



Contribution of Biodiversity to Sustainable Development Goals

A contribution of **DIVERSITAS** (international programme of biodiversity science) and **ICSU** (International Council for Science)

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Executive summary

We provide three key recommendations on the importance of integrating biodiversity in the development of Sustainable Development Goals (SDGs), and examples of biodiversity-related targets.

Key recommendation 1

To develop biodiversity-related targets for SDGs related to the different determinants of human well-being such as food, health, water, energy.

Key recommendation 2

To integrate biodiversity-related issues into the SDGs related to enabling processes for human well-being such as governance systems, equity, measures of growth.

Key recommendation 3

To develop a set of targets to ensure the conservation of intrinsic value of biodiversity and its role in the maintenance of the Earth "life-support system" as part of an SDG on biodiversity and ecosystems.

Context

Biodiversity is the variety of genes, species and ecosystems including a wealth of ecosystem functions and processes. Biodiversity is at the foundation of Earth's life support systems on which past and current human generations have depended, and on which future generations will depend. It yields direct and indirect benefits that support human and societal needs of poorer and richer nations, such as health, food, water, energy, climate regulation, etc.¹ (Figure 1), and provides an environmental adaptive capacity that secures current and future generations from impacts of global change. Biodiversity is, by excellence, a cross-cutting issue of all dimensions of human well-being.

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Abundant and increasing evidence shows that the replacement of biodiversity and ecosystem services by advanced technologies is generally partial, costly or has secondary impacts that are detrimental to human welfare. Its persistence is therefore of primary interest for humanity.

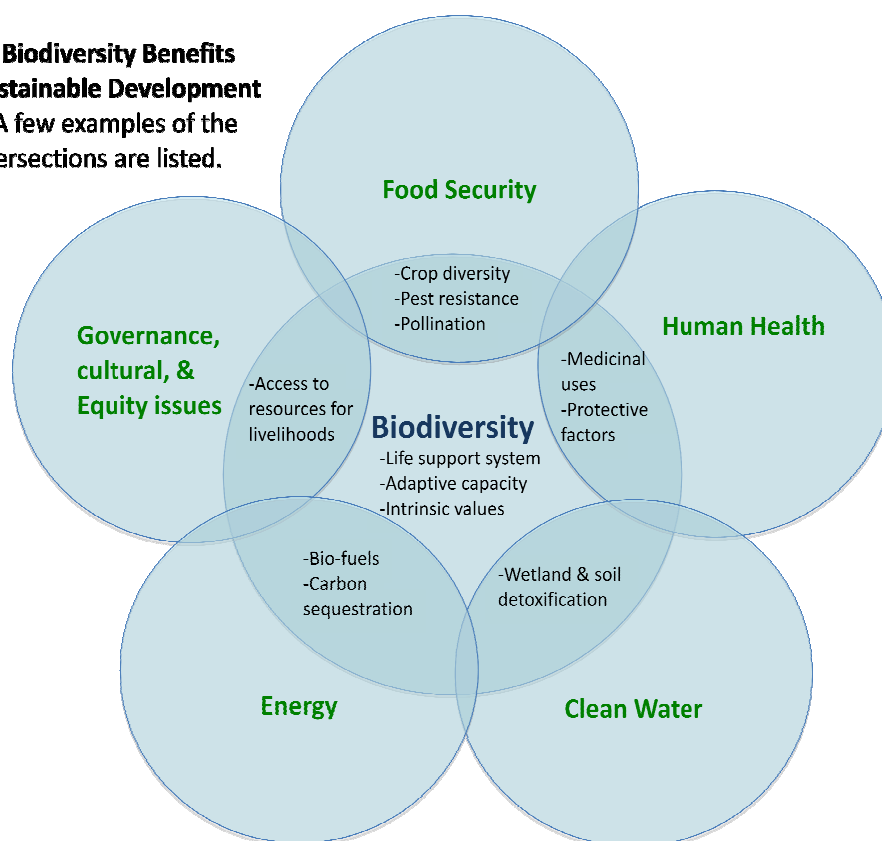
The properties of biodiversity have three consequences for the development of Sustainable Development Goals (SDGs):

- 1) Biodiversity-related targets need to be defined for most – if not all – of the SDGs related to the different determinants of human well-being.
- 2) Biodiversity-related targets need to be defined for SDGs related to enabling processes for human well-being such as governance systems and equity.
- 3) An SDG needs to account for the underpinning role of biodiversity in our "life support systems" and its intrinsic value.

