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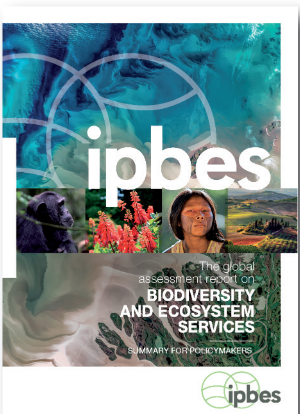
Agriculture and biodiversity

In 2019, IPBES published its "Global Assessment report on Biodiversity and Ecosystem Services"[1], the first global assessment of this kind in almost 15 years and the first ever carried out by an intergovernmental body. It identifies key drivers of change in nature, its societal implications and possible actions that can be taken to address these changes.

Since the Intergovernmental Assessment of Agricultural Science and Technology for Development (IAASTD) was published ten years ago there has been a significant increase in our scientific understanding of how agricultural practices have affected biodiversity and how the loss of biodiversity is impacting agriculture. The evidence is unequivocal that most agricultural practices are unsustainable and have been a major driver of the loss of terrestrial biodiversity (IPBES 2019.

Trends in nature's contributions to people[2] and how they are affected by biodiversity loss

People depend on nature, and while some core contributions of nature have increased, the global assessment of IPBES found that most of nature's contributions are in decline. Nature plays a critical role in providing many material goods, and, since 1970, agricultural production, fish harvest, bioenergy production and harvest of materials have increased (IPBES 2019: 2.3.5). The value of agricultural crop production, $2.6 trillion in 2016, has increased approximately threefold since 1970, and raw timber harvest has increased by 45 per cent, reaching some 4 billion cubic meters in 2017, with the forestry industry providing about 13.2 million jobs (FAO 2019). In addition, nature, through its ecological and evolutionary processes, sustains the quality of the air, fresh water and soils on which humanity depends, distributes fresh water, regulates the climate, provides pollination and pest control and reduces the impact of natural hazards (IPBES 2019: 2.3.1). However, most of these regulating contributions of nature, as well as its non-material contributions – inspiration and learning, physical and psychological experiences, and supporting identities – are in decline (IPBES 2019: 2.3.5). Declines in 14 of the 18 categories of nature's contributions to people evaluated (Figure 1) indicate that gains in material contributions are often not sustainable. For example, land degradation has reduced productivity in 23 per cent of the global



terrestrial area (IPBES 2018), and between $235 billion and $577 billion in annual global crop output is at risk as a result of pollinator loss (IPBES 2016). Moreover, declines in the diversity of nature reduce humanity's ability to choose alternatives in the face of an uncertain future.

Biodiversity is particularly important for agriculture, and declines in biodiversity threaten agriculture in a variety of ways (IPBES 2019: 2.2.3.4.3). For example, more than 75 percent of global food crop types, including fruits and vegetables and some of the most important cash crops, such as coffee, cocoa and almonds, rely on animal pollination (IPBES 2016). Globally, local varieties and breeds of domesticated plants and animals are disappearing (IPBES 2019: 2.2.5.2.6). This loss of diversity in cultivated crops, crop wild relatives and domesticated breeds poses a serious risk to global food security by undermining the resilience of many agricultural systems to threats such as pests, pathogens and climate change. Fewer and fewer varieties and breeds of plants and animals are being cultivated, raised, traded and maintained around the world, despite many local efforts, which include those by indigenous peoples and local communities (IPBES 2019: 2.2.4). By 2016, 559 of the 6,190 domesticated breeds of mammals used for food and agriculture (over 9 per cent) had become extinct and at least 1,000 more are threatened (FAO 2016). In addition, the conservation status of wild relatives of domesticated mammals and birds is worsening, and many crop wild relatives that are important for long-term food security lack effective protection.

Land degradation has reduced productivity in 23 per cent of the global terrestrial area.

