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## **Biodiversity and Covid-19: a report and a long road ahead to avoid a next pandemic**

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### **Summary**

A report from a workshop organized by the Intergovernmental Platform on Biodiversity and Ecosystem Services on biodiversity and pandemics examined the scientific evidence on the origin of COVID-19 and other emerging zoonotic diseases. Here, we reflect upon the report's findings regarding how several important global initiatives are tackling the problems of preventing the emergence of zoonotic diseases using the One Health approach.

### **Introduction**

On March 11, 2020, following the emergence of SARS-CoV-2 in the city of Wuhan in China, the World Health Organization (WHO) declared the COVID-19 disease as a pandemic. Fifteen months later, more than 175 million people have been infected and 3.7 million have died from the disease according to the Johns Hopkins University Covid-19 tracker. The social and economic impacts of the pandemic are enormous, as all sectors have been affected due to restrictions of travels and trade and lockdown measures, yet far from being fully determined.

Such a major pandemic was foreseeable. The WHO had listed several potential infectious agents, including influenza viruses and coronaviruses, as potential candidates for "disease X" – a priority disease with epidemic potential for which there were no, or insufficient, medical countermeasures<sup>1</sup>. The "One Health" tripartite collaboration, gathering the World Organisation of Animal Health (OIE), the Food and agriculture Organization of the United Nations (FAO) and the WHO was established in 2008 to better improve the surveillance of zoonotic diseases at the interface of

human, animal and environmental health. A Global Early Warning System for Major Animal Diseases Including Zoonosis which “embodies a cross-sectoral and multidisciplinary collaborative tool in addressing health risks at the human-animal-ecosystem interface” was established in 2013 into GLEWS+<sup>2</sup> with the aim to: “*systematically link to areas such as wildlife health, food and biological threats*”. Important programs, endowed with considerable resources, have been put in place to predict, prevent and prepare for such a disease outbreak. Finally, the “*Berlin principles on One Health*” were released in 2019 during the “*One Planet, One Health, One Future conference*” as an “update” of the Manhattan Principles.<sup>3</sup> However, the Covid-19 pandemic cruelly highlights the failure of predictions of emergence and preparedness strategies for pandemics<sup>4</sup>.

The experience of Covid-19 urges the need to understand the processes that led from the onset of emergence to the global health crisis.<sup>5</sup> For this, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) launched a workshop, held virtually on 27-31 July 2020<sup>6</sup>, to examine the scientific evidence on the origin of COVID-19 and other emerging zoonotic diseases, and to provide options for controlling and preventing future pandemics. The workshop participants included 17 experts nominated by Governments and organizations following an international call for nominations. Starting with the statement that 70% of emerging diseases are zoonoses caused by microbes of animal origin, the IPBES workshop report explored the conditions that favor the spillover of these microbes at the interfaces among wildlife, livestock and people.

Here, we reflect on how this report addresses the scientific evidence linking global changes (biodiversity loss, land use changes, livestock expansion, global trade) to the emergence and outbreaks of zoonotic diseases. We then discuss how several important global initiatives are tackling the problems of preventing the emergence of zoonotic diseases at the local level, i.e. the source of emergence, and at the global level, i.e. the source of global epidemics, using the One Health approach. Finally, we present areas for future action to avoid failing again in pandemic prevention.

## **Biodiversity and pandemics**

### *A large unknown diversity of potential emerging viruses*

The IPBES workshop report starts by stressing the unknown diversity of potential emerging diseases. An estimated of 1.7 million undiscovered viruses are supposedly circulating in mammals and birds with, among them, 631,000 to 827,000 that may have the potential to infect humans. This estimated number must be compared to the total number of well characterized viruses (including the viruses of plants), which is only a little more than 10,000 according to the International Committee on Taxonomy of Viruses (<https://talk.ictvonline.org>). The report emphasizes that the most important reservoirs of pathogens with pandemic potential are mammals (bats, rodents and primates) and birds

(water birds), as well as livestock (pigs, camels, poultry). Historically, the domestication of animals has been a major event in the acquisition of infectious diseases. Recent studies confirmed the disproportionate role of primates, rodents and domesticated animals in the sharing of DNA and RNA viruses, although bats appeared important for the sharing of RNA viruses with other mammals including humans<sup>7</sup>.