This paper is consistent with and supportive of the proposals in the Technical Support Team Issues Brief on Biodiversity (2013).

In the sections below, we give generic goals, examples of targets, and provide some scientific rationales on how biodiversity contributes to the SDGs agenda.

Figure 1: Biodiversity Benefits Other Sustainable Development Targets. A few examples of the many intersections are listed.



1. Goals related to secure human well-being determinants

Ensure food security and nutrition

Agriculture –It is increasingly clear that the solutions of agricultural sustainability rely on the persistence of biodiversity², since biodiversity improves both food production and nutritional value. Soil biodiversity underpins soil fertility³ and crop pollinators (bees and other insects) support global food production for fruit, vegetable or seed⁴. Forested riparian corridors improve water quality for irrigation and reduce soil erosion⁵. New breeds of livestock, varieties of crops, drug-resistant crops, and biological control agents

are provided by biodiversity. Biodiversity diversifies diets by providing a variety of food sources and nutrients^{6,7}.

Fisheries – Fish and fishery products provide diversified and healthy diets and many populations in developing countries have a daily consumption of fish⁸. A plethora of organisms of no apparent utilitarian value are key in sustaining fisheries. For instance, seagrass provide shelter of larval and juvenile stages of species of commercial interest⁹. The current rates of overexploitation depletes commercial fish stocks at alarming rates and poses unprecedented challenges to fisheries management¹⁰. The persistence of non-food species and ecosystem processes is a prerequisite to sustaining the supply of species of commercial interest.

Example of target:

- *Targets could be derived from the Aichi Biodiversity Targets 6 (management of marine stocks) and 7 (management of agriculture, aquaculture and forestry)*
- *Increase biodiversity in agricultural landscapes at multiple scales to improve resilience of agricultural landscapes*
- *Maintain fishing effort within safe ecological limits (within Multi-species maximum sustainable yield)*

Ensure water security

Healthy and well-functioning freshwater ecosystems (e.g. wetlands and streams) support important environmental functions such as biological filtration, nutrients recycling, and protection against nutrient pollutions. For example, algae diversity supports the uptake and storage of nitrate, a nutrient pollutant of global concern¹¹. Higher microbial diversity diminishes the populations of pathogenic bacteria causing diarrhea¹². Water security is also enhanced through water use efficiency and efficient storage in aquifers, both provided by healthy biodiverse soils.

Example of target: *Maintain hydrological flows in ecosystems without crossing ecological boundaries.*

Ensure good health

Biodiversity provides genetic resources necessary to develop antibiotics, vaccines and biotechnological solutions for modern and traditional medicine¹³. Most commonly-used antibiotics are natural or derived from natural compounds (e.g. antimalarial treatment is derived from fungi¹⁴). Three-fourths of the world's population depends on a wide range of botanical and animal-origin traditional medicines (e.g. substances from *Ginkgo biloba*⁶).

Biodiversity loss can also increase infectious disease risk¹⁵. For instance, some research suggests that maintaining intact biodiversity-rich habitats protects humans from being exposed to diseases carried by wildlife. Conversion of native forests for food production or resource extraction, and intensified farming increase mechanisms for human-wildlife contact, which in turn increase infectious disease risk¹⁶.

Indirect health-supporting benefits of biodiversity are related to food security and nutrition, provision of clean water, climate change mitigation through biodiversity's contribution to healthy ecosystems.

The reliance of human health on biodiversity illustrates why a biodiversity-related SDG is warranted (see below).

