Background Paper for the Regional Workshop on the Inter-Linkages between

Human Health and Biodiversity in the Americas

Manaus, Brazil (4-6 September 2012)
Co-sponsors:

Convention on Biological Diversity (CBD) &

Pan American Health Organization (PAHO/WHO)

Executive Summary and Focus of the Workshop

There is growing evidence of the impacts of global environmental changes on ecosystems and people, and a renewed consciousness among peoples and nations of the need to act quickly to protect the planet's ecological and climatic systems. Increasingly unsustainable practices are placing pressure on natural resources to meet the demands of our economies and the needs of a rapidly growing global population, resulting in soil, water and air pollution, increased greenhouse gas emissions, deforestation and land use change, expanded urban areas, introduction of invasive species, and inadequately planned development of water and land resources to meet food and energy needs. These changes are having both direct and indirect impacts on our climate, ecosystems and biological diversity, and in turn on human health. More than ever, the pursuit of public health at all levels from local to global, now depends on careful attention to the processes of environmental change worldwide. Health is our most basic human right and one of the most important indicators of sustainable development. We rely on healthy ecosystems to support healthy communities and societies. **Well functioning ecosystems provide goods and services essential for human health.** These include nutrition and food security, clean air and fresh water, protection from coastal storms and inland flooding, medicines, cultural and spiritual values, and contributions to local livelihoods and economic development. They can also help to limit disease and stabilize the climate. Health policies need to recognize these essential contributions.

The goal of this workshop is to support national efforts to reflect health issues in National Biodiversity Strategies and Action Plans and to develop or update action plans that take into account health and biodiversity concerns and opportunities at the national and regional levels as a contribution to the Strategic Plan for Biodiversity 2011-2020 and its related Aichi Biodiversity Targets. It also seeks to build capacity to integrate information on the ecosystems services upon which health, livelihoods and well-being depend, which is essential in both developed and developing countries. Workshop participants should make action plans that consider urgency, feasibility and significance. More specifically, this workshop will provide a forum for Parties and experts from the health and biodiversity sectors to:

(i) Contribute to the implementation of the Strategic Plan, in particular as it relates to health issues;
(ii) Discuss regional best practices in order to incorporate biodiversity and health considerations in national and regional conservation programmes;

(iii) Strengthen capacity and identify further needs for successful implementation of the Strategic Plan;

(iv) Identify potential joint activities to achieve health and biodiversity co-benefits for consideration in national biodiversity strategies and action plans, and;

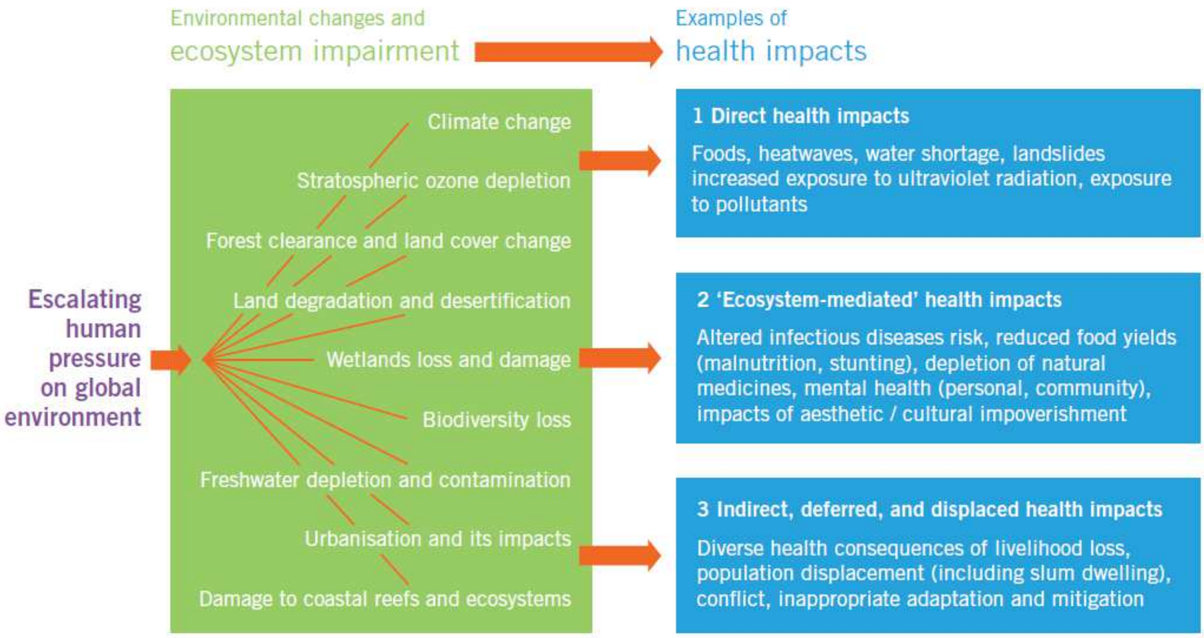
(v) Promote transboundary and regional cooperation and support networks on health and biodiversity issues and strategies.

