recurring issue of training professionals who are already in service. To establish training programmes that are sustainable and fair, it may be helpful to secure funding for students during the development of future recognised training programmes.

Biodiversity remains overlooked:

The importance of biodiversity and ecosystem services in preventing pandemics seems to be overlooked. According to a survey conducted among students participating in competency-based training in One Health, 'biodiversity and ecosystem services' were ranked relatively low in terms of their perceived significance. The One Health paradigm has historically neglected environmental and ecosystem contexts, which may explain the lack of perceived importance in this survey.

Employers need to reward One Health training:

During an evaluation of the competency-based training in One Health for members of AFROHUN and other similar networks, over 90% of the participants expressed that they believed earning a One Health certificate after training and assessment would be beneficial for the workforce. However, the survey revealed that only around 60% of the participants expected their current employers and supervisors to reward One Health credentials with promotion, merits or placement in decision-making positions. This suggested that employees do not anticipate being rewarded for One Health training, and that there is a diverse

perception of the necessary skills needed to address One Health-based challenges to global health security. These issues highlight the need to sensitise employers to the One Health approach and increase the visibility of the competency-based approach to One Health training.

Case study sources

Stephen T. Garnett et al. (2018) 'A Spatial Overview of the Global Importance of Indigenous Lands for Conservation', *Nature Sustainability* 1(7): 369–74. <https://doi.org/10.1038/s41893-018-0100-6> ;

Ava Sullivan et al. (2023) 'International Stakeholder Perspectives on One Health Training and Empowerment: A Needs Assessment for a One Health Workforce Academy', *One Health Outlook*, 5: 8. <https://doi.org/10.1186/s42522-023-00083-4>.

8. Barriers to collaboration: knowledge dissemination and dialogue

8.1 Barriers

Building a common understanding between the forest and health sectors is necessary to ensure the translation and dissemination of knowledge across and within both sectors.⁹⁴ The major barriers to intersectoral knowledge dissemination are the use of technical language and a professional culture that maintains sectoral silos and existing knowledge gaps. For example, a 2018 literature review revealed that while many health professionals acknowledge the impact of climate change on their patients' health, they still lack sufficient knowledge on the subject.⁹⁵ Using technical and sector-specific language can hinder intersectoral discussion. One study aimed to identify challenges and opportunities for the WHO in addressing broader health determinants and working across sectors. In interviews with five senior WHO officials, one interviewee outlined that the health sector is "weak in speaking the language of the other sectors," highlighting the need to bridge the communication gap when collaborating across disciplines and professions.⁹⁶

Healthcare systems that prioritise acute biomedical interventions can further limit collaboration across sectors. This approach tends to overlook prevention and non-medical determinants of health, even though biomedically actionable determinants only contribute to one-fifth of individual and overall population health.⁹⁷ Longer-term environmental or equity factors that represent the underlying causes of ill health are often ignored in favour of short-term health gains.⁹⁸ Healthcare professionals usually prioritise the most urgent issues in their day-to-day work, which can lead to a lack of understanding or appropriate weighting of the urgency of the ecological crisis.⁹⁹ The conservation sector must communicate effectively to convey the urgency and significant cost savings of disease prevention compared to disease treatment, raising awareness about the enormous risks that biodiversity loss poses to human health.

Some literature suggests a lack of awareness among General Practitioners (GPs) about the health benefits of nature due to the limited dissemination of evidence linking health and nature on platforms where GPs update their knowledge. Researchers have explored how knowledge about the health benefits of nature can be applied in practical settings.¹⁰⁰ A study in the Netherlands revealed that in approximately 26% of patient consultations, GPs recommended physical activity, but they did not mention the term "nature".¹⁰¹ There are four potential explanations for this omission: a lack of media or platform representation of evidence linking health and nature, a lack of GP awareness, a lack of conviction regarding the health benefits of nature, or a perceived lack of responsibility to incorporate nature benefits into consultations.¹⁰² The study further identified two key obstacles that need to be overcome: raising awareness among professionals about research findings and fostering collaboration among medical, health, environmental, and intermediary professionals.

Some literature suggests a lack of awareness among General Practitioners (GPs) about the health benefits of nature due to the limited dissemination of evidence linking health and nature on platforms where GPs update their knowledge.

8.2 Opportunities and successes

The current post-pandemic environment provides more incentives for cross-sectoral dialogue between the health and conservation sectors. In April 2023, the WHO developed its Preparedness and Resilience for Emerging Threats (PRET) initiative — a case study for intersectoral collaboration. The PRET initiative focuses on improving worldwide disease pandemic preparedness by providing tools and technical guidance through One Health.¹⁰³ On a national scale, the Australian government developed the One Health Surveillance Initiative following the immediate aftermath of the COVID-19 pandemic to strengthen the country's ability to prevent, anticipate, and respond to zoonotic diseases, including those with pandemic potential. The initiative brings together representatives from the Department of Agriculture, Water and the Environment, and the Department of Health.¹⁰⁴ The initiative fosters a platform for the health and conservation sectors to collaborate at policy and activity levels to co-create research, projects, and joint-management plans addressing current and future risks to human health and environmental wellbeing.¹⁰⁵

Rising global incidences of wildfires have also effectively brought together public health and conservation officials, demonstrating how intersectoral knowledge dissemination can be facilitated when both sectors recognise the urgency. In the summer of 2023, Canada saw unprecedented wildfires.¹⁰⁶ The lingering smoke engulfed Canada and part of the United States, increasing visits for asthma and causing mental health side effects of anxiety and isolation as people were forced to remain indoors due to the health consequences.¹⁰⁷ This record-breaking wildfire season has propelled public attention on the issue of joint forestry-health management responses to wildfires¹⁰⁸. At the end of the wildfire season in August 2023, the Government of Canada released a toolkit for public health authorities to support their management of wildfire-associated human health risks and dangers.¹⁰⁹ Considering the audience, the toolkit was developed with resources and language

that would be relatable to the health sector. Input and consultations from several ministries, including Environment and Climate Change Canada, Indigenous Services Canada, Natural Resources Canada, and Public Safety Canada, were included to ensure alignment with the environmental sector.¹¹⁰ Co-creating resources allowed for a comprehensive joint-management plan for future wildfire seasons and fostered a vital communication channel for health professionals and conservationists to develop effective action plans to address emerging challenges and ensure the protection of human health and the environment.



