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Item 5 of the provisional agenda\*\*

### **BIODIVERSITY AND HUMAN HEALTH**

*Note by the Executive Secretary*

#### **I. INTRODUCTION**

1. The Conference of the Parties at its twelfth and thirteenth meetings considered the interlinkages between biodiversity and human health (see decisions XII/21 and XIII/6).
2. In decision XIII/6, the Conference of the Parties, recognized that biodiversity and human health are interlinked in various ways and noted that better consideration of health-biodiversity linkages could contribute to improving many aspects of human health. It took note of the findings of the publication *Connecting Global Priorities: Biodiversity and Human Health, a State of Knowledge Review*, prepared by the World Health Organization and the Secretariat, and invited Parties and other Governments, to consider using the State of Knowledge Review and its key messages, as appropriate, to promote the understanding of health biodiversity linkages with a view to maximizing health benefits, addressing trade-offs, and where possible, addressing common drivers for health risks and biodiversity loss. To this end, the Conference of the Parties also invited Parties and other Governments to make use of information contained in an annex to the decision (and reproduced in annex I herein), as appropriate and taking into account national circumstances.
3. Decision XIII/6 also sets out guidance for activities by Parties and other actors, including, inter alia: to facilitate dialogue between agencies responsible for biodiversity and those responsible for health and other relevant sectors, across all levels of Government; to consider relevant health-biodiversity linkages in developing and updating relevant national policies and programmes, strategies, plans, and accounts, and in various environmental and health assessments; to strengthen national monitoring capacities and data collection; and to develop interdisciplinary education, training, capacity-building and research programmes.
4. By decision XIII/6, paragraph 10, the Executive Secretary was requested to collaborate with the World Health Organization and other relevant organizations, through the interagency liaison group on biodiversity and human health co-convened by the Secretariat and the World Health Organization, to promote and facilitate the implementation of decision XIII/6 through, among other things, the dissemination of the State of Knowledge Review, the development of toolkits and good practice guides, and support to capacity-building, and the tasks set out in paragraph 9 of decision XII/21. In the same decision, the Conference of the Parties requested the Executive Secretary to prepare technical guidance to

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support the consideration of biodiversity and ecosystem management in the application of the “One Health” approach, and to submit a report to the Subsidiary Body on Scientific, Technical and Technological Advice.

5. Also at its thirteenth meeting, the Conference of the Parties adopted a comprehensive decision on mainstreaming and the integration of biodiversity within and across sectors (decision XIII/3), focusing on the sectors of agriculture, forestry, fisheries and tourism. For its fourteenth meeting, the Conference of the Parties will focus on mainstreaming biodiversity in the health sector, among others<sup>1</sup> (paragraph 103).

6. This note provides a summary of activities carried out or planned in response to decisions XII/21 and XIII/6 on biodiversity and health, under the CBD-WHO joint work programme. Section II provides a progress report on (a) work of the interagency Liaison Group on Biodiversity and Health, (b) information dissemination and partnerships; and (c) regional meetings. Section III provides guidance on integrating biodiversity into One Health approaches.

7. The conclusions and recommendations of the Subsidiary Body on this item may also contribute to the consideration by the Conference of the Parties at its fourteenth meeting of the mainstreaming of biodiversity within and across sectors, including the health sector.

## II. PROGRESS REPORT

### A. Interagency liaison group on biodiversity and health

8. In line with decision XIII/6 (para. 10) the Secretariat and the World Health Organization established the Interagency Liaison Group on Biodiversity and Health with the following core members: CGIAR, FAO, Future Earth, IUCN, OIE, UN Environment, UNFCCC, UNISDR, United Nations University. The first meeting was held at WHO Headquarters, Geneva, 4-5 May 2015,<sup>2</sup> with the participation of the core members (including representatives from various divisions and regional offices of WHO) and some expert observers.<sup>3</sup> Relevant information is available on the Group’s website<sup>4</sup> and the full report of the meeting will be made available.<sup>5</sup>

9. Some key points addressed at the first meeting of the Interagency Liaison Group are briefly summarized below supported by concrete examples detailed in the report of the ILG:

(a) *Capacity-building*: It was agreed that dissemination of knowledge is critical to the shaping of common values, and maximizing co-benefits arising from the protection of biodiversity and health outcomes Group members can play a valuable role to help build capacity among policy makers and implementing institutions and contribute to national and sub-national implementation of decisions XII/21 and XIII/6, as well as the Sustainable Development Goals. This includes the development of tailored materials and tools, such as online training modules;

(b) *Data, metrics and indicators*: A vast number of indicators and measurements for health and biodiversity have been developed. However, these are largely developed in discrete disciplinary siloes making the development of indicators to monitor the relationship between the two particularly challenging, particularly given the complexity of causal relationships and the generally poor understanding of them among policy makers.<sup>6</sup> Group members agreed that it was essential to bring

<sup>1</sup> Energy and mining, infrastructure, and manufacturing and processing. See CBD/SBSTTA/21/5.

<sup>2</sup> Funding from the European Union is gratefully acknowledged.

<sup>3</sup> Participants in the first meeting also included expert observers from the following institutions, who have played an important support role in the development of the State of Knowledge Review and to the activities under the CBD-WHO joint work programme on biodiversity and health: WHO/China Center for Disease Control, Ecohealth Alliance, FIOCRUZ, Harvard School of Public Health, London School of Hygiene and Tropical Medicine, Rockefeller Foundation-Lancet Commission on Planetary Health, Planetary Health Alliance, University of Canberra, University of Geneva, and World Bank.

<sup>4</sup> <https://www.cbd.int/health/ilg-health/default.shtml>

<sup>5</sup> CBD/WHO/LG-Health/1/1.

<sup>6</sup> Moreover, it was also noted that limited national capacity and integration of environmental health services may leave countries vulnerable to health risks from ecosystem degradation.

together partners who are developing cross-disciplinary expertise and are working on the ground to gather relevant data. The following areas were identified as priorities for the development of indicators: (i) Integrated indicators to identify broad health impacts resulting from anthropogenic changes which cause biodiversity loss; (ii) Indicators of ecosystem degradation, disruption and fragmentation and human health outcomes; (iii) Integrated indicators on the links between biodiversity loss, ecosystem disruption and zoonotic and vector-borne disease outbreaks; and (iv) Integrated indicators on loss of genetic diversity, food security and nutrition. Creating mechanisms for improved data sharing, and engaging with national partners, was also identified as a core need;

(c) *Education, communication and awareness-raising*: It was agreed that education and awareness raising on the interlinkages between biodiversity and health should be addressed as a matter of priority. This includes the development of tools, case studies, online learning and exchange platforms. Examples of suggested activities include the joint development of tailored materials on education and communication aimed at increasing knowledge on the links between biodiversity and health, promoting ecosystem protection to maximize health outcomes, and furthering community health. Moreover, it is important to compile national level case studies and best practices of projects implemented on the ground which could be widely disseminated across the ILG network.

10. The liaison group also discussed the CBD mandate to develop One Health guidance and to more effectively engage the biodiversity sector in international One Health activities, with greater consideration for biodiversity-health linkages. Several ways to address this gap at the international level were explored to strengthen cross-agency cooperation. For example, a useful strategy could be to identify clear entry points that would make it possible for the Secretariat to enter into an existing ‘One Health’ conversation with international institutions working to implement One Health (notably including WHO, OIE, and FAO). This could be achieved by identifying areas in which biodiversity and ecosystem health input is important to addressing a specific health issue or outcome.