Introduction

Traditional knowledge and scientific evidence both point to the inexorable role of environmental changes worldwide in terms of their impact on human health and well-being. In many countries, anthropogenic changes to agriculture-related ecosystems have resulted in great benefits for human health and well-being, in particular through increased global food production and improved food security. These positive impacts, however, have not benefited everyone, and unsustainable pressures on ecosystems have resulted in irreparable loss and degradation, with negative consequences for health and well-being. These range from emerging infectious diseases to malnutrition, and contribute to the rapid rise in non-communicable diseases. Large-scale human transformation of the environment has contributed to increased disease burdens associated with the expansion of ecological and climatic conditions favorable for disease vectors. For all humans, the provision of adequate nutrition, clean water, and long-term food security depend directly on functioning agro-ecosystems and indirectly on the regulating ecosystem services of the biosphere; these ecosystem services can be eroded if overexploited and poorly managed.

Biodiversity is one foundation for human health; its loss undermines this foundation. Biodiversity underpins the functioning of the ecosystems on which we depend for our food and fresh water; it aids in regulating climate, floods and diseases; and it provides recreational benefits and offers aesthetic and spiritual enrichment. Biodiversity contributes to local livelihoods, medicines (both traditional and modern) and economic development. All human health ultimately depends on ecosystem services that are made possible by biodiversity and the products and services derived from them. The loss of biodiversity inhibits our efforts to improve human health. The links between biodiversity, ecosystem services and human health are complex and often we do not have a clear understanding of all of the relevant causal relationships (see figure 1).

Figure 1. Examples of health impacts from environmental changes



Current and Future Anthropogenic Trends posing Ecological and Societal Risks

In 2005, 1360 experts from 95 countries produced a consensus document evaluating the state of the planet's ecosystems, The Millennium Ecosystem Assessment (MA). In the Summary for Decision Makers, the authors warned that "any progress achieved in addressing the Millennium Development Goals of poverty and hunger eradication, improved health, and environmental sustainability is unlikely to be sustained if most of the ecosystem services on which humanity relies continue to be degraded." At the same time, the Director-General of the World Health Organization wrote that "Nature's goods and services are the ultimate foundations of life and health, even though in modern societies this fundamental dependency may be indirect, displaced in space and time, and therefore poorly recognized."

The preservation and sustainable use of biodiversity offers significant opportunities to improve health outcomes such as through enhanced provision of diverse foods and medicines, while ecosystem-based approaches to land management and to climate change adaptation and mitigation can reduce the threats to health from climate change and desertification. Biodiversity loss, climate change and desertification threaten health and human well-being in many ways, which this the reason there are three "Rio Conventions" dedicated to grappling with each of these challenges.

Marginalized populations are more likely to face greater health risks from environmental change. These include lower-income communities and indigenous peoples that are coping with changes driven largely by economic processes in other parts of the world. They are often especially vulnerable to diseases as a result of multiple stresses, and they have few resources for combating global environmental change and little voice in the decision-making processes of local, regional, national or global policy institutions. Because health is a central element in sustainable development, poor communities face a double challenge: their greater risk to environmental impacts worsens the development challenges they face, which in turn further weakens their ability to respond to health risks.

The growing confluence of health and global environmental change highlights the need to redouble efforts to improve the lives of the poorest and most vulnerable populations and to protect the planet's ecosystems. Global inequalities are increasing. While all nations face future health risks from environmental change, such risks are already most hard felt by the poorest populations, and by vulnerable individuals within them. Existing disparities are exacerbated by the loss of ecosystem services required to support and maintain health and well-being for many people already struggling with poverty, malnutrition and the effects of natural and human-induced disasters. These disparities point to the immediate need to invest not only in more thorough efforts to reduce global environmental change but also in more significant health programs to assist developing countries reduce their vulnerability to such changes that are already occurring and are likely to intensify in the short to medium term.

Health is an important outcome in the management of natural resources and the environment, but is often left out of environmental assessment and policy processes. Similarly, health actors often neglect the potential to improve health through protection of biodiversity and enhancement of ecosystem services and reduction of environmental risk factors. While the public health community will always face the necessity of responding to the acute health needs of populations, an improved understanding of environment–health linkages has the potential to significantly strengthen capacity to identify and analyze long-term health risks, to encourage participation in policy decisions that have significant health implications and to develop strategies for disease prevention.