Great Smoky Mountains National Park, by Gabriel Sollmann, Unsplash.

8.3 Recommendations

Quick wins

Build upon pre-existing systems and mechanisms:

Existing systems, including the OH-SMART system, enhance communication channels between the forest and health sectors. The OH-SMART is a readily

available framework which can be used as preparedness and capacity-building measures. For example, it was employed in the Avian Influenza Emergency Response Plans and Exercises in Indonesia and the United States. This helped support collaborative working between the Indonesian Ministry of Health, the Indonesian Ministry of Agriculture and representatives from the in-country offices of the United States Agency for International Development (USAID), the UN, the WHO, and the US Centers for Disease Control and Prevention (CDC).

Develop shared standard operating procedures (SOPs):

Collaborating actors can develop shared standard operating procedures (SOPs) to guide interaction and coordination. These play a vital role in effective collaboration by aligning the practices of both sectors. Research has shown that developing and implementing joint SOPs improves coordination and cooperation between sectors, resulting in positive health and environmental outcomes.¹¹¹

Empower local institutions:

Governments and local stakeholders should be encouraged to define their own objectives rather than introduce top-down objectives imposed by external bodies.¹¹² Ground-level expertise from local teams is essential and complementary to international guidelines. This approach emphasises the importance of engagement with local stakeholders in order to create local knowledge and respond to the needs of local governments and communities.

Long-term actions

Creating a common language and joint aims:

To enhance communication across sectors, stakeholders should familiarise themselves with each sector's missions, goals, and culture.¹¹³ Clear and common definitions support the development of a common language. However, developing a common language tends to be ad-hoc, which may not be time- or resource-effective in a health emergency. The forest conservation and restoration

sector should understand health partners' "missions, concerns, funding issues" for long-term collaboration, advocating for health equity and preventative health solutions over short-term goals.¹¹⁴

Robust governance and accountability mechanisms:

Legislation supporting intersectoral collaboration draws on established mechanisms in government to ensure accountability and longevity. Examples of such mechanisms include the South Australian Public Health Act and the incorporation of health equity mandates in Scandinavian municipality budgets. To avoid blurred boundaries of accountability in intersectoral collaboration, stakeholders can set clear goals, delineate division of labour, and integrate accountability mechanisms to consider the contributions of each sector.

Creating a platform for information exchange:

Information exchange platforms are crucial for multi-sectoral communication between the public health and environment sectors. These platforms facilitate collaboration among professionals, policymakers, and stakeholders, promoting open dialogue to address complex issues of climate change, pollution and infectious disease.¹¹⁵ Programmes like Leaders Across Borders/Líderes Atraves de la Frontera adopt an Interprofessional Education Framework, training public health professionals to work collaboratively across borders.¹¹⁶ These platforms serve as a space for consensus building on projects, frameworks, and policies that promote evidence-based decision-making to benefit public health and the environment.¹¹⁷

Conclusion

A growing body of evidence supports the benefits of conserving and restoring forests for human health. However, there is still much opportunity to expand that evidence base so that both the conservation and health sectors understand why nature and human health are linked and thus require collaboration.

This report has demonstrated that forests (in which most terrestrial biodiversity is held) support human health by improving food security and the social determinants of health; advancing the health of Indigenous peoples, who act as the world's primary stewards of biodiversity; delivering essential medicines; reducing health impacts associated with climate change, mainly related to heat waves and higher temperatures; lowering the risks of NCDs; and mitigating the spread of infectious and zoonotic diseases. In other words, the health sector can benefit significantly from working with the conservation sector to leverage nature's cost-effective, preventive healthcare services. The conservation sector, too, can benefit from the resources, technical know-how, and access to the public held by health sector policymakers and practitioners.

To truly realise the mutual benefits of collaboration, addressing the barriers outlined here regarding the evidence base, data, funding, capacity, and knowledge will be necessary. Yet, this report has also clearly demonstrated the opportunities for and successes of collaboration. Ultimately, collaboration can help to bring about visible improvements in both the conservation sector and health outcomes at lower costs than if either sector acted in isolation, making it all the more imperative.

Appendix 1: Key trends in forest and health publications

AN ANALYSIS OF A COMPETITIVE SAMPLE OF 18 REPORTS CONSIDERING THE LINK BETWEEN FORESTS, HEALTH AND THE ECOSYSTEM SERVICES ASSOCIATED WITH HEALTH.