## **B. Information dissemination and partnerships**

11. The Secretariat, in cooperation with partner organizations, has promoted dissemination of the findings of the *State of Knowledge review, Connecting Global Priorities: Biodiversity and Human health* in line with decision XIII/6, through various activities:

(a) Contributing to the preparation of 10 video lectures for a Massive Open Online Course on Global health to be launched in spring 2018;

(b) Providing inputs to the World Bank’s “Operational Framework for Strengthening Human, Animal and Environmental Public Health Systems at their Interface”, which highlights the value of One Health approaches; provides examples of existing and potential applications of the approach, and reviews some tools for advancing implementation. The Framework will be made available online later this year;

(c) Delivering presentations on the findings of the State of Knowledge Review in the context of the Strategic Plan for Biodiversity and the 2030 Agenda for Sustainable Development at : (i) The European OneHealth/EcoHealth workshop, 6 and 7 October 2016 in Brussels; (ii) the 15<sup>th</sup> World Congress on Public Health, 3 to 7 April 2017, Melbourne, Australia, including its World Leadership Dialogue; (iii) the UNISDR Global Conference on Disaster Risk Reduction, Cancun, Mexico, May 2017; (iv) the European Conference on Biodiversity and Health in the Context of Climate Change, Bonn, June 2017; and (v) the 28<sup>th</sup> International Congress for Conservation Biology, Cartagena, Colombia, July 2017. The Secretariat is also participating in the health summit, led by WHO and other partners, for the 23<sup>rd</sup> session of the Conference of the Parties to the United Nations Framework Convention on Climate Change in Bonn from 6 to 17 November 2017;

(d) Strengthening collaboration with a range of organizations and initiatives including the participants in the first meeting of the interagency liaison group on biodiversity and health and others such as World Bank, GEO-BON, Parks Victoria. The Secretariat is an active partner of various international networks and initiatives, such as the Future Earth Health Knowledge Action Network, the Rockefeller Foundation-Lancet Commission on Planetary health, and the Bridge Collaborative;

### C. Regional workshops

12. In support of decision X/20 to promote the mainstreaming of biodiversity issues in health programmes and plans, the Secretariat and the World Health Organization, in collaboration with relevant partners, are co-convening a series of regional capacity-building workshops on human health and biodiversity.

13. The first and second regional workshops for the Americas and Africa regions, were held respectively in Manaus, Brazil in 2012 and Maputo, Mozambique in 2013.<sup>7</sup> Further to decisions XII/21 and XIII/6, by which the Secretariat was invited, in collaboration with WHO, to co-organize additional capacity-building workshops on biodiversity and human health in other regions, a regional capacity building workshop on biodiversity and health for the Europe region was held from 23-25 October 2017.<sup>8</sup> Relevant information is available on the website for the meeting<sup>9</sup> and the full report is being prepared.<sup>10</sup>

14. Based on expert presentations, the workshop addressed a number of the issues at the intersection of health and biodiversity:

(a) The importance of the human microbiome for human health, especially in immunoregulation, and its links with biodiversity in the broader environment. The microbiome associated with animals, plants and soil is also important in maintaining health in these organisms;

(b) The role of green spaces in the urban environment, and their physiological and psychological benefits;<sup>11</sup>

(c) The role of biodiversity in healthy diets, and the role of biodiversity in the sustainable production of food;

(d) The complex links between biodiversity, environmental change and zoonotic, vector-borne and other infectious diseases.

15. Representatives from 27 countries in the European Region, from both ministries of health and ministries of the environment, as well as representatives from Mexico and Egypt, presented a range of experiences and case examples. The workshop provided an opportunity for participants to exchange national or sub-national experiences and practices for implementation, to explore ways to integrate consideration of biodiversity-health linkages into health strategies, NBSAPs, and other national reporting instruments including National Adaptation Plans, and to pursue new areas of cooperation to address issues relevant to biodiversity and health and well-being.

16. Some of the conclusions of the workshop included:

(a) A better understanding of ecological and evolutionary processes can help societies to manage the complex socio-ecological systems that encompass health systems, food systems and the way societies plan where and how to live;

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<sup>7</sup> For further information, see <https://www.cbd.int/health/workshops/americas/default.shtml> and <https://www.cbd.int/health/workshops/africa/default.shtml>. Summaries were provided in UNEP/CBD/COP/11/INF/27 and UNEP/CBD/SBSTTA/18/17, respectively.

<sup>8</sup> Financial support from the Government of Finland and the European Commission, as well as in kind contributions from WHO, IUCN and the European Centre for Disease Control, are gratefully acknowledged.

<sup>9</sup> <https://www.cbd.int/health/europe/default.shtml>

<sup>10</sup> CBD/WHO/LG-Health/1/1.

<sup>11</sup> In addition to the findings of the *State of Knowledge Review* and the biocultural dimensions of health and biodiversity linkages, discussion under this item includes, inter alia, the presentation of two recent reports launched by WHO regional office for Europe on green spaces, including a State of the Evidence on green spaces produced in 2016 and available from:

<http://www.euro.who.int/en/health-topics/environment-and-health/urban-health/publications/2016/urban-green-spaces-and-health-a-review-of-evidence-2016> and a recent publication on the effectiveness of green space interventions in urban environments, launched at the European Conference on Biodiversity and Health in the context of Climate Change, held in June 2017. The full report is available from: <http://www.euro.who.int/en/health-topics/environment-and-health/urban-health/publications/2017/urban-green-space-interventions-and-health-a-review-of-impacts-and-effectiveness.-full-report-2017>.

(b) While more research is always needed, enough is known to move to action in many areas; there are a number of no regrets actions that could be pursued: investing in nature based solutions such as the integration of biodiverse green spaces in urban development; better control and use of antimicrobials, pesticides and other biocides; addressing together the drivers of ill health and biodiversity loss; and better monitoring of environmental change (e.g. in relation to disease emergence);

(c) In general too little is invested in preventive measures, which may lead to avoidable costs of addressing consequences in reactive response driven approach;

(d) Health-biodiversity linkages need to be integrated not only into strategies and policies for health and for biodiversity, but also for agriculture, fisheries and food production, planning (especially urban planning and land use), and adaptation to climate change and disaster risk reduction, as well as economy and finance.

17. Additional regional workshops are anticipated for the 2018-2020 period, for the WHO regions of the Eastern Mediterranean, South-East Asia, and the Western Pacific, subject to additional funding.

### **III. GUIDANCE ON INTEGRATING BIODIVERSITY CONSIDERATIONS INTO ONE HEALTH APPROACHES**

#### **A. Introduction, rationale and background to “One Health” approaches**

18. In decision XII/21, the Conference of the Parties recognized the value of the “One Health” approach to address the cross-cutting issue of biodiversity and human health, as an integrated approach consistent with the ecosystem approach (decision V/6) that integrates the complex relationships between humans, microorganisms, animals, plants, agriculture, wildlife and the environment. Further, as noted above, in decision XIII/6, the Conference of the Parties requested the Executive Secretary to prepare technical guidance to support the consideration of biodiversity and ecosystem management in the application of the “One Health” approach, and to submit a report to the Subsidiary Body on Scientific, Technical and Technological Advice.

19. Health is a dynamic concept influenced by a range of interacting social, biological, physical, economic and environmental factors and is a fundamental indicator of sustainable development. While social status and economic security are perhaps most important in determining the capacity of individuals to manage their health and maintain healthy lifestyles, the roles of environmental and ecosystem change in determining health status are increasingly recognized.

20. Biodiversity supports human health in many ways, including through the delivery of basic goods and services, sustained by well-functioning ecosystems. In addition to its direct effects on health, biodiversity is integral to key development sectors that modulate health outcomes directly or indirectly, such as forestry, fisheries, agriculture, and tourism, on which an estimated 1.5 billion people depend for their livelihoods. The impacts of environmental degradation, and biodiversity loss in particular, on health outcomes are most significant among vulnerable populations, particularly those most reliant on natural resources and less covered by social protection mechanisms such as health coverage. Vulnerable groups include women, children, Indigenous Populations, and others highly dependent on biodiversity and ecosystem services for survival, such as subsistence farmers.

21. While there is no universal definition, One Health has been broadly defined by the World Health Organization as “an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes.”<sup>12</sup> It is an interdisciplinary and cross-sectoral approach that seeks to examine holistically interconnections among human and environmental or ecosystem health.

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<sup>12</sup> <http://www.who.int/features/qa/one-health/en/>

22. Modern manifestations of One Health at the international level arose from the One World, One Health symposium in 2004.<sup>13</sup> The symposium focused on the current and potential movements of diseases among human, domestic animal, and wildlife populations using case studies on Ebola, Avian Influenza, and Chronic Wasting Disease as examples. The Symposium culminated in the Manhattan Principles on One World, One Health, which delineated priorities for an international, interdisciplinary approach for combating threats to the health of life on Earth.<sup>14</sup>

23. Areas of work in which a One Health approach has been increasingly applied include food safety, the control of zoonoses (diseases that can spill over from animals to humans, such as avian flu, rabies and Rift Valley Fever), and combatting antibiotic resistance (when bacteria evolve after being exposed to antibiotics and become more difficult to treat).<sup>15</sup> At the global level, One Health has garnered increasing interest over the past decade, most prominently across animal/livestock and public health communities. This includes, for example, formalized collaboration between the WHO, OIE and FAO.<sup>16</sup>

24. Ecohealth, a similarly holistic, transdisciplinary and cross-sectoral approach, emphasizes the intimate interconnections between ecosystem health, human health and social justice. In particular, it aims to consider how biological, physical, social and economic environments mediate human health outcomes in research, policy and practice. Ecohealth is inherently founded upon and guided by the principles of the ecosystem approach. Lessons learned from the application of this approach should be considered in the implementation of One Health policies, plans, projects and research.<sup>17</sup>