BOX 1:
Mechanisms of Disease Emergence or Resurgence

Ecosystem changes that result from human activities can trigger ecological mechanisms that increase the risk of human disease transmission. Alternatively, they can exacerbate conditions of vulnerability in the human population, such as malnutrition, stress and trauma (in floods and storms, for example), immunosuppression, and respiratory ailments associated with poor air quality. In recognition of these relationships, the *Millennium Ecosystem Assessment* defined the "regulation of infectious diseases" as an ecosystem service.

The reasons for the emergence or reemergence of some diseases are unknown, but the following mechanisms and examples of underlying drivers have been identified as causes of change or increase in the incidence of many diseases.

Altered habitat, which can lead to changes in the number of vector breeding sites or in disease reservoir host distribution. Three types of drivers are primarily responsible for altered habitat: (1) destruction, conversion, or encroachment of wildlife habitat, particularly through deforestation and reforestation; (2) changes in agricultural land use, including proliferation of both livestock and crops; and (3) changes in the distribution and availability of surface waters, such as through dam construction, irrigation, and stream diversion.

Biodiversity change, including loss of predator species and changes in host population density The main drivers of biodiversity change are the same as those that alter habitat, in addition to overharvesting (such as overfishing) and invasive species.

Niche invasion or host-shifting by pathogens. The drivers of niche invasion include human migration, international travel and trade, and accidental or intentional introduction of pathogens by humans.

Human-induced genetic changes in disease vectors or pathogens, such as mosquito resistance to pesticides or the emergence of antibiotic-resistant bacteria. The drivers of these changes include pesticide application and the overuse of antibiotics.

Environmental contamination by infectious disease agents, such as fecal contamination of source waters. The drivers of such contamination include (1) lack of sanitation; (2) increased rainfall and runoff, often from impervious surfaces caused by urban sprawl or climate change-related extremes of the hydrologic cycle; and (3) deposition of chemical pollutants, including nutrients and fertilizers.

Break-out Group Themes for the Workshop

While content on links between biological diversity and health can be grouped in a variety of ways, we have selected the following division of topics toward a comprehensive approach to this mutually dependent and complex issue:

1) water and food security;

2) soil, air and non-communicable diseases;

3) infectious diseases; and

4) medicines and cultural well-being.

1. Water and Food Security

Water Security:
Biodiversity loss, climate change and desertification threaten **water security**. Shifting rainfall patterns, the melting of glaciers and increased evapotranspiration rates will compound existing challenges to provide of clean water, thereby destabilizing fragile environmental and social systems. Lack of access to safe water increases the risk of diarrheal disease and other diseases related to chemical and biological contaminants. Increased frequency and severity of drought and flooding is predicted to further destabilize vulnerable populations. Rising sea levels could result in salination of coastal freshwater aquifers and may disrupt water treatment services, including stormwater drainage and sewage disposal. Repeat flooding or increased salination may force population displacement, heightening their vulnerability. Forests, wetlands and other ecosystems play a major role in water regulation. Thus the quantity and quality of clean water is also affected by ecosystem degradation. Water availability is the major limiting factor for sustainable development in dry regions. Droughts exacerbate water scarcity and, coupled with food deprivation, can bring about famines. Droughts may also lead people, mostly men, to migrate, thus spreading endemic infectious diseases. Populations in dry areas, most of which occur in developing countries, often lag far behind the rest of the world in human well-being and developmental indicators. Dryland areas in particular are susceptible to drought, though this is a global phenomenon. Droughts in Africa have had particularly tragic consequences. The effects of droughts over large territorial ranges of Africa and Asia are often felt globally, such as dust from wind erosion or altered rainfall patterns. Severe dust storms from Africa to the Caribbean and from Asia to North America, for example, may increase the levels of airborne fine particles and potentially infectious agents and may have serious health consequences for both humans and animals.

Food Security:
Biodiversity loss, climate change and desertification also threaten food security. Changing climate patterns, including extreme dry or cold periods and erratic rainfall, as well as other factors such as land degradation and biodiversity loss, can have a direct impact on food availability and nutrition in many parts of the world and lead to increased vulnerability to disease, population displacement and malnutrition. When combined with pre-existing issues associated with global food security, climate change threatens to significantly impede sustainable agricultural improvement efforts that are necessary for sustainable development. In some developing nations, the downstream health impacts of decreased agricultural productivity can be devastating. Biodiversity loss not only affects current food security, nutrition and livelihoods, but the loss of genetic diversity also limits our future options for species to be used in food production. These options include adaptations for climate change and improvements to yields and nutritional quality. Traditional shifting cultivation has helped to increase the capacity of drylands to produce food and fibre and provide food security for local populations, as well as improved nutrition and overall well-being. Despite this, increasing population pressure in many parts of the world has led to unsustainable agricultural practices that have irreversibly transformed vegetation cover, causing a number of consequences for health.