Appendix 1: Key trends in forest and health publications

Organisation	Report Title	Publication Date	Health Aspect Focus							Ecosystem Services Associated with Health								
			Mental Wellbeing	Heat-related risks	(Mal)nutrition	Infectious and zoonotic diseases	Cardiovascular disease	Cancers	Respiratory Health	Recreation	Forestry Products	Clean air	Clean Water	Flood, landslide, and erosion	Carbon sequestration	Biodiversity habitat and	Food security	Climate regulation
CIFOR	Forests and human health: assessing the evidence	2006	X		X	X			X		X						X	
CI	Could a future pandemic come from the Amazon?	2021				X												
GCHA	The limits of livability: the emerging threat of smoke impacts on health from forest fires	2021	X					X	X						X			
FAO	Forests for human health and well-being: strengthening the forest-health-nutrition nexus	2020	X	X	X	X	X	X	X	X	X	X	X		X	X		
FAO	A guide to forest-water management	2021	X					X		X	X	X	X	X	X	X	X	X
Forest Europe	Human health and sustainable forest management	2021	X					X		X	X	X	X	X	X			X
IPBES	Global assessment report on biodiversity and ecosystem services	2019	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
HLPE	Sustainable forestry for food security and nutrition	2017	X		X	X				X	X	X	X	X	X	X	X	X
HRW	"The Air is Unbearable:" health impacts of deforestation-related fires in the Brazilian Amazon	2020						X	X									
IUFRO	Forests and trees for human health: pathways, impacts, challenges and responses options	2023	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WWF	The vitality of forests: illustrating the evidence connecting forests and human health	2022	X	X	X	X	X	X	X	X		X	X	X		X	X	X
WWF	Stop spillover at the source: evidence-based strategies for the pandemic era	2021				X			X	X		X			X			X
World Agroforestry	Treesilience: an assessment of the resilience provided by trees in the drylands of Eastern Africa	2014				X			X		X	X	X	X	X	X	X	X
WHO	Connecting global priorities: biodiversity and human health	2015	X	X	X	X	X	X	X	X		X	X	X		X	X	X
WRI	Better forests, better cities	2022	X	X		X	X	X	X	X		X	X	X	X	X	X	X
WRI	Not just carbon: Capturing the benefits of forests for stabilizing the climate from local to global	2022		X								X	X					
UNEP	The state of the world's forests 2022: forest pathways for green recovery	2022	X	X		X				X	X	X	X	X	X	X	X	X
Rockefeller Foundation	Safeguarding human health in the Anthropocene epoch	2015	X		X	X		X	X			X	X	X	X	X	X	X

Appendix 2: Key trends in initiatives linking forests and human health

AN ANALYSIS OF A SAMPLE OF 22 INITIATIVES LINKING FORESTS AND DRIVERS OF CHANGE IN FORESTS TO HEALTH.

Appendix 2: Key trends in initiatives linking forests and human health

Initiative	Organisation(s)	Est.	Location	Forest and health link	Activity Focus				
					Research	Capacity-building	Collaboration	Awareness	Development
Amazonian landscape changes and Indigenous health impacts	EcoHealth Alliance	2020	Amazon, Brazil	Links land-clearing to negative health for Indigenous peoples.	x				
Forest Health Future, Liberia	EcoHealth Alliance	2022	Liberia	Links land use change to infectious diseases.	x	x			x
Infectious Disease Emergence and Economics of Altered Landscapes (IDEAL)	EcoHealth Alliance	2013	Malaysia, Thailand and Indonesia	Links deforestation with malaria outcomes.	x	x			
Forests and health initiative	WWF	2015	Indonesia (Sumatra), China, Myanmar, Thailand, the United States, and Vietnam	Links ecosystem services to reducing health risks	x		x	x	
The green heart project	TNC	2017	United States (Louisville, Kentucky)	Links urban forests to human health and wellbeing benefits.	x				
Turkey climate resilient forests project	The World Bank	2023	Turkey	Links forest fire management with human health and safety.		x			
Nature4Health (N4H)	Partnership between BMUV, SCBD, UNDP, ENEP, WHO, IUCN, and EcoHealth Alliance	2021	Global low-and-middle-income countries where risk of transmitting diseases between animals and humans is high.	Links ecosystem management with reduced pandemic risk.		x	x	x	
Adaptive agriculture and rangeland rehabilitation project	IFAD	2023	Somalia	Links forest rehabilitation with climate resilience, biodiversity, and human health outcomes.		x			x
Health in harmony, lower and middle Xingu Basin, Pará	Health in Harmony	2020	Lower and Middle Xingu Basin, state of Pará, Brazil	Links traditional medicine practices with conserving forests.		x			x
HealthDEEP	CNRS, Mahidol U., and Kasetsart U.	2023	South-East Asia	Researches the forest-health nexus.	x		x		
Forest school Mpigi, Uganda	Biovision	2021	Mpigi, Uganda	Links traditional medicine with forest conservation.		x	x		
Fuel efficient stoves	Jane Gooddall Institute	2010	Uganda, Tanzania, Democratic Republic of the Congo	Links efficient stoves with reducing air pollution for health.		x			x
Forest-based yard daycare programme	NRI Finland	2020	Finland	Links forest undergrowth with improved child health.	x				
NHS forest	CSH	2009	United Kingdom	Links forests to improved patient wellbeing.	x		x		x
Forest and water nexus	FAO, IUCN, SIWI	N/A	N/A	Links forest management with improved water security.	x	x	x		x
Sustainable food systems and integrated management in the Marshall Islands	FAO	2023	Marshall Islands	Links sustainable land management with food security.		x	x		x
Connecting watershed health with sustainable livestock and agroforestry	World Bank	2021	Mexico	Links land management and climate-smart agriculture with disease risk mitigation and improved livelihoods.		x	x		x
Guinean forests integrated program	CI, FAO, IUCN	2023	Guinea, Liberia, Sierra Leone	Links forest conservation with human health and wellbeing.		x	x	x	x
Healthy landscapes	UNEP	2018	Sri Lanka	Links sustainable agriculture with human health in dry zones.		x			x
SFM rehabilitation and sustainable use of peatland forests in south-east Asia	IFAD	2008	Indonesia, Malaysia, Thailand, Viet Nam, Singapore & Brunei Darussalam	Links peatlands degradation with local health outcomes.		x			x
Clearing house	EU	2019	Europe and China	Links urban forests with human health and wellbeing.	x	x	x		x
ASEAN-Korea garden	AFoCO	2023	Cambodia	Links access to nature and forests to human health.					x

