



Biodiversity loss is a development issue

A rapid review of evidence

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Biodiversity is a scientific term to describe the variability of life on Earth (wild and cultivated), so it is about sheer numbers and the abundance of different species, genetic variation between and within species, and the extent and variety of natural habitats and ecosystems. This diversity is being lost at increasing and alarming rates (now up to 1000 times higher than natural rates).

Why does it matter? Because humanity depends on the goods and services generated by nature, and the ability of nature to deliver these goods and services over the long term is underpinned by biodiversity. What's more, poor people are disproportionately dependent on biodiversity – both to meet day to day livelihood needs and to enhance resilience to climate change and other external stressors – so they are hardest hit by its loss, especially when coupled with climate change.

To date, biodiversity loss has been treated as an environmental problem. Yet continued biodiversity loss threatens to undermine development gains including in the areas of health, resilience, food security and GDP earnings. In this report we briefly review the evidence on the impacts of biodiversity loss from a development perspective and highlight why, if we're serious about development, we need to invest in conserving biodiversity now.

“Biodiversity crisis” or development challenge?

Scientific and popular media warns us that we are facing a “biodiversity crisis” [1] and that we are on the verge – if not already in the midst of – the sixth great extinction [2]. It has been estimated that there are up to 690 species extinctions per week globally [3]. The Living Planet Report 2018 finds that global populations of fish, birds, mammals, amphibians and reptiles declined by an average of 60% between 1970 and 2014 and projects that this could increase to 66% by 2020 [4]. While we most commonly hear about biodiversity loss in the form of extinctions of wild species of animals – particularly those that we can see, have four legs, fur or feathers – biodiversity loss also means loss of genetic resources, crop varieties, fungi and invertebrates as well as of entire ecosystems such as coral reefs. For example: a recent study in Germany [5] showed a 76% decline in total biomass of flying insects over the last 27 years; 30-50% of mangroves have been lost in last 50 years and nearly 50% of coral reefs [4].

Although attracting some media attention – although much less than climate change [6] – the biodiversity crisis is not a new discovery. The UN Convention on Biological Diversity (CBD) was agreed in 1992 in response to an already recognised crisis, and 25 years ago a stark paper warned of the danger of “Empty Forest Syndrome” [7] – seemingly healthy forests, full of trees, but increasingly devoid of any animal inhabitants. Now, improved evidence, analyses and communications, as well as ‘shock’ revelations such as the impact of plastics on ocean life and the collapse of bee colonies, have heightened awareness of the rate and scale of the degradation of nature and associated biodiversity loss. From a human development perspective, this loss has severe implications including escalating threats to food security, water security, climate change adaptation, disaster risk, pollution control and human health, not to mention reduced options for future innovations. **Biodiversity loss is an environmental crisis. But moreover, it is a major barrier to future development and risks undermining already hard-won development gains.**

“Just as development projects can jeopardize the benefits that flow from ecosystem services, changes in ecosystems can endanger project outcomes.” [8]

What is biodiversity (and what is it not)?

Part of the difficulty with understanding the significance of biodiversity loss and why it is a development challenge is the misuse and misunderstanding of the term biodiversity. The term biodiversity is, or should be, used to describe the *variety* of life. But it is often (mis)used as a collective noun for multiple wildlife species.¹ When the popular media tells stories of biodiversity loss, it most often refers to the demise of iconic wildlife species such as rhinos or orangutans, or iconic ecosystems such as the Amazon rainforest or the Great Barrier Reef. It does not refer to the loss of *diversity*. Part of the reason for this is the metrics used to measure biodiversity, the most common of which is numbers of species. There are also many other terms out there that get used interchangeably with biodiversity but are not quite the same thing (Table 1).

¹The term biodiversity was first used in 1986 as shorthand for biological diversity and then popularised by E. O. Wilson [9]. The internationally agreed definition is that contained in the text of the Convention on Biological Diversity (CBD) which describes it as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.” According to the scientific community and the CBD definition, biodiversity is a fundamental *property* of the natural world, not specific elements of the natural world itself.