2. Soil, Air, and Non Communicable Diseases

In the Americas, there are two fundamental problems with air quality; pollution in large cities and indoor air pollution from burning biomass (Rodriguez and Romero 2011, 20, 59). The burning of fossil fuels and biomass (primarily wood), which lead to to environmental degradation, is a cause for concern addressed by the the Millennium Development Goals (MDGs), particularly Goal 7 target 9, which seeks to ensure environmental sustainability (Rodriguez and Romero 2011, 59). Pollutants generated during the burning of biomass are: particulate matter, nitrogen oxides, sulfur oxides and carbon monoxide: these pollutants cause serious health effects such as respiratory infections, chronic obstructive pulmonary disease (COPD), increased mortality (including cardiovascular disease), and lung cancer among others (Rodriguez and Romero 2011, 60). At a global level, pneumonia and other acute respiratory diseases are the primary cause of death in children under five. Exposure to indoor air pollution doubles the risk of pneumonia and is thereby responsible for more than 900,000 of the 2 million deaths that occur annually as a result of the disease (Rodriguez and Romero 2011, 61).

Activities contributing to soil degradation in the region are:

1. Monoculture with intensive use of pesticides
2. Urban sprawl
3. Pollution from municipal solid waste
4. Extractive activities such as oil exploration and mining
5. Deforestation especially associated with extreme hydrometeorological events

Soil erosion and water contamination: **Case of mercury in Amazon River Basin**

In the Madeira and Tapajós River basins, detailed studies showed that the soils of the region had high levels of mercury of natural origin. Emissions from gold mining, even using the worst-case pollution scenarios, could not explain more than 3% of the soil-mercury burden. The sedimentary records in floodplain lakes clearly showed mercury enrichment in the more recent layers, but sediment dating indicated that this enrichment was related to the onset of human settlement and exploitation of the basin in the 1950s, rather than to the gold-mining rush of the 1980s. Comparisons of mercury levels in forest soils with those in crop soils indicated that deforestation for agricultural purposes was associated with depleted soil mercury levels, especially on slopes (Roulet et al. 1999; 2000a, b).

Human exposure to mercury reflected concentrations in the environment. Here too, no gradient was observed between villages located up and down river, even though their distances from gold-mining areas varied. Biomarkers of human exposure to mercury were closely associated with mercury in the environment and to fish consumption. Mercury levels in human hair were considerably higher than those reported elsewhere in the world (Passos and Mergler 2008). Sequential mercury analysis along human hair strands clearly showed a strong seasonal variation in mercury exposure. The hypothesis was that exposure varied because of the importance of fish consumption all year yet with seasonal variations in the availability of various fish species, particularly piscivorous versus non-piscivorous fish (Dolbec et al. 2001). Indeed, the entire subsistence diet mirrored the changes in the dynamics of the local ecosystem associated with the 5 m rise and fall of the water level over a yearly cycle. Different fish species predominate according to the time of year, and this cycle coincided directly with mercury exposure in local populations.

Neurological tests showed clear deficits in motor and visual functions, with increasing dose-related hair mercury concentrations (Lebel et al. 1998; Dolbec et al. 2000). The mobilization of mercury by slash and burn agriculture, and its exposure pathways and health effects in humans, are mediated by complex socio-cultural and political processes. These realities must be taken into account when attempting to change practices and policies (Fillion et al. 2009).

Impacts from extractive industries

Manganese Mining: The region of Molango in the state of Hidalgo, Mexico, has one of the largest manganese (Mn) ore deposits in the world. The region covers approximately 1250 square kilometres and has proven reserves of 32 million tonnes of Mn ore, plus another 250 million tonnes categorized as probable. Manganese is one of the five most abundant minerals on the planet and is valued for its use in manufacturing steel alloys. Other uses include manufacturing batteries and ceramics. In some countries, Mn can be used as an anti-knock additive in gasoline.