#### *Land use and livestock drivers of emerging zoonotic diseases*

The IPBES workshop report lists the main factors that favor the emergence of zoonotic diseases. All these factors are linked to the overexploitation of natural resources and the environment. More than 30% of emerging disease events are likely associated with land-use change, agricultural expansion and urbanization. This statement finds support with the temporal analysis of global data showing that the increase in livestock is a major cause of both the decline in biodiversity and the increase in epidemics of zoonoses<sup>8</sup>. In 1960, there were just under a billion cattle globally, their number exceeded 1.6 billion in 2019, while the number of pigs worldwide has grown from 500 million to 1.6 billion, and the number of chickens from 5 billion to 30 billion. Today, livestock have a biomass greater than that of all human beings. The number of poultry is practically of the same order of magnitude as the number of wild birds which has been recently estimated at around 50 billion individuals<sup>9</sup>. The total number of wild birds was estimated to be between 200 and 400 billion individuals in 1997, reminding us of the dramatic decline in wildlife in recent decades. The growing importance of livestock and its ecological footprint on the planet threatens biodiversity and increasingly puts human and animal health at risk.

#### *Biodiversity loss*

The IPBES workshop report stresses the role of biodiversity in emerging zoonotic diseases. This is particularly relevant in the context of the current biodiversity crisis, underlined by the IPBES, which estimated that approximately 25 per cent of species are already threatened with extinction. The Living Planet Index (<https://www.livingplanetindex.org>), based on long-term surveys of more than 4,000 species of vertebrates, showed that increasing deforestation and agricultural expansion were the key drivers of almost 70% percent of the decline of the tracked vertebrate populations between 1970 and 2016. A quarter of global forest loss is due to the conversion of forest to produce commodities (beef, soy, palm oil, timber). The IPBES workshop report recalls that deforestation and land conversion to commercial plantations have dramatic consequences on both biodiversity and emerging infectious diseases. The increases in outbreaks of zoonotic and vector-borne diseases from 1990 to 2016 were found to be associated with deforestation, mostly in tropical countries, and with the increase in areas of oil palm plantations<sup>10</sup>.

### *Climate change*

Climate change was also listed by the IPBES workshop report as an important key factor enhancing disease emergence or by modifying geographical distributions of reservoirs and vectors. Studies confirmed that zoonotic diseases and vector-borne diseases are highly climate sensitive due to the involvement of various reservoirs and vectors<sup>11</sup>. The epidemiology of Lyme disease, a tick-borne and zoonotic disease due to *Borrelia burgdorferi*, is influenced by a large number of climate factors including precipitation, temperature, climate change and climate variability. In Asia, the increasing incidence of scrub typhus, another vector-borne and zoonotic diseases, has been associated with the increase of temperature.

### *Wildlife trade, farming and consumption*

The IPBES workshop report puts its main emphasis on the trade and consumption of wildlife knowing that about 24% of all wild terrestrial vertebrate species are traded globally. International legal wildlife trade was estimated to be around 107 billion US\$ in 2019, while the illegal wildlife trade was estimated to be worth 7-23 billion US\$ annually. A recent study estimated that around 421,000,000 threatened wild animals were traded between 226 nations or territories between 1998 and 2018<sup>12</sup>. Wildlife farming has also greatly expanded in the last few decades. The IPBES workshop report concludes that farming, trade and consumption of wildlife and wildlife-derived products (food, medicine, fur) contribute to both biodiversity loss and emerging diseases, including SARS and Covid-19. The selling of wildlife in wet markets is a critical health issue and has been implicated in zoonotic outbreaks, including SARS and COVID-19<sup>13</sup>. The culling of 15 million mink in Denmark in 2020 reminds us of the role of wildlife farming in the transmission of zoonotic diseases; including COVID-19. Conservation biologists have also warned the threat COVID-19 poses for endangered species.

### *Actions needed*

The IPBES workshop report stresses the need to promote responsible consumption, such as reducing excessive consumption of meat from livestock and poultry production and to reduce unsustainable consumption of commodities, such as palm oil or exotic wood, from emerging disease hotspots. The report also calls for the implementation of the One Health approach in national governments in order to improve disease surveillance and control across human health, animal health and environmental sectors.