Table 1: Terms that often get used interchangeably with biodiversity but are not the same thing

Biodiversity is not the same as...	
Nature	Nature refers to the natural features of the world – living and non-living – that are not created by humans: plants, animals, mountains, rivers, oceans etc. Biodiversity is the <i>variety</i> of the living components of nature.
Wildlife	Biodiversity is the variety of <i>all</i> living organisms, so it includes not just well-known wild mammals and birds, but also plants, fish, fungi, insects and micro-organisms, as well as crop and livestock varieties and landraces. Individual wildlife species are supported by diverse communities of other plants, animals, fungi and microbes.
Natural resources	Natural resources are materials or substances occurring in nature which can be exploited for economic gain. They may be renewable, and derived from living resources, such as timber, bushmeat, and firewood; or finite, and derived from inanimate sources, such as oil and gas and minerals. Biodiversity secures the long-term production of these resources.
Natural capital	Natural capital is a way of explaining the value of nature and biodiversity to economically-minded decision makers. A deliberate parallel is drawn to financial systems where stocks of financial capital generate financial flows. Similarly, natural capital is the world's stock of natural assets such as water, land, soil and wildlife, from which flow a multitude of valuable goods and services. Just as a more diverse portfolio of financial stocks is more resilient to external shocks, so is a more diverse portfolio of natural capital.
Ecosystem services	Ecosystem services are the flows of benefits which people gain from natural ecosystems. Biodiversity strengthens and sustains ecosystem services. More diverse ecosystems are more resilient and therefore more able to continue to deliver ecosystem services in the long term. In addition, biodiversity enhances the productivity and efficiency of many of these services.
Green infrastructure	Green infrastructure is a term used to describe a network of natural and semi-natural features – hedgerows, rivers, green roofs, parklands – that provide benefits to people including reducing air pollution, managing rainwater run-off, providing recreation services. Green infrastructure doesn't have to be biodiverse, but the more it is the more it will be resilient and able to continue to provide benefits.
The biosphere	The biosphere is the part of the Earth's system comprising all ecosystems and living organisms – the living layer of the planet. Biodiversity describes the diversity of life within the biosphere.

Biodiversity is not the same as nature, wildlife, natural capital or any of these other commonly used terms. **But it supports and enhances all of these other things, and/or reduces the risks to them.** Biodiversity is valued by different people for different reasons, but these can be grouped into three key categories:²

- **Functional reasons** – biodiversity sustains flows of many benefits that have financial value and that underpin the **economy**.
- **Cultural reasons** – biodiversity is an intimate part of community, aesthetic and spiritual values that are essential for **society**.
- **Security reasons** – biodiversity is a fundamental basis for life itself, the foundation of a secure and functioning **environment**.

²Steve Bass, IIED, personal communication

Box 1: If biodiversity is about the variability of life on Earth, do iconic species matter?

In short, yes. Although it is diversity that underpins resilience, productivity and ecosystem functioning, interactions among species are critically important. Not all species are equal in terms of the ecological roles they play. Species towards the top of the food chain (which include in their number many iconic species) tend to have more important ecological roles than those further down the chain where there are often multiple species performing the same function and hence there is some redundancy. Large birds such as toucans are critical for dispersing seeds from large fruiting trees. Forest elephants disperse more seeds of more species of trees and over greater distances than any other animal [10]. Apex predators, particularly large carnivores such as big cats, help maintain ecological functions via multiple food web interactions [11]. Unfortunately, those at the top of the chain are naturally low in number and so easier to drive to extinction. And when this happens, ecosystems lose their integrity and ability to function – although this effect may take some time to become obvious.

What has biodiversity ever done for us?!

To understand why biodiversity loss matters for development it is important to understand what biodiversity does. Nature produces and delivers a wide range of goods and services on which humans depend – from breathable air, to fertile soil to food. And the ability of nature to deliver those goods and services over the long term is underpinned by biodiversity. Species do not exist in isolation but interact with each other and with their external environment. A large and diverse mix of species, and the interactions between them, is critical to ensuring the continued delivery of nature’s goods and services (Figure 1). Over the last 25 years, the balance of evidence from thousands of experiments and observations in a range of ecosystems shows that production of these goods and services increases in efficiency and stability with increasing diversity of plants, fungi, herbivores and predators [12, 13, 14].