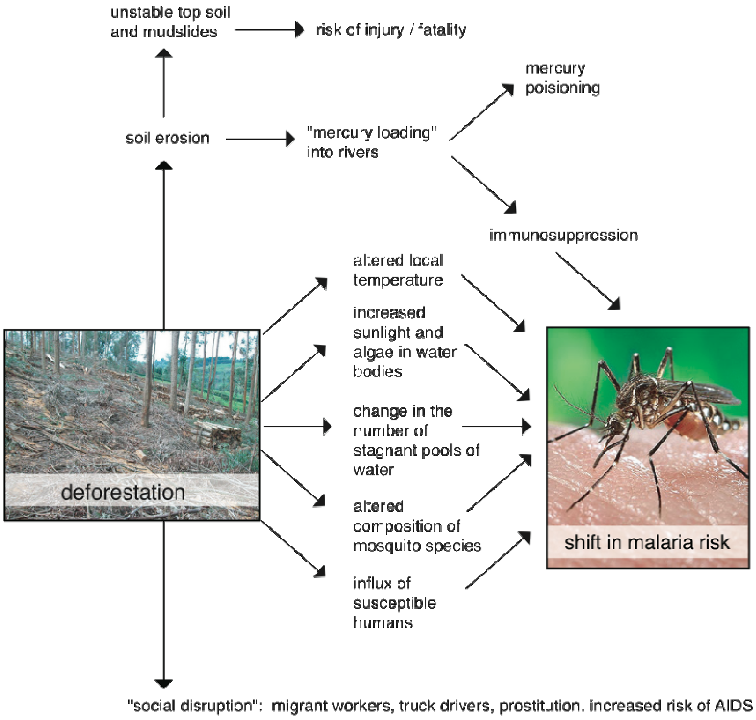
Mining activities have produced Mn levels in the air that considerably exceed international guidelines (5.86 µg/m3 in 2005 and 1.5 µg/m3 in 2009) compared with 0.05 µg/m3 as recommended by US-EPA. Consequently adverse health impacts among children and adults have been documented). These effects range from reduced motor skills to impairment in IQ levels and learning capacity. (Santos Burgoa et al. 2001, Rodríguez Agudelo et al. 2005; Riojas-Rodríguez et al. 2010).

Oil Extraction in Amazonia: As a consequence of oil extraction, an estimated 5 million gallons of untreated toxic waste is discharged into the environment each year just from routine maintenance activities at over 300 producing wells in the Amazon (Almeida 2000). Each well produces an average of 4,000 m^3 of drilling waste including drilling muds, petroleum, natural gas and formation water. These are stored in open, unlined waste pits [Kimerling 1991, Jochnick et al. 1994]. An additional source of contamination comes from dumping sludge and formation waters into local water sources. Among the most toxic of these are the BTEX group, including benzene and ethylbenzene, polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs). Heavy metals used in drill mud and extracted from beneath ground also pose health risks when they are dumped into rivers or stored in waste pits.

Air pollution is also prevalent in areas surrounding production sites, where gas flares burn continuously. At separation facilities, roughly 53 million cubic feet of 'waste' gas is burned daily without temperature or emissions control, and contaminants from the flares pollute the air. Additional air contamination may come from hydrocarbons emitted from standing oil slicks found in waste pits or from spills [Hurtig, San Sebastian 2002].

Non Communicable Diseases:

Aside from the occupational and environmental exposures to toxic agents mentioned above, the figure below shows the difficulty in separating infectious and non-infectious disease consequences from ecosystem disturbance. For example, although deforestation can alter mosquito biodiversity resulting in enhanced transmission of malaria, it can affect human health by other pathways, including soil erosion and subsequent toxic mercury contamination in rivers, as well as social disruption by an immigrant workforce (see figure).



The complex web of interdependence between ecosystems and human health. There is difficulty in selecting the proper "dose-response" relationships. Ecosystem services, in this case, malaria risk reduction and prevention of mercury contaminated waters and mudslides are difficult to quantify until the ecosystem has been disturbed.

3. Infectious Diseases

Infectious Diseases:

Worldwide events, including biodiversity loss and climate change, are associated with increased risk to humans from **infectious diseases**. Agricultural expansion into formerly natural areas increases contact among humans, domestic animals and wildlife. One result is the greater likelihood of pathogen transfer. Changes to the distribution of disease vectors and to the ecology of existing diseases, and can accelerate the spread of invasive species. Disturbance to woodlands through deforestation and subsequent land use change has resulted in the loss of many functions provided by forests, including disease regulation. While forest cover produces diverse pathogens, it also serves to maintain the ecology of such diseases through a greater diversity of hosts, reservoirs, vectors, predators and competitors. These can dilute the effect of any one pathway that transmits a disease.

A host of other impacts on infectious disease exposure due to land use change have been documented. In South America, the transition from forested land to cereal production led to sharp rises in rodent populations which, in turn, caused epidemics of hemorrhagic fever (Mills & Childs, 1998). Agricultural practices in upland Belize led to runoff of nitrogen and phosphorus into downstream aquatic systems which, in turn, caused a change in the vegetation pattern that favored the more efficient malaria vector *Anopheles vestipennis* over the less efficient vector *A. albimanus* (Rejmankova et al. 2006).