Example of target: *By 2020, incorporate disease risk analyses into environmental and health impact assessments of development projects.*

2. Goals related to enabling processes for human well-being

Transform governance for sustainable development

Institutions at national and local are important governance levels for natural resources management. However some aspects of the management of biodiversity and large-scale ecosystem processes need to be undertaken at a larger scale to account for ecosystem functions. For example, water supply has to be managed at the scale of a river basin including up- and down-stream processes. There is a need to develop bridging institutions to solve mismatches between human decisions and ecological scales.

Individual values and beliefs are drivers of individual and society decisions, and governance systems should account for these too. Trade-offs between values will also need to be assessed. For example, traditional food systems and their associated cultures are important drivers of land- and sea-use, and may compromise other ecosystem services, which may have a higher value for other societies.

Given the above, the post-2015 development framework should promote the design and development of bridging institutions accounting for spatial, temporal, and functional fit in managing multiple ecosystem services (including provisioning, supporting and regulating).

Achieve social inclusion and equity

Many cultures and peoples ascribe intrinsic values to biodiversity for spiritual, aesthetic, recreational, and other cultural reasons¹. In addition, values are representations of the intensity of preference by individuals for their social, natural and material worlds. These values guide decisions and are influenced by a series of factors including culture, education, gender, social interactions, economy, among others¹⁷.

Example of target: Promote knowledge on cultural, ethical and spiritual values of biodiversity, and mainstream its relation to human wellbeing.

Achieve development and promote socio-economic wealth

The present economic growth paradigms focus on the flows of goods and services required for well-being. However the underlying natural capital (i.e. biodiversity and natural resources) are not taken into account although it is rapidly deteriorating. Maintenance of- and accounting for natural capital as well as human (e.g. education and health) and produced capitals (e.g. buildings and roads) are critical if sustainability is to be an integral part of economic planning. This is the purpose of the inclusive wealth framework¹⁸.

Given the above, the post-2015 development framework should provide for the use of inclusive wealth accounting into measures of overall socio-economic progress.

3. Targets that relate to ensure the conservation of the intrinsic value of biodiversity and maintain its role in the Earth "life-support systems"

These may be grouped under a Goal such as "Biodiversity, and healthy and productive ecosystems"

Maintain and restore healthy and biologically diverse soils

Soils are mixtures of non-organic components, organic matters and living organisms. Soil biodiversity is essential to many soil functions and processes, such as nutrient cycling, soil formation, bioremediation of chemical pollutants and pest regulation¹⁹. These soil

functions and processes ensure stability to stress (e.g. drought, flood) and disturbance (e.g. fire), sequestration of carbon, water and nutrient use efficiencies, and overall improves agricultural sustainability²⁰. The main drivers of soil loss and degradation are unsustainable agricultural practices (e.g. use of chemical fertilisers from conventional agricultural methods) and land degradation (e.g. deforestation).

Targets could be derived from the Aichi Biodiversity Target 15: Restore at least 15% of degraded land to enhance biodiversity and contribute to carbon sequestration, climate adaptation, and combat desertification.

Maintain and restore of a healthy and productive marine environment

Oceans and seas provide food, fragrances, enzymes, medicines, etc. Marine biodiversity also plays a key role in functions such as carbon sequestration, nutrient cycling, and climate regulation. All of these are determinant in regulating the environmental functions of the Earth and maintain the resilience of marine ecosystems to current and future environmental changes. For example, phytoplankton accounts for nearly 50% of global carbon fixation and is at the bottom of the ocean food chain²¹. Targets for oceans and seas will have to address the direct and indirect drivers of marine biodiversity degradation e.g. unsustainable practices causing overfishing, habitat loss and degradation, global warming and acidification, and anoxia and pollution²².

Targets could be derived from the Aichi Biodiversity Target 11 (10% of coastal and marine areas to be protected), and Aichi Biodiversity Target 6 is relevant too.