25. Planetary Health is the most recent term among similarly holistic approaches. It considers interactions between biotic and abiotic components and human health outcomes from local to global/planetary scales. It is broadly defined as “the achievement of the highest attainable standard of health, wellbeing, and equity worldwide through judicious attention to the human systems—political, economic, and social—that shape the future of humanity and the Earth’s natural systems that define the safe environmental limits within which humanity can flourish.”<sup>18</sup> It is coherent with the ecosystem approach, notions of “tipping points” introduced in the Third edition of *Global Biodiversity Outlook*, planetary boundaries,<sup>19</sup> and the findings of the *State of Knowledge Review on Biodiversity and Health, Connecting Global Priorities: Biodiversity and Human Health*.<sup>20</sup>

26. In practice, biodiversity conservation and ecosystem dynamics have often received less attention in One Health policies, projects, plans and research than human-animal interconnections in the evaluation of disease risk, with correspondingly lesser consideration for the upstream drivers of ill health and

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<sup>13</sup> Organized by the Wildlife Conservation Society and hosted by The Rockefeller University <http://www.oneworldonehealth.org>

<sup>14</sup> [https://www.cdc.gov/onehealth/pdfs/manhattan/twelve\\_manhattan\\_principles.pdf](https://www.cdc.gov/onehealth/pdfs/manhattan/twelve_manhattan_principles.pdf)

<sup>15</sup> <http://www.who.int/features/qa/one-health/en/>

<sup>16</sup> [http://www.who.int/foodsafety/zoonoses/final\\_concept\\_note\\_Hanoi.pdf?ua=1](http://www.who.int/foodsafety/zoonoses/final_concept_note_Hanoi.pdf?ua=1)

<sup>17</sup> Ecohealth is rooted in systems thinking and embraces, as its core principles transdisciplinarity, social justice and gender equity, multi-stakeholder participation and environmental sustainability, with an added focus on “knowledge to action”. In essence, it is a framework to study and manage relationships between people and their natural and social environment in pursuit of co-benefits that simultaneously improve ecosystem and human health and social equity. Canada’s International Development Research Centre (IDRC) has played a leading role in supporting ecosystem approaches to health in numerous communities worldwide. See e.g. Charron, D., ed. 2011. *Ecohealth Research in Practice: Innovative Applications of an Approach to Health*. International Development Research Centre, Springer, New York, United States. Available from: <https://www.idrc.ca/en/book/ecohealth-research-practice-innovative-applications-ecosystem-approach-health>

<sup>18</sup> Whitmee, S. et al. “Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health.” *The Lancet* 386.10007 (2015): 1973-2028.

<sup>19</sup> Including as redefined in Steffen, W. et al. “Planetary boundaries: Guiding human development on a changing planet.” *Science* 347.6223 (2015): 1259855.

<sup>20</sup> Under its joint work programme with WHO, the Secretariat has actively participated in the preparation of the Planetary Health report, and has jointly launched the State of Knowledge Review and Planetary Health Report in various national and international fora, including meetings of the Subsidiary Body on Scientific, Technical and Technological Advice and the Conference of the Parties.

systems thinking.<sup>21</sup> Accordingly, there are opportunities to integrate more fully the full range of biodiversity-health inter-linkages in the application of One Health approaches.<sup>22</sup> This could allow, greater attention to preventive measures based on strengthening the resilience of socio-ecological systems, and greater consideration of a broader concept of health beyond the simple absence of diseases. Ultimately, these aims must be supported by measures that strengthen social and ecological resilience, made possible by fundamental shifts in political economy, governance and consideration for key social-ecological issues jointly driving biodiversity decline, environmental (resource) degradation, and other global environmental changes and ill health.

27. The relationship between biodiversity and disease is complex. The prevailing narrative around One Health developed over the past decade has largely focused on the high proportion of emerging infectious diseases, showing animal origin (zoonoses) with a significant proportion of these being of wildlife origin. However, wildlife as a source of human disease, is often highly indirect; direct infection from wildlife species, excluding vectors such as mosquitos, ticks, etc. is relatively very rare. However, domesticated animal sources may act as amplifiers of pathogens emerging from the wild, with a potentially significant influence on the human infectious disease transmission cycle. It has been found that species with the longest history of domestication not only carry more zoonotic pathogens than wildlife, but they also potentially transmit pathogens to a greater diversity of other host species.<sup>23</sup> In addition, in many cases throughout history, the proximate source of pathogens spillover in humans is more likely to have originated in contact with domesticated rather than a wildlife species given generally closer human contact with domesticated species.<sup>24</sup> Moreover, most emerging infectious diseases — whether in wildlife, domestic animals, plants or people — are driven by human activities such as agricultural intensification and human induced landscape changes, interacting in a co-evolutionary process. Against this backdrop, it is important to recognize that disease emergence is not only about the relationship between domestic animals or wildlife and people, but also about the complexity of the system as a whole and the interactions between biotic and abiotic components. Biodiversity, and the complexity of our landscapes and seascapes, is integral to social and ecological resilience. As genetic and species diversity is lost and ecosystems are degraded the complexity of the overall system is compromised making the system as a whole more vulnerable, potentially creating new opportunities for disease emergence and poor health outcomes both in humans and other animals.<sup>25</sup>

28. Further integrating biodiversity and ecosystem management into holistic approaches such as One Health provides an opportunity to better assess and address disease risk and other poor health outcomes, both through more inclusive participatory processes and by enhancing the understanding of co-evolutionary processes and dynamics of complex systems that directly or indirectly modulate risk. This can contribute to the application of One Health approaches to a broader spectrum of health outcomes, such as vector-borne diseases, food security and nutrition and interactions with other drivers of biodiversity loss and ill health, including climate change.

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<sup>21</sup> E.g. Barrett, M. A., and Bouley, T. A. (2015). Need for enhanced environmental representation in the implementation of One Health. *Ecohealth*, 12(2), 212-219; Cleaveland, S., Borner, M., and Gislason, M. (2014). Ecology and conservation: contributions to One Health. *Revue Scientifique et Technique*, 33(2), 615-27.

<sup>22</sup> E.g.: Wallace, Robert G., et al. “The dawn of structural one health: a new science tracking disease emergence along circuits of capital.” *Social Science & Medicine* 129 (2015): 68-77; Romanelli, C., H. D. Cooper, and B. F. De Souza Dias. “The integration of biodiversity into One Health.” *Rev Sci Tech* 33.2 (2014): 487-496.

<sup>23</sup> See e.g.: Morand, S., McIntyre, K. M., and Baylis, M. (2014). Domesticated animals and human infectious diseases of zoonotic origins: domestication time matters. *Infection, Genetics and Evolution*, 24, 76-81.

<sup>24</sup> It has been further noted that “domestic animal herds would have served as conduits for pathogen spillover between humans and local wildlife populations.” See Smith, K. F., and Guégan, J. F. (2010). Changing geographic distributions of human pathogens. *Annual Review of Ecology, Evolution, and Systematics*, 41, 231-250.

<sup>25</sup> It has been well-established that pathogens can have a significant impact on infectious disease emergence in animals potentially: causing temporary or permanent declines in species abundance; hindering the recovery of rare or endangered species; and together with other drivers such as habitat loss and pollution, can contribute to species extinctions. See e.g. Smith KF, Acevedo-Whitehouse K, Pederson A. (2009). The role of infectious diseases in biological conservation. *Animal Conservation*, 12:1–12.

29. Non-communicable diseases (NCDs) have been widely recognized as a major challenge to global health, and to sustainable development more broadly. NCDs such as heart and lung diseases, cancers, diabetes, obesity, chronic respiratory diseases and other inflammatory conditions are a significant cause of disability and loss of income. While many lifestyle, genetic and environmental factors combine to contribute to this global health burden, such as exposure to air pollutants, unhealthy diets, and physical inactivity, recent studies have found strong linkages between some NCDs and biodiversity loss, including at the microbial scale.