Malaria is expanding in Amazonia where deforestation has been shown to provide suitable breeding sites for *Anopheles darlingi*. In deforested areas breeding sites produce much higher *A. darlingi* biting rates, even after controlling for human population density (Vittor et al., 2006). In Manaus, the expansion of the suburbs into the surrounding jungle has led to an increase in malaria (Tadei, 1998). Malaria risk during a 2006 epidemic in Brazil jumped nearly 50% in newly deforested health districts, but only 4% over the preceding decade (Olson et al. 2010).

<u>4. Medicines and cultural well-being</u>

Traditional and Modern Medicines

The loss **of traditional knowledge** through the displacement of indigenous cultures, and the loss of species through land use change and overharvesting, continue to pose a significant threat to people's health and well-being. It is estimated that at least 89 plant-derived drugs used in Western medicine were originally discovered through traditional knowledge (Farnsworth, 1985). Preservation of intellectual property rights remains problematic for many indigenous cultures. Its loss arises not only through the transfer of traditional knowledge, innovation and practices to the public domain but also through unauthorized access to and appropriation of such knowledge.

Mental and Physical Health and Cultural Well-being

Research has identified human health benefits derived from contact with nature, particularly within urban settings (Maller et al. 2008). Commonly described benefits include increased physical activity and decreased stress. Recent research is demonstrates synergistic physical and mental health improvement through participation in "green exercise" (Pretty et al. 2005). The richness and diversity of vegetation and wildlife present within urban green spaces may elicit greater human health benefits. Stronger feelings of reflection, relaxation and emotional attachment (all associated with better mental health) have been recorded by visitors to green spaces with greater biodiversity and species richness. This suggests that bushland conservation and the quality and complexity of urban green spaces may significantly enhance human well-being (Fuller et al. 2007).

Threats to Indigenous Cultures
Due to its remoteness, the cultural and ethnic diversity still to be found in the Amazonian lowlands is staggering, yet it is extremely imperiled. Elsewhere, cultural diversity has usually not been so much at risk in instances of energy development or resource extractive projects. However, the situation of indigenous people in the Amazon is very different from much of the developed world. Thus it is extremely important to adapt traditional health-assessment methodology in order to take into account the full range of health consequences of any development project.

BOX 2 Health and Biodiversity Inter-linkages in support of the Aichi Biodiversity Targets

At its tenth meeting, the Conference of the Parties (COP) adopted, in decision X/2, the Strategic Plan for Biodiversity 2011-2020 with 20 global targets, known as the Aichi Biodiversity Targets, to guide national and international efforts to conserve biodiversity. While all the Targets have potential linkages to health and well-being, Target 14 focuses explicitly on ecosystem services that contribute to health, livelihoods and well-being.

Actions that support implementation of the Aichi Biodiversity Targets provide opportunities to improve global human health and ecosystem health. By mainstreaming biodiversity in close collaboration with the health sector, we will better understand these complex linkages, promote co-benefits through jointly developed policies and delivered activities, and improve future activities through collaborative monitoring. A summary list of health issues and corresponding Aichi Biodiversity Targets can be found in the table below.

Inter-disciplinary research is aiming to develop a more thorough understanding of the fundamental inter-linkages between ecosystem services and the conditions under which health and environment co-benefits can be achieved, as well as the development of robust predictions of the health impacts of different approaches to ecosystem management.

Human health and biodiversity co-benefits can be considered in a variety of contexts, such as, *inter alia*:

- Ecosystem integrity, changes to biodiversity and vector-borne diseases;
- Drinking water, ecosystem change and restoration, and water-related diseases;
- Non-communicable diseases, lifestyle and diet changes, and biodiversity conservation;
- Traditional knowledge, nutrition, poverty reduction and biodiversity conservation; and
- Climate change, ecosystem change, biodiversity conservation and human health impacts.

1. Our fundamental reliance on biodiversity and ecosystem services offers significant opportunities to more consistently recognize and manage biodiversity's services for human health and to contribute to biodiversity conservation and sustainable use at all scales.