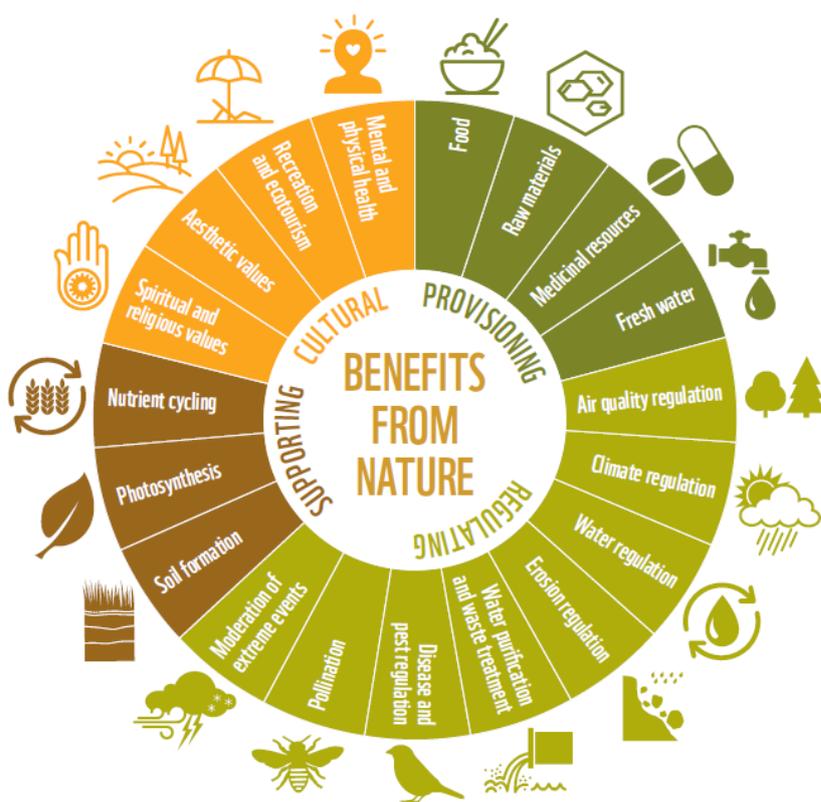


Figure 1: Different types of ecosystem services or benefits from nature (Source: Living Planet Report 2018 [4])

Box 2: Exploring the evidence that diversity matters

Biodiversity has a significant impact on the productivity and stability of ecosystems and the services they generate. Specifically: crop genetic diversity increases the yield of commercial agricultural crops; tree species diversity enhances production of wood in plantations; plant species diversity enhances the production of fodder in grasslands; fish species diversity is associated with greater stability of fisheries yields [12]. There is also evidence that these impacts of diversity on productivity and stability are **more significant than either climatic or nutrient influences [15]**. Furthermore, **biodiversity increases the resilience of ecosystem productivity to climate extremes [16, 17]**.

Beyond productivity impacts, plant biodiversity increases resistance to invasion by exotic plants and reduces prevalence of plant pathogens, increases above-ground carbon sequestration and increases nutrient mineralisation and soil organic matter. Overall there is a substantive body of evidence which shows that **diversity confers both social [18] and ecological [19] resilience and adaptive capacity – particularly under a changing climate [17]**.

An input into The Economics of Ecosystems and Biodiversity (TEEB) initiative notes that "the economic importance of wild nature does not rely solely on variability" [20]. Indeed, and particularly from a development and poverty reduction perspective, **many of the benefits obtained from nature rely as much on the amount (eg the abundance of particular species) as on diversity [21]**. The provision of developmental benefits to people also depends on the condition and extent of ecosystems and on the specific functions performed by certain species, groups of species or ecosystems – as sources of food, absorbers of air pollution, natural barriers against sea storms and so on. But **diversity underpins the abundance, extent and condition of nature, natural resources and ecosystems and secures the flow of benefits to people in the future, particularly in the face of changing environmental conditions**.