End notes

1. Loh et al. (2015). Targeting Transmission Pathways for Emerging Zoonotic Disease Surveillance and Control. *Vector Borne and Zoonotic Diseases*, 15(7), 432–37. <https://doi.org/10.1089/vbz.2013.1563>
2. IPBES. (2020). *Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services*. IPBES Secretariat. https://files.ipbes.net/ipbes-web-prod-public-files/202012/IPBES%20Workshop%20on%20Biodiversity%20and%20Pandemics%20Report_0.pdf
3. WHO. (2023). *COP28 Health Day*. WHO. Retrieved December 3, 2024, from <https://www.who.int/news-room/events/detail/2023/12/03/default-calendar/cop28-health-day>
4. WHO. (2023). *Over 40 million Health Professionals Demand Bold Health and Climate Action at COP28*. WHO. Retrieved December 2, 2023, from <https://www.who.int/news/item/02-12-2023-over-40-million-health-professionals-demand-bold-health-and-climate-action-at-cop28>
5. WHO. (n.d.). *Constitution of the World Health Organization*. WHO. Retrieved December 2, 2023, from <https://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1>
6. WHO. (n.d.) *Constitution of the World Health Organization*. WHO. Retrieved December 2, 2023, from <https://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1>
7. Giam, X. (2017). Global Biodiversity Loss from Tropical Deforestation. *Proceedings of the National Academy of Sciences*, 114(23), 5775–77. <https://doi.org/10.1073/pnas.1706264114>
8. WHO. (2015). *Connecting Global Priorities: Biodiversity and Human Health: A State of Knowledge Review*. World Health Organization. <https://www.who.int/publications/i/item/connecting-global-priorities-biodiversity-and-human-health>
9. The World Bank. (2023). *Empowering Indigenous Peoples to Protect Forests*. Retrieved August 9, 2023, from <https://www.worldbank.org/en/news/feature/2023/08/09/empowering-indigenous-peoples-to-protect-forests>
10. WHO. (n.d.) *Social Determinants of Health*. Retrieved September 19, 2023, from <https://www.who.int/health-topics/social-determinants-of-health>
11. FAO (2020). *Forests for Human Health and Well-Being: Strengthening the Forest–Health–Nutrition Nexus*. FAO. <https://doi.org/10.4060/cb1468en>.
12. UNICEF (2020). *Ending Preventable Child Deaths*. UNICEF. https://www.unicef.org.uk/wp-content/uploads/2020/01/Unicef-UK-Ending-Preventable-Child-Deaths_Report-2020.pdf.
13. Diego Herrera et al. (2017). Upstream Watershed Condition Predicts Rural Children’s Health across 35 Developing Countries. *Nature Communications*, 8(1), 811. <https://doi.org/10.1038/s41467-017-00775-2>.
14. Jin, S. L. & Arbuto N. (2023). *Healthy Forests are Vital to Human Health and Sustainable Development*. UN Chronicle. Retrieved September 19, 2023, from <https://www.un.org/en/un-chronicle/healthy-forests-are-crucial-human-health-and-sustainable-development#:~:text=Broadly%2C%20such%20benefits%20include%20nutrition,are%20critical%20for%20human%20health.>
15. WHO (2023). *The Health of Indigenous Peoples*. World Health Assembly. https://apps.who.int/gb/ebwha/pdf_files/WHA76/A76_R16-en.pdf.
16. United Nations Department of Economic and Social Affairs Indigenous Peoples (n.d.). *Health*. United Nations. Retrieved January 3, 2024, from <https://www.un.org/development/desa/indigenouspeoples/mandated-areas1/health.html>
17. United Nations Department of Economic and Social Affairs Indigenous Peoples (n.d.). *Health*. United Nations. Retrieved January 3, 2024, from <https://www.un.org/development/desa/indigenouspeoples/mandated-areas1/health.html>
18. Nikolakis, W., Gay, V., & Nygaard, A, (2023). The “Environmental Stewardship-Health Nexus” among Indigenous Peoples: A Global Systematic Literature Review. *Wellbeing, Space and Society*, 4, 100121. <https://doi.org/10.1016/j.wss.2022.100121>