Summary Table of Health and Biodiversity Interlinkages in support of the Aichi Biodiversity Targets

Health Topic	Health Sector Opportunity	Benefits to Biodiversity (Aichi Targets)
1. Food • Species, varieties and breeds including domesticated and wild components • Diversity of diet • Ecology of production systems • Total demand on resources	Direct • Recognize and promote dietary diversity, food cultures and their contribution to good nutrition • Recognize synergies between human health and sustainable use of biodiversity (e.g. moderate consumption of meat) *Indirect* • *Promote sustainable production harvesting and conservation of agricultural biodiversity*	T1 (values of biodiversity) T4 (sustainable production and consumption) T5 (reduce habitat loss) T6 (sustainable harvesting) T7 (sustainable management) T13 (genetic diversity) T14 (ecosystem services)
2. Water • Water quantity • Water quality • Water supply	Direct • Integrate ecosystem management considerations into health policy *Indirect* • *Promote protection of ecosystems that supply water and promote sustainable water use*	T1 (values of biodiversity) T5 (reduce habitat loss) T8 (reduce pollution) T9 (invasive alien species) T11 (protected areas) T14 (ecosystem services)
3. Diseases • Disease source and regulation services • Ecosystem integrity and diversity	Direct • Integrate ecosystem management considerations into health policy *Indirect* • *Promote ecosystem integrity*	T1 (values of biodiversity) T2 (poverty reduction strategies) T5 (reduce habitat loss) T8 (reduce pollution) T9 (invasive alien species) T14 (ecosystem services)

4. Traditional and Modern Medicine • Traditional medicines • Drug development (genetic resources and traditional knowledge) • Chemical/ pharmaceutical accumulation in ecosystems	Direct • Recognize contribution of genetic resources and traditional knowledge to medicine • Recognize and monitor impacts of drug accumulation (human, veterinary and agricultural sources) on ecosystems. *Indirect* • *Protect genetic resources and traditional knowledge and ensure benefit sharing*	T1 (values of biodiversity) T5 (reduce habitat loss) T13 (genetic diversity) T14 (ecosystem services) T16 (Nagoya Protocol) T18 (local/traditional knowledge)
5. Physical, mental and cultural well-being • Physical and mental health • Cultural/spiritual enrichment	Direct • Integrate 'value of nature' into health policy including mental health and non-comm. diseases *Indirect* • *Promote protection of values, species and ecosystems*	T1 (values of biodiversity) T2 (poverty reduction strategies) T11 (protected areas) T12 (preventing extinctions) T13 (genetic diversity) T14 (ecosystem services) T18 (local/traditional knowledge)
6. Adaptation to climate change • Ecosystem resilience • Genetic resources ('options' for adaptation)	*Indirect* • *Promote ecosystem resilience and conservation of genetic resources*	T1 (values of biodiversity) T3 (reduce negative subsidies) T5 (reduce habitat loss) T8 (reduce pollution) T10 (vulnerable ecosystems) T14 (ecosystem services) T15 (ecosystem resilience)

Cross-cutting: Target 17 (national biodiversity strategies and action plans), Target 19 (knowledge, science and technology) and Target 20 (resource mobilization).

<u>Tools and Methods for Assessing Ecosystem Change Effects on Human Health</u>

Now that links between ecosystem change and human disease have been demonstrated in many settings, there is a growing need for new tools and methods to detect such links more comprehensively and to characterize them so as to guide policy development and strategies to alleviate emerging health problems and better understand biodiversity and human health linkages. Two categories of tools are especially valuable.

Analytical tools are needed to improve understanding of the links between ecological change and the emergence of infectious diseases or changes in their patterns. These tools, which are usually applied in combination, include time-series analyses, geographic information systems, and other forms of spatial analyses that use digital mapping, analysis of remotely sensed imagery, spatial statistics, or ecological niche modeling.

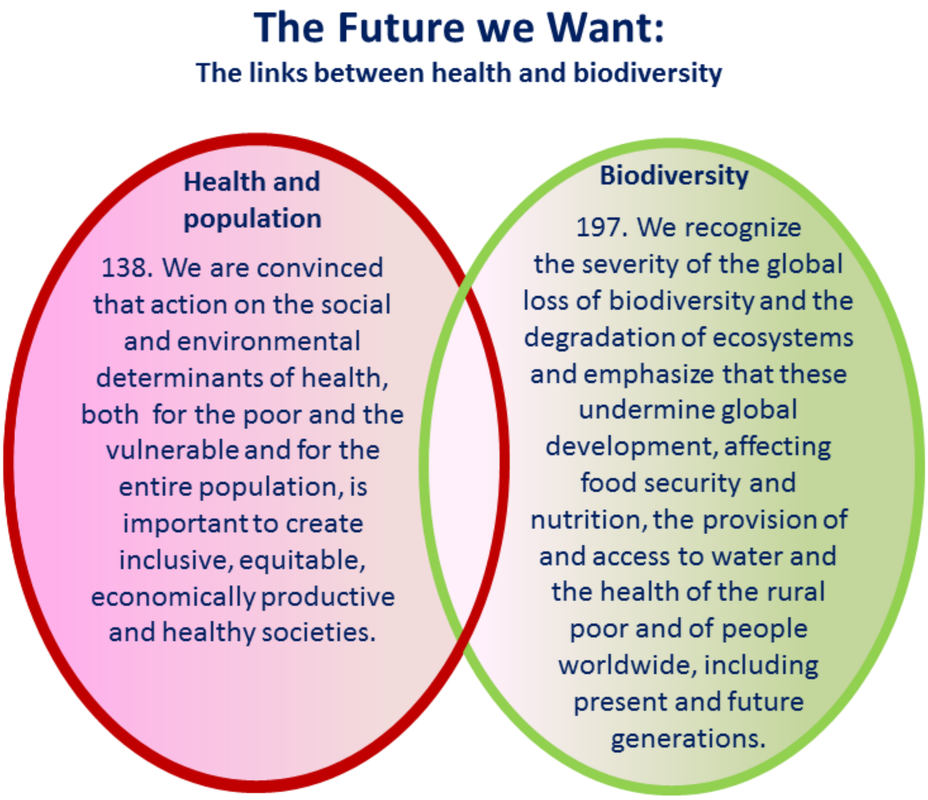
Infrastructural tools, such as developments in informatics capabilities. These are extremely important to the application of analytical tools. In addition, informatics capacities for the delivery and deployment of more "upstream" (and therefore anticipatory) health-relevant data from a broad range of key information sources —biodiversity, socio-economic, and medical/public health — are needed to build a comprehensive picture of ecological drivers of human disease.