Biodiversity loss and the risk to development gains

It is because of the importance of biodiversity in maintaining (and enhancing) stable, productive and resilient natural ecosystems – and the resources and services they provide – that biodiversity loss is an important development issue. Biodiversity is not just about the *wealth* of nature but also about the *health* of nature. Loss of biodiversity undermines the ability of ecosystems to function effectively and efficiently and thus undermines nature's ability to provide us with a healthy environment.

While some loss of species is perfectly normal – extinction is an essential part of the evolutionary process – the current rate of loss is currently estimated to be at least 1000 times higher than natural background rates [22]. This loss is largely anthropogenic, driven by conversion of forests and other ecosystems for agriculture, infrastructure and urban development, but also, and increasingly, is linked to climate change with the distribution of species and extent and quality of ecosystems changing as climatic conditions change.

Biodiversity loss is often measured in terms of losses of particular species.³ But it is also about loss of ecosystems – living places – that matter to people, and loss of genes, which determine, for example, the varieties of agricultural crops that we eat. Mangrove forests are highly productive ecosystems on which millions of coastal communities depend, and they are being lost at a rate of 1% per year, which is double that of terrestrial forests [23]. Restoration

³Biodiversity loss is manifested as a reduction in abundance or the outright extinction of individual species or groups of species. Species losses and extinctions are often measured and reported at the global level (such as in the IUCN Red List of Threatened Species or the Living Planet Index). But they also occur at the local level, particularly, for example, if a species geographical distribution changes because of climate change. And even if these represent a small dint in global populations, local extinctions can have significant ecological and socio-economic impacts.

of mangroves, without paying due attention to the diversity of mangrove species being planted, is proving to be a short-lived solution to coastal degradation [24]. And at the other end of the spectrum, loss of *genetic* diversity within our global food system has huge implications for its future sustainability. Out of the millions of species and varieties that have been described and recorded by humans, only 30 crops provide 95% of human food energy needs, and just four of them – rice, wheat, maize and potatoes – provide more than 60% [25]. This homogenisation of agricultural production has resulted in significant genetic erosion as farmers worldwide have replaced multiple local varieties and landraces with genetically uniform, high-yielding varieties [26].

Any loss, degradation or relocation of biodiversity can have an impact on human wellbeing, but it can have a particular impact on the wellbeing of poor and marginalised people who are a) often more directly dependent on natural resources and the services nature provides to meet immediate livelihood needs, and b) often unable to afford substitutes in the absence of freely available natural resources and services. There is a lot we *don't* know about the impacts of biodiversity loss but the evidence we *do* have suggests that biodiversity loss will present **challenges to the achievement of many development priorities** – from health to food security to disaster risk reduction – as summarised in the sections below and in Table 2.

Table 2: Risks to development priorities from biodiversity loss

Development Priority	Implications of biodiversity loss
Food systems and food security	Reduced availability of wild foods, reduced productivity of agricultural systems, reduced nutritional security.
Health	Nutrition impacts linked to impacts on food systems and security, exposure to chemicals to compensate for reduced agriculture productivity, reduced access to traditional medicines, reduced options for future drug development, increased disease burden, reduced protection against pollution.
Climate change and disaster risk reduction	Reduced carbon storage, reduced adaptive capacity and resilience, exacerbation of natural disasters, increased vulnerability.
Gender equality	Increased time and labour burden – different genders and ages affected by different types of losses – with knock on effects on time availability of other activities.
Private sector development	High risk to doing business – in terms of likelihood and severity of impact – particularly in the Least Developed Countries (LDCs).