There are often trade-offs in the production and use of nature's contributions (IPBES 2019: 2.3.5). Giving priority to the production of food, feed, fiber and bioenergy can result in ecological changes that reduce other contributions of nature to quality of life, including regulation of air and water quality, climate regulation and habitat provision, as well as non-material contributions. Synergies also exist, such as sustainable agricultural practices that enhance soil quality, thereby improving productivity and other ecosystem functions and services such as carbon sequestration and water quality regulation. In addition, benefits and burdens associated with the production and use of nature's contributions to people are often distributed unequally across space and time and among different segments of society, social groups, countries and regions. Some of these tradeoffs may benefit some people at the expense of others, particularly the most vulnerable, as may changes in technological and institutional arrangements. For example, although food production today is sufficient to satisfy global needs, approximately 11 per cent of the world's population is undernourished, and diet-related disease drives 20 per cent of premature mortality, related both to undernourishment and to obesity (FAO 2017).

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Figure 1. Global trends in the capacity of nature to sustain contributions to good quality of life from 1970 to the present, which show a decline for 14 of the 18 categories analyzed. Data supporting global trends and regional variations come from a systematic review of over 2,000 studies (IPBES 2019: 2.3.5.1). For many categories, two indicators are included that show different aspects of nature's capacity to contribute to human well-being. Figure from IPBES 2019 [1].

Most of nature's contributions are co-produced with people, but while anthropogenic assets – knowledge and institutions, technology, infrastructure and financial capital – can enhance or partially replace some of those contributions, some are irreplaceable (IPBES 2019: 2.3.2). Loss of diversity, such as phylogenetic and functional diversity, can permanently reduce future options, such as wild species that might be domesticated as new crops and be used for genetic improvement (IPBES 2019: 2.2.3.4.3). People have created substitutes for some contributions of nature, but many of these are imperfect or financially prohibitive (IPBES 2019: 2.3.2). For example, high-quality drinking water can be achieved either through ecosystems that filter pollutants or through human-engineered water treatment facilities. Similarly, coastal flooding from storm surges can be reduced either by coastal mangroves or by dikes and sea walls. In both cases, however, built infrastructure can be extremely expensive, incur high future costs and fail to provide synergistic benefits such as nursery habitats for edible fish or recreational opportunities. More generally, human-made replacements often do not provide the full range of benefits provided by nature.

Agriculture, biodiversity and climate change

Agriculture is a key driver of global changes in nature over the past 50 years, as discussed in IAASTD (IAASTD 2009). The direct drivers of changes in nature with the largest global impact have been (starting with those with most impact): changes in land and sea use, including agriculture; direct exploitation of organisms; climate change; pollution; and invasion of alien species (IPBES 2.2.6). Those five direct drivers result from an array of underlying causes – the indirect drivers of change – which are in turn underpinned by societal values and behaviors that include production and consumption patterns, human population dynamics and trends, trade, technological innovations and local through global governance (IPBES 2019: 2.1).

The average per capita consumption of materials (e.g., plants, animals, fossil fuels, ores, construction material) has risen by 15 per cent since 1980 (IPBES 2019: 2.1). Producing, consuming and disposing of these materials has generated unprecedented impacts (IPBES 2019: 2.1): since 1980, greenhouse gas emissions have doubled, raising average global temperatures by at least 0.7 degrees Celsius, while plastic pollution in oceans has increased tenfold. Over 80 per cent of global wastewater is being discharged back into the environment without treatment, while 300–400 million tons of heavy metals, solvents, toxic sludge and other wastes from industrial facilities are dumped into the world's waters each year. Excessive or inappropriate application of fertilizer can lead to run off from fields and enter freshwater and coastal ecosystems, producing more than 400 hypoxic zones which affected a total area of more than 245,000 km^2 as early as 2008. The rate of change in the direct and indirect drivers differs among regions and countries.

While, globally, climate change has not been the most important driver of the loss of biodiversity to date, it is projected to be as, or more, important than the other drivers in the coming decades (IPBES 2019: 2.1.17). In addition, climate change will interact with other drivers, exacerbating their impact. Climate change adversely affects genetic variability, species richness and populations, and ecosystems. In turn, loss of biodiversity can adversely affect climate, for example, deforestation and conversion of grasslands and mangroves increases the atmospheric abundance of carbon dioxide. Climate change, through changes in temperature, precipitation and pests, also has an adverse impact on agricultural production. Therefore, the issues of climate change, loss of biodiversity and agriculture must be addressed together.