Maintain the evolutionary capacity of species

All services and benefits humans derive from organisms and their communities are the product of past evolution. Evolution is an on-going process and organisms need to evolve if they are to persist in changing environments. Genetic diversity within species confers this evolutive capacity. Genetic diversity provides benefits, such as protection from pathogens and crop production stability in the face of environmental change. For example, rice production in China benefits from genetically-diverse rice plantations by preventing pathogens from specialising on any single type of rice²³. In addition, many organisms exist that could provide benefits to humans (e.g., drug discovery) that have yet to be identified. Then preserving genetic diversity means preserving options for the future.

Example of target: By 2020, genetic diversity among groups of organisms is maintained by preserving evolutionarily distinctive species and distinctive populations within species.

Maintain or restore the protective functions of ecosystems

Biodiversity provides protection and mitigation solutions to environmental changes such as climate change, environmental disasters (e.g. flood, tsunami, diseases outbreaks). For instance, mangroves and coral reefs ensure coastal protection; and forests protect from landslide, especially in mountainous region. The combination of the increase in extreme climatic events and coastal degradation and deforestations have had disastrous economic and human aftermaths over the past decade.

Targets could be derived from the Aichi Biodiversity Targets 5 (halving or stopping the rate of loss of natural habitats) and 14 (restore and safeguard ecosystems providing essential ecosystem services).

References

- 1 Millennium Ecosystem Assessment, 2005.
- 2 FAO and Platform for Agrobiodiversity Research, (2011).
- 3 J. R. McNeill and Verena Winiwarter, *Science* **304** (5677), 1627 (2004).
- 4 A. M. Klein, B. E. Vaissiere, J. H. Cane et al., *Proceedings of the Royal Society B-Biological Sciences* **274** (1608), 303 (2007).
- 5 L. E. Jackson, U. Pascual, and T. Hodgkin, *Agriculture Ecosystems & Environment* **121** (3), 196 (2007).
- 6 P. Bridgewater, Mathieu Régnier, and Wang Zhen, Guide, 2012.
- 7 FAO, 2010b; FAO and Platform for Agrobiodiversity Research, 2010a.
- 8 FAO, 2012.
- 9 L. C. Scott, J. W. Boland, K. S. Edyvane et al., *Environmetrics* **11** (5), 541 (2000).
- 10 Philippe Maurice Cury, Yunne-Jai Shin, Benjamin Planque et al., *Trends in Ecology & Evolution* **23** (6), 338 (2008).
- 11 Bradley J. Cardinale, *Nature* **472** (7341), 86 (2011).
- 12 S. Blumenfeld, C. Lu, T. Christophersen et al., 2009.
- 13 A. T. Bull, A. C. Ward, and M. Goodfellow, *Microbiol. Mol. Biol. Rev.* **64** (3), 573 (2000).
- 14 G. Nagaraj, M. V. Uma, M. S. Shivayogi et al., *Antimicrob. Agents Chemother.* **45** (1), 145 (2001).
- 15 Felicia Keesing, Lisa K. Belden, Peter Daszak et al., *Nature* **468** (7324), 647 (2010).
- 16 W. B. Karesh, A. Dobson, J. O. Lloyd-Smith et al., *Lancet* **380** (9857), 1936 (2012).
- 17 Sebastian Bamberg and Guido Möser, *Journal of Environmental Psychology* **27** (1), 14 (2007).
- 18 UNEP and UNU-IHDP, 2012.
- 19 M. Pulleman, R. Creamer, U. Hamer et al., *Current Opinion in Environmental Sustainability* **4** (5), 529 (2012).
- 20 L. Brussaard, P. C. de Ruiter, and G. G. Brown, *Agriculture Ecosystems & Environment* **121** (3), 233 (2007).
- 21 Stephen J. Giovannoni and Ulrich Stingl, *Nature* **437** (7057), 343 (2005).
- 22 Paul G. Harnik, Heike K. Lotze, Sean C. Anderson et al., *Trends in Ecology & Evolution* **27** (11), 608 (2012).
- 23 Y. Y. Zhu, H. R. Chen, J. H. Fan et al., *Nature* **406** (6797), 718 (2000).