Food systems and food security

Biodiversity loss means reduced availability of key wild foods such as fish and wild meat. Large decline in the diversity of fish species is correlated with lower catches, lack of resilience to exploitation and higher incidence of collapse of stocks [27]. Biodiversity loss also means reduced productivity of cultivated food systems. There is unequivocal evidence that biodiversity loss reduces the efficiency by which ecological communities capture biologically essential resources (nutrients, water, light) and produce biomass [12]. Loss of components of biodiversity with key functions – pollinators for example – has major implications for food production [28]. And pollinators themselves are dependent on biodiversity: plant diversity is a key driver of bee health, and biodiversity loss a main reason behind bee population decline [29]. Loss of genetic diversity within agricultural crops makes crops less resilient to new pathogens or pests, to poor soils and to changing climatic conditions. The capacity of agricultural systems to adapt to climate change depends on maintaining diversity in cropping systems, crop varieties and animal breeds [26].

Health

Human health is directly linked to food production. Loss of crop diversity and increased reliance on chemical inputs to compensate for lack of resilience to disease and/or poor soil, results in increased exposure of people and the environment to chemical pollutants. A lack of diversity in food production also severely limits dietary diversity and potential to improve *nutrition*. Studies have found a positive correlation between agricultural diversity and dietary diversity and hence the inverse can be assumed – as agricultural diversity declines, so does dietary diversity and quality of nutrition [26]. Research on wild foods also finds a strong correlation between forest diversity, dietary diversity and nutritional outcomes [30]. According to the World Health Organisation (WHO) “Healthy local diets, with adequate average levels of nutrients intake, necessitates maintenance of high biodiversity levels” [31].

In terms of more direct linkages, 60% of the world’s population use traditional medicines, of which medicinal plants are the most common constituent [31]. Loss of biodiversity and subsequent reduced availability of medicinal plants compromises the ability of those who cannot afford modern medicines to maintain their health. It also limits the evolutionary potential of the ecosystem to continue to produce new, therapeutic variants. Nearly 20 years ago it was estimated that 50% of modern drugs have been developed from natural products [32], and new discoveries are continuously emerging. Loss of biodiversity undermines future options for new drug discovery. Furthermore, given the Nagoya Protocol provides for source countries to benefit fully from commercial products derived from their natural resource, biodiversity loss reduces potential revenue streams from well-managed bio-prospecting.

Aside from these direct medicinal uses of biodiversity, there is also evidence that loss of intact natural systems is increasing the disease burden on humans, particularly on poor, vulnerable groups [33]. For example, in rural areas where local people are directly dependent on untreated water from rivers and lakes, watershed degradation from loss of tree cover is directly correlated with an increase in diarrhoea – a major cause of under 5 child mortality [34]. Loss of biodiversity can also result in reduced protection against air pollution. Different shapes and sizes of leaves have different impacts on capture of particulates and chemicals. The biodiversity of plant types within an area affects the total amount of leaf area and hence impact on air quality. Loss of biodiversity reduces the ability of natural systems to full this pollution ‘scrubbing’ function. The Rockefeller Foundation-Lancet Commission on Planetary Health suggests that improvements in human welfare achieved in the past are likely to be reversed if the current trends of environmental degradation continue [35].

Climate change and disaster risk reduction

Biodiverse ecosystems support both the mitigation of and adaptation to climate change, including disaster risk reduction. For example, large tree species rich in carbon tend to produce large fruits which can only be processed and dispersed by large bodied birds and mammals. Loss of these species can lead to tropical forests dominated by fast-growing, small-seeded plants with lower carbon stores [27]. Beyond trees, natural habitats secure and regulate water supplies and protect communities from flooding, soil erosion and landslides [36] while mangroves, reefs and salt marshes can provide protection from storm surges, salt water intrusion and erosion [37]. Because more diverse systems are in general better able to perform these functions now and into the future, a *loss* of biodiversity undermines this potential. Furthermore, more diverse ecosystems are more able to recover from extreme events and hence more likely to be able to continue supplying these functions and services in the face of rapid environmental change [17, 19, 38]. Even if natural ecosystems can’t *prevent* natural disasters, their loss can *exacerbate* the impacts of natural disasters, for example, if wetlands are drained and thus unable to contribute to flood protection. The 2009 UN International Strategy for Disaster Reduction Global Assessment Report identified ecosystem degradation as one of the main drivers of disaster risk worldwide [39].