19. The World Bank. (2023). *Indigenous Peoples*. The World Bank. Retrieved April 4, 2023, from <https://www.worldbank.org/en/topic/indigenouspeoples>
20. FAO (2020). *Forests for Human Health and Well-Being: Strengthening the Forest–Health–Nutrition Nexus*. FAO. <https://doi.org/10.4060/cb1468en>
21. FAO (2020). *Forests for Human Health and Well-Being: Strengthening the Forest–Health–Nutrition Nexus*. FAO. <https://doi.org/10.4060/cb1468en>
22. Ekor, M. (2014). The Growing Use of Herbal Medicines: Issues Relating to Adverse Reactions and Challenges in Monitoring Safety. *Frontiers in Pharmacology*, 4, 177. <https://www.frontiersin.org/articles/10.3389/fphar.2013.00177>
23. United Nations Economic Commission for Europe. (n.d.). *Forests as Pharmacy*. United Nations. Retrieved December, 14, 2023 from <https://unece.org/forests-as-pharmacy>
24. IUCN. (2017). *Nature-Based Solutions to Disasters*. IUCN. https://www.iucn.org/sites/default/files/2022-07/nbs_to_disasters_issues_brief_final.pdf
25. Kalilou, O. (2022). Indigenous and Local Communities-Led Initiatives for Climate Change Resilience Development in Niger. *International Conference on Sustainable Development*. https://ic-sd.org/wp-content/uploads/2022/11/submission_533.pdf
26. Ellison, D. et al. (2017). Trees, Forests and Water: Cool Insights for a Hot World. *Global Environmental Change*, 43, 51–61. <https://doi.org/10.1016/j.gloenvcha.2017.01.002>
27. Alves de Oliveira, B.F., Bottino, M.J., & Nobre C.A. (2021). Deforestation and Climate Change Are Projected to Increase Heat Stress Risk in the Brazilian Amazon. *Communications Earth & Environment*, 2(1), 1–8. <https://doi.org/10.1038/s43247-021-00275-8>
28. European Environment Agency. (2011). *Forests, Health and Climate Change*. European Environment Agency. Retrieved October 1, 2021 from <https://www.eea.europa.eu/articles/forests-health-and-climate-change>
29. Susan C. Cook-Patton et al. (2020). Mapping Carbon Accumulation Potential from Global Natural Forest Regrowth. *Nature*, 585(7826), 545–50. <https://doi.org/10.1038/s41586-020-2686-x>.
30. Asri, A. K., Lee, H. Y., Wu C. D., & Spengler J. D. (2022). How Does the Presence of Greenspace Related to Physical Health Issues in Indonesia? *Urban Forestry & Urban Greening*, 74, 127667. <https://doi.org/10.1016/j.ufug.2022.127667>.
31. Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A Systematic Review of Evidence for the Added Benefits to Health of Exposure to Natural Environments. *BMC Public Health*, 10(1), 456. <https://doi.org/10.1186/1471-2458-10-456>.
32. Younan, H. C., Junghans, C., Harris, M., Majeed, A., & Gnani, S. (2020). Maximising the impact of social prescribing on population health in the era of COVID-19. *Journal of the Royal Society of Medicine* 113 (10): 377–82. <https://doi.org/10.1177/0141076820947057>.
33. Saraev, V., O'Brien, L., Valatin, G. & Bursnell, M. (2021) *Valuing the Mental Health Benefits of Woodlands*. Forest Research. <https://cdn.forestresearch.gov.uk/2021/12/frfp034.pdf>.
34. Department for Environment, Food and Rural Affairs, UK Government (2023). *Environmental Improvement Plan 2023*. UK Government. <https://www.gov.uk/government/publications/environmental-improvement-plan>.
35. Brancalion, P. H. S. et al. (2020). Emerging Threats Linking Tropical Deforestation and the COVID-19 Pandemic. *Perspectives in Ecology and Conservation*, 18(4), 243–46. <https://doi.org/10.1016/j.pecon.2020.09.006>.
36. Gibb, R. et al. (2020). Zoonotic Host Diversity Increases in Human-Dominated Ecosystems. *Nature*, 584 (7821), 398–402. <https://doi.org/10.1038/s41586-020-2562-8>.
37. MacDonald, A.J. & Mordecai, E. A. (2019). Amazon Deforestation Drives Malaria Transmission, and Malaria Burden Reduces Forest Clearing. *Proceedings of the National Academy of Sciences*, 116(44), 22212–18. <https://doi.org/10.1073/pnas.1905315116>.
38. Rohr J. R. et al. (2019). Emerging Human Infectious Diseases and the Links to Global Food Production. *Nature Sustainability*, 2(6), 445–56. <https://doi.org/10.1038/s41893-019-0293-3>.
39. Patz, J. A. et al. (2004). Unhealthy Landscapes: Policy Recommendations on Land Use Change and Infectious Disease Emergence. *Environmental Health Perspectives* 112(10): 1092–98. <https://doi.org/10.1289/ehp.6877>.
40. Dobson, A. P. et al. (2020). Ecology and Economics for Pandemic Prevention. *Science*, 369(6502), 379–81. <https://doi.org/10.1126/science.abc3189>.
41. Hlávka, J. & Rose, A. (2023). *COVID-19's Total Cost to the U.S. Economy Will Reach \$14 Trillion by End*

of 2023. USC Schaeffer. Retrieved January 3, 2024, from <https://healthpolicy.usc.edu/article/covid-19s-total-cost-to-the-economy-in-us-will-reach-14-trillion-by-end-of-2023-new-research/>.

42. King, S., Lemieux, C. J., & Lem, M (2023). An Urgent Call to Integrate the Health Sector into the Post-2020 Global Biodiversity Framework. *International journal of environmental research and public health*, 20(1), 861. <https://doi.org/10.3390/ijerph20010861>.

43. Pullin, A. S., Knight, T. M., Stone, D. A., & Charman, K. (2004). 'Do Conservation Managers Use Scientific Evidence to Support Their Decision-Making?' *Biological Conservation* 119(2): 245–52. <https://doi.org/10.1016/j.biocon.2003.11.007>.

44. WHO (2023). *Global Health Workforce Statistics Database*. WHO. Retrieved January 12, 2024 from <https://www.who.int/data/gho/data/themes/topics/health-workforce>.

45. King, S., Lemieux, C. J., & Lem, M. (2023). An Urgent Call to Integrate the Health Sector into the Post-2020 Global Biodiversity Framework. *International journal of environmental research and public health*, 20(1), 861. <https://doi.org/10.3390/ijerph20010861>

46. Organisation for Economic Cooperation and Development (OECD). (2020). *A Comprehensive Overview of Global Biodiversity Finance*. OECD. <https://www.oecd.org/environment/resources/biodiversity/report-a-comprehensive-overview-of-global-biodiversity-finance.pdf>.

47. WHO (2022). *Global Spending on Health: Rising to the Pandemic's Challenges*. World Health Organization. Retrieved January 12, 2024 from <https://www.who.int/publications/i/item/9789240064911>

48. Pienkowski, T., Dickens, B. L., Sun, H. & Carrasco, L. R. (2017). Empirical Evidence of the Public Health Benefits of Tropical Forest Conservation in Cambodia: A Generalised Linear Mixed-Effects Model Analysis. *The Lancet Planetary Health*, 1(5), e180–87. [https://doi.org/10.1016/S2542-5196\(17\)30081-5](https://doi.org/10.1016/S2542-5196(17)30081-5).