Limiting human-induced climate change requires transitioning to a low-carbon economy as rapidly as possible, and not just from the energy sector. It is critical that agricultural emissions, particularly methane and nitrous oxide, are reduced. It is equally critical that agricultural production becomes more climate resilient by ensuring crops are more temperature, drought, salinity and pest resistant.

Potential solutions

We personally think that protecting and improving our environment is critical. To do so, we must engage with a broad range of people, especially indigenous and local communities. We need to understand how they are impacted and develop adaptation strategies together. A technological fix imposed from above is no solution. One key area we're passionate about is changing the food system, including removing agricultural subsidies, reducing food waste, and reconsidering diets. In addition, making the agricultural sector both more climate friendly and more climate resilient will be a huge challenge, and one we look forward to seeing a diverse community take on.

Urgent and concerted efforts are needed to address the direct drivers together with the root causes of nature deterioration, such as poor governance, unsustainable economic systems, social inequalities, lack of cross-sectoral planning and appropriate incentives, and unsustainable social narratives and values (IPBES 2019: 6).

Nature and the benefits it provides can be conserved, restored and used sustainably while simultaneously meeting other global societal goals. Feeding humanity and enhancing the conservation and sustainable use of nature are complementary and closely interdependent goals that can be advanced through sustainable agriculture, aquaculture and livestock systems, the safeguarding of native species, varieties, breeds and habitats, and ecological restoration. Specific actions include promoting sustainable agricultural practices, such as good agroecological practices, multifunctional landscape planning and cross-sectoral integrated management that supports the conservation of genetic diversity and associated agricultural biodiversity. Further actions to simultaneously achieve food security and protect biodiversity are context-appropriate climate change mitigation and adaptation actions that incorporate knowledge from various systems, including the sciences and sustainable indigenous and local practices. These practices include avoiding food waste, providing storage and transport infrastructure to limit post-harvest losses, empowering producers and consumers to transform supply chains and facilitating sustainable and healthy dietary choices. As part of integrated landscape planning and management, prompt ecological restoration emphasizing the use of native species can offset current degradation and save many endangered species, but it is less effective if delayed.

As noted earlier, there has been a world-wide decline in the populations and diversity of wild pollinators and hence pollination services (IPBES 2016). This has been accompanied by seasonal colony loss of western honey bees in some regions of the world. Therefore, it is important to maintain healthy pollinator communities through (i) agroecological farming practices, (ii) strengthening existing diversified farming systems, and (iii) investing in ecological in- frastructure by protecting, restoring and connecting patches of natural and semi-natural habitats throughout productive agricultural landscapes. These need to be complemented by reducing the risk of lethal and non-lethal effects of pesticides, particularly insecticides such as neonicotinoids, on pollinators. This could be facilitated by the use of integrated pest management. Honey bees need to be protected from a broad range of parasites, including Varroa mites, by placing greater emphasis on hygiene and control of pathogens.

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Another key set of key actions include steering away from the current limited paradigm of economic growth and the use of Gross Domestic Product (GDP) as a measure of economic growth to one which incorporates natural capital into national accounting systems, recognizes both market, non-market and social values of biodiversity in decision-making, eliminates harmful agricultural, energy and transportation subsidies, provides incentives for sustainable production and consumption, embraces a circular economy and recognizes the social costs of environmental degradation.

Recognizing the knowledge, innovations and practices, institutions and values of indigenous peoples and local communities, it is critical to ensure their inclusion and participation in environmental governance. Doing so often enhances their quality of life while promoting nature conservation, restoration and sustainable use, which is relevant to broader society. Governance, including customary institutions and management systems and co-management regimes involving indigenous peoples and local communities, can be an effective way to safeguard nature and its contributions to people, incorporating locally attuned management systems and indigenous and local knowledge. The positive contributions of indigenous peoples and local communities to sustainability can be facilitated through national recognition of land tenure, access and resource rights in accordance with national legislation, the application of free, prior and informed consent, improved collaboration, fair and equitable sharing of benefits arising from the use of resources and co-management arrangements with local communities.

Endnotes

1 See at https://ipbes.net/global-assessment

2 The IPBES global assessment predominantly used the term "nature's contributions to people," which is more inclusive than the common term "ecosystem services"

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