30. Urbanization and access to green spaces are also increasingly being discussed in relation to NCDs, which constitute a rapidly increasing social and economic burden.<sup>26</sup> There is an increasing body of evidence examining the causal effects and benefits of exposure to green spaces – as well as exposure to microbial diversity in the environment - on mental, physical, social and spiritual health and well-being. Some studies have suggested that exposure to green spaces, particularly in urban settings, can provide a range health benefits associated with psychological, cognitive and physiological health.<sup>27</sup> There is also strong evidence demonstrating the health benefits of children’s interaction with nature.<sup>28</sup> The health benefits of exposure to nature is also notably affected by cultural perspectives and experiences relating to social interaction and contact with the natural environment. This biocultural component of the health-biodiversity dynamic has largely been underappreciated and insufficiently addressed in research and policy-making. However, it is increasingly seen to be fundamental to understanding how group and individual behaviours affect health risks, health outcomes, and uptake of health services. Inclusive One health policies, plans and programmes should also consider the incremental health benefits (mental, physical, social and biocultural) of exposure to nature.

31. The effects of biodiversity loss on environmental and commensal microbiomes, as well as alterations in the composition of microbial communities of the gut and skin have been associated with various inflammatory conditions, including asthma, allergic and inflammatory bowel diseases, type1 diabetes, and obesity. While the complex relationships between microbial communities and the surrounding environment have been notably absent from One Health policies, plans, and actions, a growing body of research suggests that they have potentially significant implications for One Health. Further research in this area is critical to a more complete understanding of the complex relationships that occur at the microbial level, including the interactions of microscopic life with the larger physical, biological and built environments, and the resulting impacts on human and planetary health.

32. There are important parallels between soil, plant, animal, human and ecosystem health, all of which could be addressed under One Health approaches. One example regards the importance of the diversity of the plants themselves, of the associated microbiomes, and related microbial communities in soil as well as diversity in and of plants.<sup>29</sup> While plant health has generally not been considered in the application of most One Health Approaches, there is a potential to do so, and to consider agricultural

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<sup>26</sup> E.g. It has been projected that the costs of mental health alone, estimated at US\$ 2.5 trillion in 2010 could increase to US\$ 10 trillion by 2030. See Bloom, D.; Cafiero, E.; Jané-Llopis, E.; Abrahams-Gessel, S.; Bloom, L.; Fathima, S.; Feigl, A.; Gaziano, T.; Mowafi, M.; Pandya, A.; et al. *The Global Economic Burden of Noncommunicable Diseases*; WHO: Geneva, Switzerland, 2011.

<sup>27</sup> See e.g. Cox, Daniel TC, et al. “Doses of neighborhood nature: the benefits for mental health of living with nature.” *BioScience* 67.2 (2017): 147-155; Gascon, M. et al. Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. (2015) *International journal of environmental research and public health* 12.4: 4354-4379; Sandifer, P. A., Sutton-Grier, A. E., and 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.

<sup>28</sup> See e.g. Nutsford, D., Pearson, A. L., and Kingham, S. (2013). An ecological study investigating the association between access to urban green space and mental health. *Public health*, 127(11), 1005-1011. See also Louv, R. (2008). *Last child in the woods: Saving our children from nature-deficit disorder*. Algonquin Books, for a discussion of the health benefits of children’s exposure to nature, and related discussion on “nature-deficit disorder” discussing behavioural and related health concerns as a product of children’s separation from nature in increasingly urbanized landscapes.

<sup>29</sup> See e.g.: Berg, Gabriele, et al. “Plant microbial diversity is suggested as the key to future biocontrol and health trends.” *FEMS Microbiology Ecology* 93.5 (2017); Adam, Eveline, et al. “Controlling the microbiome: microhabitat adjustments for successful biocontrol strategies in soil and human gut.” *Frontiers in Microbiology* 7 (2016).

systems as an integral part of socio-ecological systems that influence both human health and ecosystem health. Soil microbial communities may also provide an important benchmark for the study of resilience given their relatively rapid response to disturbances and established protocols to measure their ecologically meaningful functions.<sup>30</sup>

33. In the light of the foregoing and building upon fundamental principles of the ecosystem approach, the present guidance aims to extend the application of One Health beyond infectious diseases, antimicrobial resistance and food safety to include other issue areas and multiple health outcomes in line with the findings of the *State of Knowledge Review* as summarized in annex I, taking into account the guidance set out in decision XIII/6 and discussions arising from regional capacity-building workshops on biodiversity and health. It aims to adopt a more holistic, whole-of-government, whole-of-society approach that is not discipline or sector-based to support the integration of biodiversity across all relevant sectors and disciplines in the development of One Health policies, plans, programmes and research. As such, it is closely aligned with systems thinking, and draws on the principles of the Ecohealth approach.

### **B. Purpose of the guidance**

34. The purpose of this Guidance is to assist Parties to the Convention, and other relevant stakeholders, in the process of developing policies, plans, programmes and research aligned with One Health approaches, with more balanced consideration of biodiversity and ecosystem dynamics and management, in line with decision XIII/6.

35. It is understood that One Health policies, plans or projects must take into consideration differences in national circumstances, goals and priorities, as well as cross-cutting issues related to child and maternal health, indigenous peoples and local communities, smallholders, and inequality, and promote the understanding that biodiversity conservation and healthy ecosystems provide an opportunity to help achieve broader societal and development goals in addition to supporting a healthy environment and society. Under the right conditions, these approaches contribute to, *inter alia*:

(a) Strengthening adaptation and building social and ecological resilience in the face of global environmental change and promoting intergenerational equity;

(b) Reducing high costs and inefficiencies of single-sector interventions as well as high financial and social costs associated with disease outbreaks and poor health outcomes;

(c) Improving assessment, monitoring and response to changes in ecosystems and associated impacts on health and well-being;

(d) Achieving greater policy coherence, alignment and complementarity across scales of governance in ecosystem, environmental and public health management and planning for environmentally sustainable development in line with the objectives of the 2030 Agenda for Sustainable Development and other commitments for sustainable development.

36. The Guidance is intended as a starting point to facilitate a more balanced and integrated consideration for ecosystem and human health dynamics. It is best understood as a decision support tool in conjunction with other relevant guidance and guidelines (see, for example, annex II).

### **C. Guiding principles**

37. Application of One Health approaches may be guided by the key principles outlined below. These are aligned with the CBD guidelines of the ecosystem approach, and draw upon the findings of the *State of Knowledge Review, Connecting Global Priorities: Biodiversity and Human Health* and its key messages,<sup>31</sup> and decisions XII/21 and XIII/6, as well as the foregoing rationale (section A).

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<sup>30</sup>Döring, Thomas F., et al. "Resilience as a universal criterion of health." *Journal of the Science of Food and Agriculture*, 95.3 (2015): 455-465.

<sup>31</sup>[www.cbd.int/en/health/stateofknowledge](http://www.cbd.int/en/health/stateofknowledge)

(a) *Consider all dimensions of health and human well-being.* The right to health is a fundamental right of every human being.<sup>32</sup> Health is understood as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. This encompasses the full range of health outcomes, including food and nutrition security, infectious and non-communicable diseases as well as the psychological and biocultural dimensions of health;

(b) *Enhance resilience of socio-ecological systems to prioritize prevention.* Coordinated preventive action is essential to minimizing and mitigating health risks associated with biodiversity loss and ecosystem degradation. It is also important to minimize the economic and social impacts associated with these risks. The added value of working across sectors is to design, adopt and implement policies, plans and programmes that are preventive. This implies adoption of measures that are precautionary, placing a value on ecosystem services to health, and making positive use of these connections, to minimize and mitigate risks to ecosystems, animals, plants, and humans. To be effective, it is important to consider that the precautionary approach and the implementation of long-term management also requires stability of institutions, legal and policy frameworks across sectors, monitoring programmes, and extension and awareness-raising programmes. Strengthening of evidence-based risk management policies is also important;

(c) *Apply the ecosystem approach.* The health of people is intimately linked to the health of ecosystems. To maximize co-benefits, One Health policies, plans or programmes should be aligned with principles of the ecosystem approach set out in decision V/6 and the guidance set out in decision VII/11. Ecosystems should be managed for their intrinsic values as well as for the tangible or intangible benefits for humans, in a fair and equitable way. Cultural and biological diversity are central components of the ecosystem approach, and coherent with the WHO definition of health, and One Health should take the full range of these principles into account. This understanding should also seek to inform the appropriate level for management decisions and actions and will often imply decentralization to the level of local communities;

(d) *Participatory and inclusive.* One Health should seek to encourage participatory approaches that are inclusive, support adaptive management practices and maximize the involvement of all stakeholders. Concepts of stewardship, intergenerational equity and sustainable use should be embedded in One Health policies, plans and projects and research, and applied to considerations of the temporal scale to evaluate short-, medium- and long-term gains. Boundaries for management should also be defined through participatory processes, and should facilitate adaptive management and consider gender-differentiated impacts on health;