The report identifies several actions. The first concerns the prediction of geographic origins of future pandemics by identifying key reservoir hosts and likely microbes to emerge in relation to

environmental and socioeconomic changes. The second calls for a transformative change to reduce consumption, globalized agricultural expansion and trade that have led to pandemics using taxes or other mechanisms on meat demand and consumption. The third action asks to implement policies to reduce pandemic emergence related to the wildlife trade by building better collaborations among international organizations. Lastly, the IPBES workshop report acknowledges the importance of valuing Indigenous Peoples and Local Communities for their engagement and knowledge in pandemic prevention programmes.

## **Lessons learned and research needs**

### *New global initiatives*

Most of the recommendations that emerged from the IPBES workshop report, and from other reports, have been taken into account in recent global initiatives.

In June 2021, the One Health WHO-OIE-FAO tripartite together with the United Nations Environment Programme (UNEP) jointly launched a One Health High Level Expert Panel<sup>14</sup>. The 26 appointed experts serving as members of the OHHLEP will help the One Health tripartite plus UNEP to provide “*policy relevant scientific assessment on the emergence of health crises arising from the human-animal-ecosystem interface*” and “*guidance on development of a long-term strategic approach to reducing the risk of zoonotic pandemics, with an associated monitoring and early warning framework, and the synergies needed to institutionalize and implement the One Health approach, including in areas that drive pandemic risk*”. The Subsidiary Body on Scientific, Technical and Technological Advice<sup>15</sup> recommended that the fifteenth Conference of the Parties of the Convention on Biological Diversity (CDB), to be held at Kunming at end of 2021, adopt a decision “*Recognizing that the COVID-19 pandemic has further highlighted the importance of the relationship between people and nature and highlights the urgency of addressing the biodiversity crisis alongside the climate crisis, the need for transformative change as part of the “build back better” agenda, and the recognition of a biodiversity-inclusive One Health approach that would support preventing and reducing the risk of future zoonotic pandemics*” and requests the Executive Secretary “*to facilitate, as appropriate, the implementation of the global action plan for biodiversity and health*” and “*To continue collaboration with the WHO, OIE, FAO and UNEP, including, as appropriate, the One Health High-level Expert Council (OHHLEP), to promote a biodiversity-inclusive One Health approach*”.

A new international initiative for Preventing Zoonotic Disease Emergence (PREZODE) has been launched at the One Planet Summit for Biodiversity organized on 11 January 2021. The PREZODE program (<https://prezode.org/>) aims at bringing together international research teams to prevent the risk of the emergence of zoonoses at the interface between environment, wildlife and livestock.

### *Boundary spanning for science and policy dialogue*

To prevent the emergence and spread of zoonotic diseases, it is crucial to develop boundary spanning in relation to human and animal health, environment and the economic model. Boundary spanning presupposes system-thinking in order to be less dependent on particular settings and more knowledgeable, adaptable, and flexible. The concept of boundary spanning is a tool to explore, access and obtain knowledge outside local processes<sup>16</sup>, and to foster interconnections between organizations, institutions or disciplines, in order to tackle complex issues. Boundary spanning gives the opportunity to consider a new way to conduct research, notably research on emerging zoonotic diseases at the interface between humans, animals and the environment. Boundary spanning facilitates new integrative research in support of the One Health approach and opens it at the interface of disciplines as well as political sectors (Fig. 1).