49. FAO (2021). *Global Remote Sensing Survey*. FAO. <https://www.fao.org/3/cb7449en/cb7449en.pdf>

50. Headey, D., Hirvonen, K. & Hoddinott, J. (2018). Animal sourced foods and child stunting. *American Journal of Agricultural Economics*, 5, 1302-1319. <https://doi.org/10.1093/ajae/aay053>

51. Rosenstock, T. S. et al. (2019). A Planetary Health Perspective on Agroforestry in Sub-Saharan Africa. *One Earth*, 1(3), 330–44. <https://doi.org/10.1016/j.oneear.2019.10.017>.

52. Guinto, R. R., Baluyot, C. J., Gan, C. C. R., Ghosh, U., & Mahadzir, M. D. A. (2022). Health sector solutions for promoting sustainable and nutritious diets. *British Medical Journal*, 378, e071535, <https://doi.org/10.1136/bmj-2022-071535>

53. WHO (n.d.) *One Health*. WHO. Retrieved December, 14, 2023 from <https://www.who.int/health-topics/one-health>.

54. Willetts, E. et al. (2022). *Health in the Global Environmental Agenda: A Policy Guide*. International Institute for Sustainable Development. <https://www.iisd.org/system/files/2022-01/health-environment-nexus.pdf>.

55. Abbas, S. S., Shorten, S. & Rushton, J. (2022). Meanings and Mechanisms of One Health Partnerships: Insights from a Critical Review of Literature on Cross-Government Collaborations. *Health Policy and Planning*, 37(3), 385–99. <https://doi.org/10.1093/heapol/czab134>.

56. Aerts, R. Honnay, O. & Van Nieuwenhuysse, A. (2018). Biodiversity and Human Health: Mechanisms and Evidence of the Positive Health Effects of Diversity in Nature and Green Spaces. *British Medical Bulletin* 127(1), 5–22. <https://doi.org/10.1093/bmb/ldy021>.

57. Marselle, M. R. et al. (2021). Pathways Linking Biodiversity to Human Health: A Conceptual Framework. *Environment International*, 150, 106420. <https://doi.org/10.1016/j.envint.2021.106420>.

58. Marselle, M. R. et al. (2021). Pathways Linking Biodiversity to Human Health: A Conceptual Framework. *Environment International*, 150, 106420. <https://doi.org/10.1016/j.envint.2021.106420>.

59. Aerts, R. Honnay, O. & Van Nieuwenhuysse, A. (2018). Biodiversity and Human Health: Mechanisms and Evidence of the Positive Health Effects of Diversity in Nature and Green Spaces. *British Medical Bulletin* 127(1), 5–22. <https://doi.org/10.1093/bmb/ldy021>.

60. Marselle, M. R. et al. (2021). Pathways Linking Biodiversity to Human Health: A Conceptual Framework. *Environment International*, 150, 106420. <https://doi.org/10.1016/j.envint.2021.106420>.

61. MacDonald, A.J. and Mordecai, E. A. (2019). Amazon Deforestation Drives Malaria Transmission, and Malaria Burden Reduces Forest Clearing. *Proceedings of the National Academy of Sciences*, 116(44), 22212–18. <https://doi.org/10.1073/pnas.1905315116>.

62. Wood, C. L. et al. (2017). Human Infectious Disease Burdens Decrease with Urbanization but Not with Biodiversity. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 372(1722), 20160122.

<https://doi.org/10.1098/rstb.2016.0122>.

63. Wood, C. L. et al. (2017). Human Infectious Disease Burdens Decrease with Urbanization but Not with Biodiversity. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 372(1722), 20160122. <https://doi.org/10.1098/rstb.2016.0122>.

64. Daszak, P. et al. (2019). *Infectious disease emergence and economics of altered landscapes - IDEEAL*. Ecohealth Alliance. https://www.ecohealthalliance.org/wp-content/uploads/2019/09/IDEEAL_report_final.pdf

65. Daszak, P. et al. (2019). *Infectious disease emergence and economics of altered landscapes - IDEEAL*. Ecohealth Alliance. https://www.ecohealthalliance.org/wp-content/uploads/2019/09/IDEEAL_report_final.pdf

66. Daszak, P. et al. (2019). *Infectious disease emergence and economics of altered landscapes - IDEEAL*. Ecohealth Alliance. https://www.ecohealthalliance.org/wp-content/uploads/2019/09/IDEEAL_report_final.pdf

67. Dean, J., van Dooren, K. and Weinstein, P. (2011) Does biodiversity improve mental health in urban settings? *Medical hypotheses*, 76(6), 877–880. <https://doi.org/110.1016/j.mehy.2011.02.040>

68. Aerts, R. Honnay, O. & Van Nieuwenhuysse, A. (2018). Biodiversity and Human Health: Mechanisms and Evidence of the Positive Health Effects of Diversity in Nature and Green Spaces. *British Medical Bulletin* 127(1), 5–22. <https://doi.org/10.1093/bmb/ldy021>

69. Aerts, R. Honnay, O. & Van Nieuwenhuysse, A. (2018). Biodiversity and Human Health: Mechanisms and Evidence of the Positive Health Effects of Diversity in Nature and Green Spaces. *British Medical Bulletin* 127(1), 5–22. <https://doi.org/10.1093/bmb/ldy021>

70. Aerts, R. Honnay, O. & Van Nieuwenhuysse, A. (2018). Biodiversity and Human Health: Mechanisms and Evidence of the Positive Health Effects of Diversity in Nature and Green Spaces. *British Medical Bulletin* 127(1), 5–22. <https://doi.org/10.1093/bmb/ldy021>

71. Sandifer, P. A., Sutton-Grier, A. E. & Ward, B. P. (2015) Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem Services*, 12, 1–15. <https://doi.org/10.1016/j.ecoser.2014.12.007>.

72. Hough, R.L. (2014). Biodiversity and human health: evidence for causality? *Biodiversity and Conservation*, 23(2), 267–288., <https://doi.org/10.1007/s10531-013-0614-1>

73. Sandifer, P. A., Sutton-Grier, A. E. & Ward, B. P. (2015) Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem Services*, 12, 1–15. <https://doi.org/10.1016/j.ecoser.2014.12.007>.