(e) *Cross-sectoral, multinational, and transdisciplinary.* The management of complex social-ecological systems intrinsically requires cross-sectoral, multinational, and multi- and transdisciplinary collaboration. The establishment of broad-based partnerships across sectors, the formation of relevant bodies within the Government where necessary and the creation of networks along the research-to-delivery continuum in ways that support the sharing of information and experience are all essential to the success of comprehensive One Health policies, plans or projects. The integration of biodiversity and ecosystem-related considerations should be given due consideration in the development of One Health policies, plans, programmes and research;

(f) *Multi-scalar.* As the definition of the ecosystem approach indicates, an ecosystem is a functioning unit that can operate at any scale, depending on the issue being addressed. As ecosystem processes are characterized by varying temporal scales and lag effects, the scale of analysis is a fundamental component in the design, development and implementation of integrative One Health policies, plans, projects and research. Management interventions, methodologies, data, and monitoring of

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<sup>32</sup> In line with the Universal Declaration of Human Rights and Article 1 of the WHO Constitution ([http://www.who.int/governance/eb/who\\_constitution\\_en.pdf](http://www.who.int/governance/eb/who_constitution_en.pdf)). The WHO constitution was the first international instrument to enshrine the “right to health” as the “enjoyment of the highest attainable standard of health”, also reflected in the Universal Declaration of Human Rights in 1948. The right to health is understood as an inclusive right that extends beyond health care to include the underlying determinants of health, such as access to water and food, essential medicines, etc.

results must assess impacts (and resilience) across scales in ways that can be compared across relevant sectors, with due consideration for future benefits and inter-generational equity, in line with Principle 8 of the ecosystem approach;

(g) *Social justice and gender equity.* Social and economic determinants also have a significant influence on the dynamics between biodiversity changes and human health. Social inequities mean that the freedom to lead a flourishing life and to enjoy good health is unequally distributed between and within societies. This unequal distribution of health-damaging experiences is often the result of a combination of poor social policies and programmes, unfair economic arrangements, and power relationships.<sup>33</sup>As foundational principles of the Ecohealth approach and sustainable development more broadly, social justice and gender equity should be embedded in One Health policies, plans or projects.

#### **D. Measures to apply One Health approaches**

##### *1. The enabling environment*

38. Create mechanisms to ensure that all relevant stakeholders, including indigenous and local communities, smallholder experts, and local decision makers, can be involved effectively in the design, implementation and review of One Health policies, plans or projects, including by ensuring equitable access to information, and the ability to participate in relevant processes. Communities of interest can be identified using appropriate mechanisms, such as stakeholder mapping to facilitate more.

39. Align regulatory and legislative policies at the national level, taking into account the principles in this guidance. At the national level, appropriate legislative frameworks, guidelines and safeguards to minimize or mitigate impacts of ecosystem alteration, waste, pollution, unsustainable use of resources, pharmaceuticals and antibiotics on ecosystem, animal, plant and human health are needed. For example, legislation could be designed to:

(a) Guide the development of human activity/settlements, such as the establishment of urban centres, mining, industrial and intensive agriculture and livestock systems, away from areas adjacent to highly biodiverse and sensitive ecosystems;

(b) Reduce environmental contamination with antibiotics used for treating people and animals. This includes adopting appropriate restrictions on antibiotic misuse both in human and agricultural settings, including, where relevant, antibiotic remediation of wastewater.

40. Strengthen integrated monitoring and active disease surveillance capacity (at the national, regional and international levels), making use of international standards, tools and monitoring processes, as a cost-effective measure to promote early detection and avoid the much greater damage and costs to ecosystems and societies of disease outbreaks.

41. Promote, insofar as possible, the implementation of relevant safeguard measures to strengthen social-ecological resilience, avoid adverse impacts on biodiversity and ecosystem integrity, and improve long-term health outcomes while supporting livelihoods and well-being, including the health and well-being of vulnerable populations according to national circumstances and priorities.

42. Use economic analysis and national accounting to support the integration of biodiversity and ecosystem functions and services concerns into national development strategies and sectoral development plans, fiscal and, as appropriate, national accounting systems, and their implementation and reporting. National economic tools that work across sectors may be effective for ensuring biodiversity-ecosystem-health linkages into One Health national planning and budgets in line with Aichi Biodiversity Targets 2 and 3.

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<sup>33</sup> WHO (2008). *Closing the Gap in a Generation: Health Equity through Action on the Social Determinants of Health*, Geneva. While these principles are also explicitly embedded in Ecohealth approaches, they are also closely aligned with fundamental principles of Planetary Health.

43. Apply One Health policies, plans or projects in a manner coherent with and reflected in national biodiversity strategies and action plans, national health plans and other reporting instruments, including those under the Convention, the WHO, UNFCCC and UNISDR, to jointly support the implementation of the Convention, the Strategic Plan for Biodiversity 2011-2020, the 2030 Agenda for Sustainable Development and other relevant global commitments.

44. Leverage international agencies, institutions, mechanisms and tools to support the implementation of One Health approaches, including raising awareness, building capacity, developing integrated knowledge exchange platforms and supporting advocacy. Efforts should be made to align national priorities with global commitments for sustainable development, including the Strategic Plan for Biodiversity 2011-2020, the Paris Agreement, the Sendai Framework for Disaster Risk reduction and the Sustainable Development Goals.

45. Implement and enforce relevant international regulations and guidance, including the International Health Regulations (IHR). Instruments such as the IHR not only contribute to preventing and controlling the spread of disease, they can help to reduce undue interference with international traffic and trade; help to curtail the deleterious impacts of illegal wildlife trade on animal, plant and human health; strengthen reporting, information and multi-sectoral consultation and improve risk communication across sectors. For other examples of relevant guidelines, see annex II.

2. *Identification, appraisal and assessment for integrated one health policies, plans, or projects*

46. Conduct a preliminary assessment of the potential for successful implementation of One Health policies, plans or projects with input from all relevant sectors, including the environment sector. Such assessments should also take into account cultural acceptance, financial and institutional capacity, geophysical features, and other relevant criteria, identifying barriers and potential means to address them including through consultation with the health, environment and other related sectors. Assessments should cast a wide net to identify key linkages between ecosystem alteration and health outcomes notably including common drivers of biodiversity loss and ill health, including those identified in the *State of Knowledge Review*, and the annex to decision XIII/6.

47. Employ economic valuation tools to assess multi-sectoral costs and benefits of a proposed use of an ecosystem, rather than only costs or values that enter markets in the form of private goods. Capturing the full range of values associated with biodiversity loss, including socio-cultural dimensions, requires that economic valuation tools are complemented with non-monetary valuation methods and planning tools based on (cross-sectoral) criteria that help to differentiate benefits and trade-offs. Qualitative analyses should also be used to complement economic valuation in assessments of One Health projects.

48. In assessments, utilize specific voluntary tools to inform risk and impact assessments, such as mapping of social and environmental vulnerability, and distributional studies assessing country- and region-specific links between biodiversity and health.

49. Carry out and act upon environmental impact assessment (EIAs),<sup>34</sup> strategic environmental assessments (SEAs), and social impact assessments, as applicable, with consideration for potential impacts on biodiversity, health and offsite impacts. Identifying existing and potential risks or threats to ecosystems at different scales also needs to be considered. For an integrated One Health approach, prospective policies, plans or projects should apply the voluntary Guidelines on biodiversity-inclusive impact assessment in line with Conference of the Parties decision VIII/28, adopted in 2006. These provide guidance on whether, when and how to consider biodiversity in both project and strategic-level impact assessments.

50. Systematically evaluate health impacts, often excluded from these SEAs and EIAs in practice, in strategic planning and project evaluation, including aggregate or multiple health exposures on given

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<sup>34</sup> Here, it is understood that, in general, EIAs apply to projects, SEAs generally apply to policies, plans or programmes, HIA generally apply to policies, plans or projects and Risk Assessment refers to the risk of exposure to substances such as pesticides or other pollutants.

affected populations.<sup>35</sup> Relevant measures include the integration of health impact assessments (HIAs) within biodiversity-inclusive EIAs and SEAs, including through the development of minimum standards, clear identification of data needs, an assessment of available methodologies for the quantification of impacts and unique threats requiring a more thorough assessment. Integrated assessments would have the added benefits of reducing overlap and costs of conducting separate assessments, and could contribute to the development of comparable data sets across sectors.