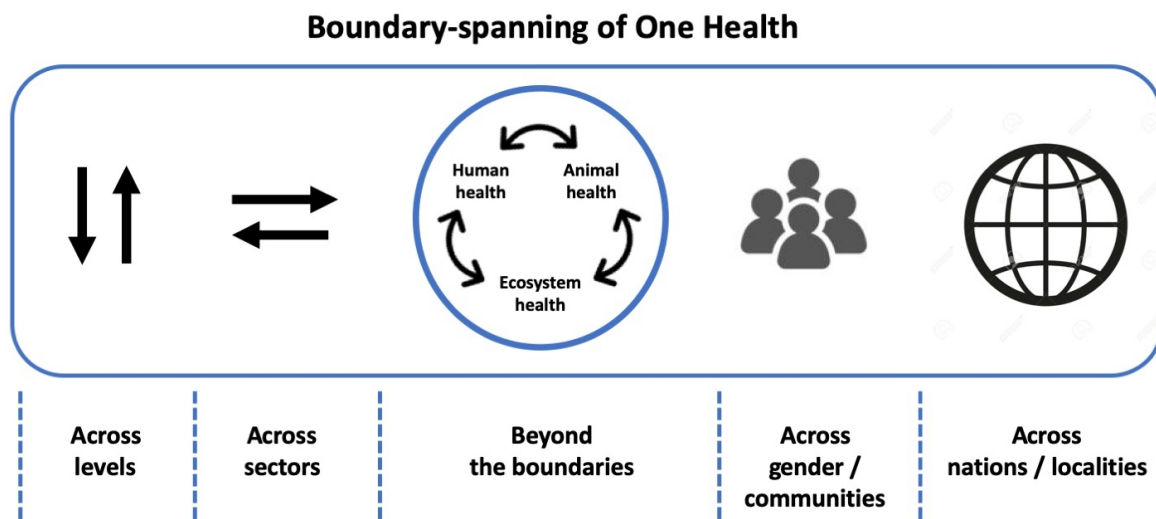


Fig. 1. Boundary spanning helps to think about a new way for the One Health approach to tackle the risk of emerging zoonotic diseases at the interface between humans, animals and the environment. The concept of boundary spanning is a tool for exploring, accessing and obtaining knowledge outside of local processes using system thinking to be more informed, adaptable, and flexible. The use of boundary spanning in One Health fosters interconnections across levels of organizations, sectors, academic disciplines, communities, gender and nations in order to tackle complex issues of emerging zoonotic diseases at the boundary of human health, animal health or ecosystem health.

### *Adaptive law and policies*

In order to respond in an appropriate manner to the environmental emergency we need adaptive law embedded in a framework able to integrate new environmental and health objective knowledge in order to produce evidence -based measures or policies adapted to the situation in a specific socio-ecosystem. It implies that national laws should have the same properties as those promoted by the One Health approach and contain in their drafting the possibility of a cursor which can move with

advances in science. Environmental law needs to be reconsidered around the notion of science-based knowledge relying on One Health approach.

For example, the increase in epidemics due to land change and deforestation is acknowledged in the joint report of the Secretariat of the CBD and the WHO. Scientists, public health practitioners, and policymakers should reconcile the need to preserve biodiversity while taking into account the health risks. One way would be the implementation of an international governance of forests and their contributions to a healthy planet and people together with the development of research on disease regulating service provided by forests and other ecosystems. In turn, it may help at better manage forested and planted areas, revise the forest definitions of the FAO as to avoid afforestation, forest expansion, and agricultural conversion of grasslands<sup>10</sup>. The identification of sectors contributing to the national law and governance of forests is pivotal for coherent and common action.

While the notion of adaptive law might be criticized in the name of the security and stability of a legal system, the COVID-19 pandemic led to major adaptation of significant parts of the law in various sectors in different countries.<sup>18</sup> This feasibility of such an adaptation should be carefully scrutinized to be fully integrated into a new framework for adaptive environmental law, for the sake of public health.

## **Conclusion**

The IPBES workshop report has explored the conditions favoring the emergence of zoonotic diseases and has proposed several recommendations, most of them have been taken into account in recent global initiatives such as the launching of OHHLEP. The main remaining question is how to avoid future failure in preventing new emerging infectious diseases and pandemics.

New global initiatives give the opportunity to consider the socio-ecosystems and the interactions between the sociocultural practices and animal and human health, as well as environmental health. The dialogue between science and policy makers will be crucial, but it requires transformation of political commitment into concrete involvement. Moving from strategy to strategy, knowing at the time of their implementation at the national level that they will fail because of the delay between the international commitment and its national translation is no longer an option. We should step back, change the rules and start to act simultaneously, internationally and locally in a genuine way and not only to check boxes on lists that report advancement towards the objectives.

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