74. Brady, D. (2023). *Planetary Health: A Holistic Vision for People and the Planet*. The European Policy Centre. <https://www.sitra.fi/app/uploads/2023/09/planetary-health-epc-discussionpaper.pdf>.

75. Daszak, P. et al. (2019). *Infectious disease emergence and economics of altered landscapes - IDEEAL*. Ecohealth Alliance. https://www.ecohealthalliance.org/wp-content/uploads/2019/09/IDEEAL_report_final.pdf

76. Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-Being: Synthesis*. Island Press. <https://www.millenniumassessment.org/documents/document.356.aspx.pdf>.

77. WHO. (2015). *Connecting Global Priorities: Biodiversity and Human Health: A State of Knowledge Review*. World Health Organization. <https://www.who.int/publications/i/item/connecting-global-priorities-biodiversity-and-human-health>

78. European Commission. (2020). *Data Spaces*. European Commission. <https://joinup.ec.europa.eu/collection/semic-support-centre/data-spaces>.

79. European Commission. (2023). *European Health Data Space*. European Commission. https://health.ec.europa.eu/ehealth-digital-health-and-care/european-health-data-space_en.

80. Belgian Biodiversity Platform. (2021). *Highlights Report*. Belgian Science Policy Office (BELSPO). <https://purews.inbo.be/ws/portalfiles/portal/84191846/HighlightsReport2021digital.pdf>.

81. Belgian Biodiversity Platform. (2021) *Highlights Report*. Belgian Science Policy Office (BELSPO). <https://purews.inbo.be/ws/portalfiles/portal/84191846/HighlightsReport2021digital.pdf>.

82. WHO. (2015). *Connecting Global Priorities: Biodiversity and Human Health: A State of Knowledge Review*. World Health Organization. <https://www.who.int/publications/i/item/connecting-global-priorities-biodiversity-and-human-health>

83. McGuire, F. et al. (2019) Financing Intersectoral Action for Health: A Systematic Review of Co-Financing Models. *Globalization and Health*, 15(1), 86. <https://doi.org/10.1186/s12992-019-0513-7>.

84. McGuire, F. et al. (2019) Financing Intersectoral Action for Health: A Systematic Review of Co-Financing

- Models. *Globalization and Health*, 15(1), 86. <https://doi.org/10.1186/s12992-019-0513-7>.
85. McGuire, F. et al. (2019) Financing Intersectoral Action for Health: A Systematic Review of Co-Financing Models. *Globalization and Health*, 15(1), 86. <https://doi.org/10.1186/s12992-019-0513-7>.
86. McGuire, F. et al. (2019) Financing Intersectoral Action for Health: A Systematic Review of Co-Financing Models. *Globalization and Health*, 15(1), 86. <https://doi.org/10.1186/s12992-019-0513-7>.
87. International Centre for Environment Management. (2006). *Lessons from Global Experience: Protected Areas and Community Development*. International Centre for Environment Management. <https://icem.com.au/documents/biodiversity/pad/tlp-06.pdf>.
88. Croft-Cusworth, C. (2017). A Promising (but Uncertain) Future for Tenure Rights Devolution. *CIFOR Forests News*. Retrieved January 3, 2024, from <https://forestsnews.cifor.org/51411/a-promising-but-uncertain-future-for-tenure-rights-devolution?fnl=en>.
89. Mundo, W. et al. (2019). A Qualitative Study of Health in All Policies at the Local Level. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, 56. <https://doi.org/10.1177/0046958019874153>.
90. Molnar, A. et al. (2016) Using Win-Win Strategies to Implement Health in All Policies: A Cross-Case Analysis. *PLoS ONE*, 11(2): e0147003. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4742077/>.
91. Storm, I. et al. (2016) How to Improve Collaboration between the Public Health Sector and Other Policy Sectors to Reduce Health Inequalities? – A Study in Sixteen Municipalities in the Netherlands. *International Journal for Equity in Health*, 15(1), 97. <https://doi.org/10.1186/s12939-016-0384-y>.
92. WHO. (2024). *Health Workforce*. WHO. Retrieved January 5, 2024 from <https://www.who.int/health-topics/health-workforce>.
93. Molnar, A. et al. (2016) Using Win-Win Strategies to Implement Health in All Policies: A Cross-Case Analysis. *PLoS ONE*, 11(2): e0147003. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4742077/>.
94. Aguirre, A. A. et al. (2019). Transdisciplinary and Social-Ecological Health Frameworks—Novel Approaches to Emerging Parasitic and Vector-Borne Diseases. *Parasite Epidemiology and Control*, 4. <https://doi.org/10.1016/j.parepi.2019.e00084>
95. Hathaway, J. & Maibach, E. W. (2018). Health Implications of Climate Change: A Review of the Literature About the Perception of the Public and Health Professionals. *Current Environmental Health Reports* 5(1), 197–204. <https://doi.org/10.1007/s40572-018-0190-3>.
96. Gopinathan, U. et al. (2015). Conceptual and Institutional Gaps: Understanding How the WHO Can Become a More Effective Cross-Sectoral Collaborator. *Globalization and Health*, 11(1), 46. <https://doi.org/10.1186/s12992-015-0128-6>.
97. Gonzalez-Holguera, J. et al. (2022). Translating Planetary Health Principles Into Sustainable Primary Care Services. *Frontiers in Public Health*, 10. <https://www.frontiersin.org/articles/10.3389/fpubh.2022.931212>.
98. Tallis, H. et al. (2019). Aligning Evidence Generation and Use across Health, Development, and Environment. *Current Opinion in Environmental Sustainability*, 39, 81–93. <https://doi.org/10.1016/j.cosust.2019.09.004>.
99. Lenzholzer, S. et al. (2020). Urban Climate Awareness and Urgency to Adapt: An International Overview. *Urban Climate*, 33, 100667. <https://doi.org/10.1016/j.uclim.2020.100667>.
100. Maas, J. & Verheij, R. A. (2007). Are Health Benefits of Physical Activity in Natural Environments Used in Primary Care by General Practitioners in The Netherlands? *Urban Forestry & Urban Greening*, 6(4), 227–33. <https://doi.org/10.1016/j.ufug.2007.03.003>.
101. Meyer, K. & Botsch, K. (2017). Do Forest and Health Professionals Presume That Forests Offer Health Benefits, and Is Cross-Sectional Cooperation Conceivable? *Urban Forestry & Urban Greening*, 27, 127–37. <https://doi.org/10.1016/j.ufug.2017.07.002>.
102. Van Herzele, A. et al. (2011). Health Benefits of Nature Experience: The Challenge of Linking Practice and Research. *Forests, Trees and Human Health*, 169–82. https://doi.org/10.1007/978-90-481-9806-1_6.
103. WHO. (2023). *Preparedness and Resilience for Emerging Threats (PRET)*. WHO. Retrieved January 5, 2024 from <https://www.who.int/initiatives/preparedness-and-resilience-for-emerging-threats>.
104. Department of Agriculture, Fisheries, and Forestry. (2023). *Australia Leads New Collaborating Centre in Fight against Health Risks in Wildlife – DAFF*. Australia Government. <https://www.agriculture.gov.au/about/news/australia-leads-new-collaborating-centre-in-fight-against-health-risks-in-wildlife>.
105. Ollerenshaw, R. (2023). *Australia's Response to CITES Notification to the Parties 2023/028 - Risk of Future Zoonotic Disease Emergence Associated with International Wildlife Trade*. CITES Management