51. Employ risk assessment to assess the effects of exposure of individuals or populations to hazardous materials and substances. Key components of risk assessment to jointly minimize risks to biodiversity, ecosystems and health include adequate consideration of human health risks through an evaluation of risks to other organisms and ecological functions that influence health and well-being, including risks to relevant species and ecosystems, biodiversity structure and composition, ecological processes and functions and the services they sustain.<sup>36</sup> Integrated evaluation of these risks allows for more comprehensive and coherent problem formulation and helps to identify the full range of health and ecological effects presented by related stressors.

52. Vulnerability and adaptation assessments, tailored to the contexts of vulnerable populations, can promote a social justice perspective in integrated approaches to health.

### 3. *Integrated data collection, monitoring and surveillance*

53. Promote integrated mechanisms of data collection, monitoring, review and surveillance, which are central to the effective implementation of One Health approaches, including the following:

(a) Strengthening national surveillance capacity for early warning, prevention and control of disease outbreaks by establishing coordinated active surveillance systems that facilitate systematic inputs and data exchange between public health, environment, wildlife and other sectors;

(b) Establishing data-sharing platforms between the field level and national levels, with a view to establishing a central surveillance mechanism to gather and disseminate data;

(c) Collecting and disseminating geospatial data of high-risk areas for disease transmission in biodiversity hotspots;

(d) Developing alternative scenarios that jointly predict effects on biodiversity, ecosystems and human health for the design of sustainable conservation strategies;

(e) Identifying and scaling up best practices in the sustainable management of ecosystems and health outcomes, sharing this knowledge via available tools and shared knowledge platforms in information technology, and supporting technological development and innovation to develop new data collection methods, such as citizen science; e-health platforms, etc.

54. Develop robust indicators that also consider the impact of biodiversity loss and ecosystem degradation on health outcomes is essential to the assessment and evaluation of progress of One Health policies, plans and programmes. Relevant considerations for the design and application of indicators include the following:

(a) Developing national evidence-based indicators to evaluate progress and to measure health effects of ecosystem change considering established “exposure” threshold values;

(b) Monitoring and forecasting progress toward the achievement of national, regional and global biodiversity targets at regular intervals against integrated evidence-based indicators on biodiversity

<sup>35</sup> Inconsistent consideration for health impacts is often the result of lacking environmental, epidemiological and related data as well as inconsistent regulatory and legislative standards. As a result of these omissions, related impacts on biodiversity and ecosystem management may not fully be considered.

<sup>36</sup> For example, the IUCN Red List of Ecosystems (RLE) provides an adaptable framework for risk assessment across terrestrial, subterranean, freshwater and marine ecosystems. See Keith, D. A., Assessing and managing risks to ecosystem biodiversity, *Austral Ecology*, 40, 4: 1442-9993.

and health that consider threshold values for critical services, such as the availability and access to food, water and medicines;

(c) Making use of, and adapting existing indicators, in line with national circumstances and priorities (e.g. biodiversity indicators for the Strategic Plan for Biodiversity 2011-2020 listed in [decision XIII/28](#));

(d) Making use of the relevant guidance for the identification of indicators (e.g. guidance on developing ecosystem service indicators developed by United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)).<sup>37</sup>

#### 4. *Education, capacity-building and communication*

55. Support the development of cross-sectoral and intercultural curricula on the importance, linkages and interactions of biodiversity, ecosystems and health for sustainable development, including, as applicable, for the prevention of infectious and non-communicable diseases, to strengthen food security and nutritional outcomes and in ways that support healthy lifestyle choices, and sustainable production and consumption patterns.

56. Support training of educators, health care workers, practitioners and decision-makers focused on prevention and the protective role of biodiversity and healthy ecosystems in the delivery of ecosystem goods and services, drawing on local expertise whenever possible.

57. Strengthening core (international, regional, national and local) capacities across disciplines is important. In particular: (a) strengthening and retaining capabilities in the public sector across departments, including but not limited to; health, finance, justice, the environment and social services, to enable countries and regions to prevent, prepare for and respond effectively to public health threats resulting from ecosystem degradation; (b) undertaking cooperative actions toward capacity-building that promote the training of professionals in health, biodiversity and related disciplines, and (c) defining, assessing and strengthening capacities for risk management, including around drivers of biodiversity loss and ill health.

58. Engaging the private sector in the implementation of integrated approaches to health and supporting sustainable technological innovation is important to their success. Insofar as possible, the private sector should be actively engaged in supporting innovation and the development of new technologies and broad-scale solutions. This engagement is important but should also be cautious, forward-looking and carried out from the perspective of sustainable development.

59. Develop and disseminate integrated and tailored risk management and communication strategies focused on prevention to increase the popular understanding of health services provided by biodiversity and improve understanding of how health services provided by biodiversity may influence disease risk (both communicable and non-communicable). Disseminating findings and raising awareness on the direct drivers of biodiversity loss and ill health, including land use change, climate change, pollution, overharvesting, habitat alteration, unsustainable consumption and production and other critical drivers as well as indirect drivers, is essential to biodiversity-inclusive One Health governance.

#### 5. *Supporting integrated research and knowledge co-production*

60. Integrate knowledge from the social science and humanities to understand social, economic, biocultural values and behavioural drivers, and inform sustained communication and engagement efforts to increase awareness of biodiversity and its values to human health.

61. Supporting inter- and transdisciplinary research to address gaps in knowledge on the links between health and environmental change requires integrated methodologies, metrics and tools. Accordingly, One Health implementing partners should be encouraged to:

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<sup>37</sup> <https://www.bipindicators.net/resources/global-publications/measuring-ecosystem-services-guidance-on-developing-ecosystem-services-indicators>

(a) Contribute to the development of standardized methodology, and make use of existing standards and guidelines, to enable a more systematic evaluation of biodiversity and health outcomes, and rigorous monitoring of results;

(b) Develop metrics defining health, as appropriate, to include its relation to broader dimensions of health and well-being, such as mental health, connectedness, and cultural values;

(c) Develop comparable research tools and data across sectors - and maximize the use of existing tools - to promote a common evidence base across sectors. These should consider ecosystem-biodiversity-health linkages to manage current and future risks and safeguard ecosystem functioning while ensuring that social costs, including health impacts, associated with new measures and strategies do not outweigh potential benefits;

(d) Make use of innovative knowledge-sharing platforms, tools and data gathering and dissemination methods. Emerging digital technologies are not only useful data-gathering tools but can also be effective communication strategies.

62. Integrated approaches to health require a more holistic understanding of the epistemology of risks (how evidence-based knowledge is produced) and policymaking (how this knowledge then translates into policy outcomes). Knowledge co-design and co-production should be encouraged at all stages of knowledge generation and implementation; from the formulation of research questions to the application of transdisciplinary knowledge in the design of policies, plans and projects. Knowledge co-design and co-production should create an enabling environment for mutual learning from traditional discipline-based fields (such as public health, ecology, epidemiology, etc.) and knowledge generated from integrated approaches to health, and should incorporate learnings across knowledge systems, including, for example, traditional ecological knowledge.

#### **E. Enhancing the integration of biodiversity and biodiversity-health linkages in One Health**

63. Further to the application of the ecosystem approach and the other Guiding Principles set out in section B above, and taking into account decision XIII/6 and its annex (reproduced in annex I), the integration of biodiversity and biodiversity-health linkages could be enhanced in the application of One Health approaches through the application of the present guidance.

##### *1. Maintain, protect and enhance diversity in socio-ecological systems*

64. This includes species diversity and genetic diversity as well as cultural diversity and institutional diversity.

65. Loss of genetic diversity may directly and indirectly contribute to poor health outcomes in a number of ways. For example, biodiversity loss makes plants and crops more vulnerable to disease, increasing the need for chemical fertilizers and pesticides which in turn can also contribute to numerous public health threats including antibiotic resistance and non-communicable diseases. One Health policies, programmes or projects should seek to prioritize measures that conserve and restore genetic diversity, with corresponding benefits for human health.

66. The loss of species diversity may alter ecosystem processes and disturbance regimes at continental scales, and trigger cascades of extinction, with consequences for human health.<sup>38</sup> Changes in the diversity of species may alter ecosystem function and directly reduce access to provisioning ecosystem services; they may also alter the abundance of species that control ecosystem processes essential to the provision of those services.

67. Assess causes and consequences of biodiversity loss at all levels, including the microbial level. For example, research on exposure to microbial diversity in the environment is emerging as a promising new approach to prevention and cure of many human diseases, including immunoregulatory diseases. Supporting research in this area can serve to inform options for the deliberate modification and

<sup>38</sup> See e.g. Dirzo, Rodolfo, et al. "Defaunation in the Anthropocene." *Science* 345.6195 (2014): 401-406.

diversification of the microbiota, contribute to the identification of beneficial organisms and genes, and jointly strengthen health and conservation outcomes. Information exchange with other sectors is needed to strengthen research at this intersection and to determine urban planning and architectural design options that optimize exposure to beneficial microbial diversity in both low and high-income urban settings.