Institutional Frameworks

Internationally, *Agenda 21* and the *Rio Declaration on Environment and Development* describe a comprehensive approach to ecologically sustainable development that incorporates cross-sector policies, many of which are relevant to human health. These include:

- Integrated action for health, such as a *health impact assessment* of major development projects, policies, and programs, and indicators for health and sustainable development;
- Inclusion of health in sustainable development planning efforts, such as *Agenda 21*, in multilateral trade and environmental agreements, and in poverty reduction strategies;
- Improvement of cross-sector collaboration between different tiers of government, government departments, and NGOs; and
- International capacity-building initiatives that assess health and environmental linkages and use the knowledge gained to create more effective national and regional policy responses to environmental threats.

The more recent United Nations Conference on Sustainable Development in June 2012, better known as the Rio +20 Conference, resulted in the agreed outcome document, titled *The Future We Want*, which makes specific reference to issues in biodiversity and health which need our urgent attention. Paragraph 30 of the document states that: "we recognize that many people, especially the poor, depend directly on ecosystems for their livelihoods, their economic, social and physical well-being, and their cultural heritage. For this reason, it is essential to generate decent jobs and incomes that decrease disparities in standards of living in order to better meet people's needs and promote sustainable livelihoods and practices and the sustainable use of natural resources and ecosystems". In the section on Health and Population, it is made clear the need to protect the environment for the health of populations, in particular the poor and vulnerable. In the section on Biodiversity, associations are made about biodiversity changes and health, either directly or through adverse changes in ecosystem services such as food and water (figure 3 below).



The Future we Want can be accessed at:
http://daccess-dds-ny.un.org/doc/UNDOC/LTD/N12/436/88/PDF/N1243688.pdf?OpenElement

Pre-Workshop Preparation and Expected Workshop Outcomes

While recommendations from previous assessments have been synthesized and are listed in Annex 3, participants should work to identify next steps for each of their respective countries and the region as a whole both prior to and during the workshop.

Participants are requested to reflect on the questions below to prepare a 4-5 minute presentation to be delivered at the regional workshop:

1) What joint actions could the health and biodiversity sectors take at the national level in order to develop policies and promote activities that try to achieve co-benefits for human health and biodiversity?

2) What would be the key elements for a joint human health and biodiversity action plan? At what scale (local, sub-national, national, regional and global) do you think that this would this be most effective?

3) What is needed, at the national and regional scales, in terms of research, capacity building and information dissemination for joint human health and biodiversity sector actions?

4) What, if any, are the best practices in your country that jointly address human health and biodiversity concerns and opportunities?

5) What collaborative mechanisms/examples currently exist within your country or region for cross-sector human health and biodiversity collaboration? How can we promote further collaboration? What impedes collaborative action?

6) What actions for human health and biodiversity are needed as a matter of urgency (1 year); medium term (2- 5 years); and in the long term (6 – 8 years)?

Appendix (attached or hyperlinked Reports)

Annex 1: CBD Strategic Plan

Annex 2: Our Planet, Our Health, Our Future

Annex 3: Recommendations: a synthesis across recent reports on ecosystem services and health

Annex 4: Ecosystems and Human Well-being: Health Synthesis

Annex 5: Drinking Water, Biodiversity and Development

Annex 6: EcoHealth (Merida Declaration) 2008.

Key References

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