Authority of Australia. <https://cites.org/sites/default/files/projects/zoonotic/Australia.pdf>.

106. NASA Earth Observatory. (2023). *Tracking Canada's Extreme 2023 Fire Season*. NASA. Retrieved January 5, 2024, from <https://earthobservatory.nasa.gov/images/151985/tracking-canadas-extreme-2023-fire-season>.

107. MacGuire, F. & Sargeeva, M. (2021). *The Limits of Livability: The Emerging Threat of Smoke Impacts on Health from Forest Fires and Climate Change*. The Global Climate and Health Alliance. https://climateandhealthalliance.org/wp-content/uploads/2021/06/016062021_GCHA_bushfire_report_limits_livability_health.pdf.

108. Zhang, Y. et al. (2020). The 2020 Special Report of the MJA–Lancet Countdown on Health and Climate Change: Lessons Learnt from Australia's "Black Summer." *Medical Journal of Australia*, 213(11). <https://www.mja.com.au/journal/2020/213/11/2020-special-report-mja-lancet-countdown-health-and-climate-change-lessons>.

109. Public Health Agency of Canada. (2023). *Wildfires in Canada: Toolkit for Public Health Authorities*. Public Health Agency of Canada. <https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/wildfires-canada-toolkit-public-health-authorities/wildfires-canada-toolkit-public-health-authorities-en.pdf>.

110. Public Health Agency of Canada. (2023). *Wildfires in Canada: Toolkit for Public Health Authorities*. Public Health Agency of Canada. <https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/wildfires-canada-toolkit-public-health-authorities/wildfires-canada-toolkit-public-health-authorities-en.pdf>.

111. Pruvot, M. et al. (2023). WildHealthNet: Supporting the Development of Sustainable Wildlife Health Surveillance Networks in Southeast Asia. *Science of The Total Environment*, 863, 160748. <https://doi.org/10.1016/j.scitotenv.2022.160748>.

112. Pruvot, M. et al. (2023). WildHealthNet: Supporting the Development of Sustainable Wildlife Health Surveillance Networks in Southeast Asia. *Science of The Total Environment*, 863, 160748. <https://doi.org/10.1016/j.scitotenv.2022.160748>.

113. Errecaborde K. M., Macy K. W., Pekol, A., Perez, S., O'Brien, M. K., Allen, I., et al. (2019). Factors that enable effective One Health collaborations - A scoping review of the literature. *PLoS ONE*, 14(12), e0224660. <https://doi.org/10.1371/journal.pone.0224660>.

114. Molnar, A. et al. (2016) Using Win-Win Strategies to Implement Health in All Policies: A Cross-Case Analysis. *PLoS ONE*, 11(2): e0147003. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4742077/>.

115. Pezzoli K., Kozo J., Ferran K., Wooten W., Rangel Gomez G., Al-Delaimy W.K. (2014). One bioregion/ one health: an integrative narrative for transboundary planning along the US–Mexico border. *Glob. Soc.*, 28(4):419–440. <https://doi.org/10.1080/13600826.2014.951316>

116. Pezzoli K., Kozo J., Ferran K., Wooten W., Rangel Gomez G., Al-Delaimy W.K. (2014). One bioregion/ one health: an integrative narrative for transboundary planning along the US–Mexico border. *Glob. Soc.*, 28(4):419–440. <https://doi.org/10.1080/13600826.2014.951316>

117. Pezzoli K., Kozo J., Ferran K., Wooten W., Rangel Gomez G., Al-Delaimy W.K. (2014). One bioregion/ one health: an integrative narrative for transboundary planning along the US–Mexico border. *Glob. Soc.*, 28(4):419–440. <https://doi.org/10.1080/13600826.2014.951316>



**INTERNATIONAL UNION
FOR CONSERVATION OF NATURE**

WORLD HEADQUARTERS
Rue Mauverney 28
1196 Gland, Switzerland
mail@iucn.org
Tel +41 22 999 0000
Fax +41 22 999 0002
www.iucn.org

Supported by:



Based on a donation of
the German Bundestag