## 2. *Take into account ecological and evolutionary processes*

68. One Health policies, plans and projects must consider that systems have emergent properties that are not possessed by their individual components or parts. Correspondingly, measures to strengthen the capacity of ecosystems to absorb shocks (which may, in turn, alter ecosystem dynamics), in the face of disturbance should be prioritized and targeted measures developed. Examples include:

(a) The microbiome plays an important role in plant, soil, human, ecosystem and animal health. An analysis of relationships between the microbiome, its hosts and the broader environment should be encouraged, where possible. A better understanding of the underlying relationships in the regulation of disease, for example, can contribute to the development, over the long-term, of targeted and predictive biocontrol methods through microbiome-based solutions;<sup>39</sup>

(b) Natural and traditional disturbance regimes (e.g., under fire or grazing) may be important for ecosystem structure and functioning and could be part of One Health policies, plans or projects based on research on the functions of species in ecosystems and the links between ecosystem functions and services;

(c) Habitat loss and fragmentation may alter components of natural selection and lead to evolutionary change. For example, several costs and benefits of population dispersal are affected by the physical structure of the environment, which are modified by habitat loss and fragmentation. Resulting potential genetic and evolutionary consequences of habitat loss and fragmentation should be considered in the evaluation of One Health projects, plans or policies;<sup>40</sup>

(d) Connectivity between (geographic) areas should be promoted, insofar as possible, and should take into account the interactions and integration between genes, species and ecosystems.

## 3. *Address the common drivers of biodiversity loss and ecosystem degradation and ill health*

69. Integrated measures must be implemented to address the direct and indirect human-induced drivers of biodiversity loss, disease emergence and the loss of ecosystem services that support health and human well-being. Direct anthropogenic drivers include land-use change, over-exploitation and destructive harvest, pollution, climate change, and invasive alien species. Monitoring and evaluating indirect drivers, including social change and development trends (such as urbanization), poverty and gender, as well as public and macroeconomic policies and structures that jointly influence biodiversity and human health outcomes is also important.<sup>41</sup> For example, land use change (e.g. land conversion, oil extraction, mining, deforestation, wetland drainage, etc.) has been identified as the leading driver of infectious disease emergence from wildlife.<sup>42</sup> Moreover, changes in habitat can alter species distribution, abundance, movement, interactions with other species, and with corresponding implications for immune responses and disease emergence.<sup>43</sup> Landscape fragmentation may not only threaten biodiversity directly but also provides potential for “edge effects” with repercussions on fragment dynamics (forest

<sup>39</sup> See e.g. Berg, Gabriele, et al. “Plant microbial diversity is suggested as the key to future biocontrol and health trends.” *FEMS Microbiology Ecology* 93.5 (2017).

<sup>40</sup> See e.g. Hanski, Ilkka. “Habitat loss, the dynamics of biodiversity, and a perspective on conservation.” *AMBIO: A Journal of the Human Environment*, 40.3 (2011): 248-255.

<sup>41</sup> Machalaba, C., Romanelli, C., and Stoett, P. (2017). “Global Environmental Change and Emerging Infectious Diseases: Macrolevel Drivers and Policy Responses”, in “Examining the Role of Environmental Change on Emerging Infectious Diseases and Pandemics” (pp. 24-67). IGI Global.Chicago.

<sup>42</sup> See e.g. Loh, Elizabeth H., et al. “Targeting transmission pathways for emerging zoonotic disease surveillance and control.” *Vector-Borne and Zoonotic Diseases* 15.7 (2015): 432-437.

<sup>43</sup> Gottdenker NL, Streicker DG, Faust CL, Carroll CR (2014). “Anthropogenic land use change and infectious diseases: a review of the evidence”. *Ecohealth* 11(4): 619-632.

microclimate, tree mortality, carbon storage, fauna) with corresponding implications for health outcomes.<sup>44</sup> At the same time, the impact of chemicals and fertilizers are not only a direct source of contamination of food crops used for human consumption but also of crops used as animal feed (with increased evidence of susceptibility to infection associated with dioxin exposure and mycotoxins). This provides a strong rationale for integrated risk assessment along the whole food chain to develop effective, efficient and integrated risk management programmes.

70. It is important not only to assess the risks and impacts of these drivers in One Health plans, policies and programmes but also to assess and monitor the risks and impact of the interacting pressures of these drivers on both ecosystem and human health so as to mitigate or adapt to their potential consequences.

71. Moreover, despite the pervasiveness of invasive organisms and their potentially deleterious effects on native flora and fauna, the consequences of invasive organisms for human health and their underlying ecological mechanisms are rarely considered. One Health policies, plans or programmes should also maximize the use of tools that will contribute to the identification, and subsequent eradication, of invasive organisms that may be harmful to plants, animal and humans. For example, the use of large-scale observational surveys in tick host and pathogen reservoirs may contribute to the identification of biotic mechanisms, such as habitat preferences for vectors infected with pathogens; integrated management of biological invasions may, in turn, help ameliorate the burden of vector-borne diseases on human health.<sup>45</sup>

#### 4. *Deploy ecosystem-based solutions (“nature-based solutions”)*

72. The prevailing approach to health emergencies and disasters is highly reactive, missing critical opportunities for prevention, early warning and detection, and timely effective response. Disasters may include geo-meteorological hazards, such as flooding, storms, extreme weather, earthquakes and wildfires, as well as biological hazards, including those leading to disease epidemics and pandemics. Some of these outcomes can be precipitated by ecosystem disruption that may also increase the frequency and intensity of climate-related extreme events and disasters. Ecosystem degradation can increase the vulnerability and exposure of human populations to disasters while compounding the effects of other drivers, including climate change. Conversely, biodiversity and ecosystem conservation, restoration and sustainable use can strengthen the resilience of ecosystems, both by contributing to adaptation to climate change and moderating the impacts of disasters on human populations and natural environments. Intact and restored ecosystems can contribute to resilience. For example, coral reefs, mangroves, seagrasses and associated habitats improve coastal protection through wave attenuation. Floodplains can reduce the impact of flooding events by diverting and holding excess water. Vegetated coastal ecosystems (e.g. mangrove forests, seagrass beds, and salt marshes) are also an important carbon sink.<sup>46</sup> They can also bury organic carbon up to 50 times faster than terrestrial forests, globally burying a similar amount of organic carbon to terrestrial forests even though the area of coastal vegetated habitats is only 3 per cent that of forests.<sup>47</sup>

73. Disaster-resilient societies are increasingly linked to and dependent upon resilience in ecosystems and sustainability and security in the flow and delivery of essential ecosystem goods and services, not

<sup>44</sup> See e.g. Laurance WF, Camargo JL, Luizão RC, Laurance SG, Pimm SL, Bruna EM, al. e (2011). “The fate of Amazonian forest fragments: a 32-year investigation”. *Biological Conservation* 144(1): 56-67.

<sup>45</sup> See e.g. Allan, Brian F., et al. “Invasive honeysuckle eradication reduces tick-borne disease risk by altering host dynamics.” *Proceedings of the National Academy of Sciences* 107.43 (2010): 18523-18527.

<sup>46</sup> See e.g. McLeod, E. et al. A blueprint for blue carbon: Towards an improved understanding of the role of vegetated coastal habitats in sequestering CO<sub>2</sub>. *Front. Ecol. Environ.* 9, 552–560 (2011).

<sup>47</sup> See e.g.: Duarte, Carlos M., et al. “The role of coastal plant communities for climate change mitigation and adaptation.” *Nature Climate Change* 3.11 (2013): 961-968; Lo, V. (2016). Synthesis report on experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction. Technical Series No.85. Secretariat of the Convention on Biological Diversity, Montreal.

only those directly associated with resilience to immediate disaster impacts, but also those that normally support communities, including vulnerable populations and society at large.

74. Ecosystem-based adaptation (EBA) and ecosystem-based mitigation (EBM) strategies should be considered preventive and response strategies to build the resilience of managed landscapes and jointly reduce the vulnerabilities of ecosystems and communities reliant upon them for their health, livelihoods and well-being. In the analysis and implementation of EBA, EBM and disaster risk reduction measures, measures that jointly contribute to human health and to the conservation of biodiversity and conservation or restoration of vulnerable ecosystems, support the health, well-being, safety and security of vulnerable human populations, and build social and ecological resilience should be enhanced.

#### IV. SUGGESTED RECOMMENDATIONS

75. The Subsidiary Body on Scientific, Technical and Technological Advice may wish to recommend that the Conference of the Parties adopt a decision along the following lines:

*The Conference of the Parties,*

*Recalling* decisions XII/24 and XIII/6,

*Noting* that consideration of health-biodiversity linkages can contribute to improving several aspects of human health and well-being including reduction of both infectious and non-communicable diseases,

*Also noting* the opportunities to contribute the achievement of the Aichi Biodiversity Targets, in particular target 14, and the Sustainable Development Goals, in particular Goal 3, through the mainstreaming of health-biodiversity linkages into relevant sectors and initiatives, including those for health, environment, agriculture, nutrition and food security, planning (including urban planning), climate change adaptation and disaster risk reduction,

*Highlighting*, in this respect, the importance of all dimensions and components of biodiversity including plants, animals and micro-organisms, and the interactions among them, as well as the ecosystems of which they are part;

1. *Takes note* of the guidance on integrating biodiversity considerations into One Health approaches, contained in the note by the Executive Secretary,<sup>48</sup> and encourages Parties, other governments and relevant organizations to make use of the guidance;

2. *Encourages* Parties to promote dialogue among ministries and agencies responsible for the sectors of health, environment, agriculture, nutrition and food security, planning (including urban planning), climate change adaptation and disaster risk reduction, to foster integrated approaches with a view to enhancing implementation of the Strategic Plan for Biodiversity 2011-2020<sup>49</sup> and the 2030 Agenda for Sustainable Development;<sup>50</sup>

3. *Encourages* Parties, and invites other governments and relevant organizations to share their experience on implementing the Guidance on Integrating Biodiversity Considerations in One Health Approaches,<sup>51</sup> through the Clearing House Mechanism.

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<sup>48</sup> CBD/SBSTTA/21/4.

<sup>49</sup> [Decision X/2](#).

<sup>50</sup> [General Assembly resolution 70/1](#), annex.

<sup>51</sup> CBD/SBSTTA/21/4, sect. III.

*Annex I***INFORMATION ON HEALTH-BIODIVERSITY LINKAGES (DECISION XIII/6, ANNEX)**

(a) *Water supply and sanitation:* In water supply and sanitation policies and programmes, including the planning and design of water-related infrastructure, take into account the role of terrestrial and inland water ecosystems as “green infrastructure” in regulating the quantity, quality and supply of freshwater and flood regulation, protect these ecosystems, and address the drivers of their loss and degradation, including land-use change, pollution and invasive species;

(b) *Agricultural production:* Enhance the diversity of crops, livestock and other components of biodiversity in agricultural ecosystems to contribute to sustainable production increases and to the reduced use of pesticides and other chemical inputs, with benefits for human health and the environment, noting the relevance in this respect of the programme of work on agricultural biodiversity (decision V/5), and of the international initiative on pollinators (decision VIII/23 B);

(c) *Food and nutrition:* Promote the diversity and sustainable use of crops and livestock diversity and wild foods, including from marine and inland water sources, to contribute to human nutrition and dietary diversity, including by making available information on the nutritional value of diverse foods, with a view to improving human health, and promoting sustainable diets, including through appropriate information and public awareness activities, recognition of traditional, national and local food cultures, and the use of social and economic incentives throughout the supply chain, noting the relevance in this respect of the cross-cutting initiatives on biodiversity for food and nutrition (decision VIII/23 A);

(d) *Human settlements:* In urban planning, design, development and management, take into account the important role of biodiversity in providing physiological benefits, in particular the role of vegetation in improving air quality and counteracting the heat-island effect, and in fostering interchange between environmental microbes and the human microbiome;

(e) *Ecosystem management and infectious diseases:* Promote an integrated (“One Health”) approach to the management of ecosystems, associated human settlements and livestock, minimizing unnecessary disturbance to natural systems and so avoid or mitigate the potential emergence of new pathogens, and manage the risk of transmission of pathogens between humans, livestock and wildlife in order to reduce the risk and incidence of infectious diseases, including zoonotic and vector-borne diseases;

(f) *Mental health and well-being:* Promote opportunities for interactions between people, especially children, and nature, to provide benefits for mental health, to support cultural well-being and encourage physical activity in green and biodiverse spaces, particularly in urban areas;

(g) *Traditional medicines:* Protect traditional medical knowledge, innovations and practices of indigenous peoples and local communities, promote the sustainable use, management and trade of plants and animals used in traditional medicine, and promote safe and culturally sensitive practices, and the integration and sharing of knowledge and experiences, based on prior and informed consent, and the fair and equitable sharing of benefits between traditional medical practitioners and the broader medical community;

(h) *Biomedical discovery:* Conserve biodiversity in terrestrial, inland water, coastal and marine areas; protect traditional knowledge, especially in areas of high importance for biodiversity and ecosystem services; and promote access to genetic resources and the fair and equitable sharing of benefits arising from their utilization consistent with Article 8(j) and with the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity;

(i) *Impacts of pharmaceutical products:* Avoid the overuse, and unnecessary routine use, of antibiotic and antimicrobial agents, both in human medicine and veterinary practice, to reduce harm to beneficial and symbiotic microbial diversity and to reduce the risk of antibiotic resistance; better manage

the use and disposal of endocrine-disrupting chemicals to prevent harm to people, biodiversity and ecosystem services; and reduce the inappropriate use of non-steroidal anti-inflammatory drugs that threaten wildlife populations;

(j) *Species and habitat conservation*: In implementing policies to protect species and habitats, including protected areas, and other methods aimed at conservation and sustainable use, consider, in compliance with national legislation, improving access to, and customary sustainable use of, wild foods and other essential resources by indigenous peoples and local communities, especially poor and resource-dependent communities;

(k) *Ecosystem restoration*: Consider human health when carrying out ecosystem restoration activities and, where necessary, take measures to promote positive health outcomes and remove or mitigate negative health outcomes;

(l) *Climate change and disaster risk reduction*: In the analysis and implementation of ecosystem-based adaptation, mitigation and disaster risk reduction measures, prioritize measures that jointly contribute to human health and to the conservation of biodiversity and of vulnerable ecosystems, and that support the health, well-being, safety and security of vulnerable human populations, and build resilience.

*Annex II***EXAMPLES OF INTERNATIONAL GUIDELINES RELEVANT TO ONE HEALTH**

One Health projects should also seek to encourage the implementation of guidelines, including voluntary guidelines, adopted by the Convention, WHO, FAO, OIE and other relevant organizations. Examples include:

(a) *Akwé: Kon Voluntary Guidelines for the Conduct of Cultural, Environmental and Social Impact Assessments regarding Developments Proposed to Take Place on, or which are Likely to Impact on, Sacred Sites and on Lands and Waters Traditionally Occupied or used by Indigenous and Local Communities* (decision VII/16 F, annex) should be used in conjunction with the voluntary guidelines on biodiversity-inclusive EIA and the draft guidance on biodiversity-inclusive SEA contained in annex II to the note by the Executive Secretary on voluntary guidelines on biodiversity-inclusive impact assessment (UNEP/CBD/COP/8/27/Add.2);

(b) *International Health Regulations*: framework for the coordination of events that may constitute a public health emergency of international concern, and for improving the capacity of countries to assess and manage acute public health risks as a pathway to international health security;

(c) *Codex Alimentarius*: shared by FAO and WHO which develops food and feed standards and provides guidelines and codes of practice with the aim of protecting the health of consumers, ensuring fair trade practices in the food trade, and promoting the coordination of all work food standards undertaken by intergovernmental organizations and NGOs. FAO, OIE and WHO also define and regularly update guidelines for good practices, methods, tools and strategies for infectious diseases, focusing on developing countries and/or endemic areas;

(d) *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* issued by the Food and Agriculture Organization of the United Nations to promote secure tenure rights and equitable access to land, fisheries and forests as a means of addressing the social determinants of health, including poverty;

(e) WHO and OIE Standards, Guidelines and Resolutions on antimicrobial resistance and the use of antimicrobial agents, including the 2017 Global Action Plan on AMR;<sup>52</sup>

(f) OIE Tool for the Evaluation of Performance of Veterinary Services (OIE PVS Tool), which form the basis for evaluating performance against the international standards published in the OIE Terrestrial Animal Health Code. A similar tool is available for the evaluation of Aquatic Animal Health Services;

(g) The Convention on International Trade in Endangered Species of Wild Fauna and Flora.

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<sup>52</sup> <http://www.who.int/antimicrobial-resistance/global-action-plan/en/>