Beyond coping with extreme weather events, biodiversity plays a key role in other aspects of adaptation to climate change, and its loss undermines adaptive capacity. For example, old-growth woodlands reduce surface temperatures more effectively than tree plantations, which is essential to mitigate climatic extremes [40]. Genetic diversity within agriculture, for example, increases the resilience of small farmer livelihoods to climate-change induced problems such as drought, salinity or new diseases. The narrow genetic base of modern agriculture is already a cause for genetic vulnerability, and further biodiversity loss will exacerbate this vulnerability. The Food Agriculture Organisation (FAO) notes that many locally adapted varieties and breeds of crops and livestock are poorly documented and may be lost before their potential roles in climate change adaptation are recognised [41]. Agroforestry (planting trees among crops or crops within forest) can maintain and even enhance yields in drier more variable climates, while supporting increased biodiversity [42].

Gender equality

Biodiversity loss affects men, women, elderly and youth in different ways, depending on their livelihoods and their different roles in society. For example, the Women and Development Network notes: “As forests are depleted and fresh water supply exhausted, it is women and young girls who travel farther each day to collect firewood and water for their communities. Having to devote more time to water collection and travelling longer distances, means that girls may be unable to attend school and often puts women at greater risk for sexual harassment” [43]. However, to date there has been no overall assessment as to whether biodiversity loss affects one group or gender disproportionately to others.

Private sector development

The World Economic Forum’s latest Global Risk Report [44] shows that big business is also increasingly concerned about the impact of escalating biodiversity loss. The 2018 report rates biodiversity loss as scoring 3.5 (on a scale of 1 to 5) for both likelihood of occurrence (1: very unlikely to happen and 5: very likely to occur) and scale of impact (1: minimal impact and 5: catastrophic impact). At a global level, biodiversity loss is ranked as the 26th risk of highest concern for doing business, and many of the risks that are ranked more highly are linked to biodiversity loss, including food crises, water crises, failure of climate change mitigation and adaptation, and natural disasters. Furthermore, in many less developed countries biodiversity loss is ranked at a much higher level of concern (the 6th highest risk in Cambodia, 9th in Nepal, 11th in Uganda, 15th in DRC).

Box 3 Biodiversity knowns and known unknowns

While the evidence is increasingly clear that more biodiverse systems are more productive and more stable and resilient [19], we do not yet know where the thresholds and tipping points are, how long it might take the full impacts of loss to be felt, how much biodiversity is sufficient to support well-functioning ecosystems, or what the impact of different levels of biodiversity loss is on the resilience of ecosystem functions [45]. We do not even know how much biodiversity we have. One estimate puts the total number of species at close to 9 million with around only 9-14% having been described to date [46].

We do know, however, that loss of biodiversity is associated with loss of ecosystem function and resilience, thus reducing the insurance capacity that a diverse system provides [45]. We also know that the change in ecosystem functioning brought about by biodiversity loss accelerates as loss increases. Initial losses of biodiversity in diverse ecosystems have relatively small impacts on ecosystem functions, but increasing losses lead to accelerating rates of change.

Who is and will be hardest hit by biodiversity loss?

The highest rates of biodiversity loss are occurring in the tropics. The 2018 Living Planet Report finds that declines are greatest in Latin America and the Caribbean where vertebrate abundance has declined by 89% between 1970 and 2014 [4]. Comparable figures from elsewhere are a 64% decline in the Indo-Pacific region, and 56% in Sub-Saharan Africa, 31% in the 'palearctic' realm (Europe, Middle East, North Africa, Central Asia) and 21% in North America. Tropical forests are one of the most diverse types of ecosystem on the planet but include major hotspots for deforestation (Figure 2). Drylands too support high levels of biodiversity (20% of the centres of global plant diversity, 30% of important bird areas, and 8 of 25 global 'biodiversity hotspots' [47]). These regions of high biodiversity loss coincide substantially with areas of high poverty and those likely to be hardest hit by climate change. Drylands for example support over 30% of the global human population including nearly half a billion chronically poor [48].

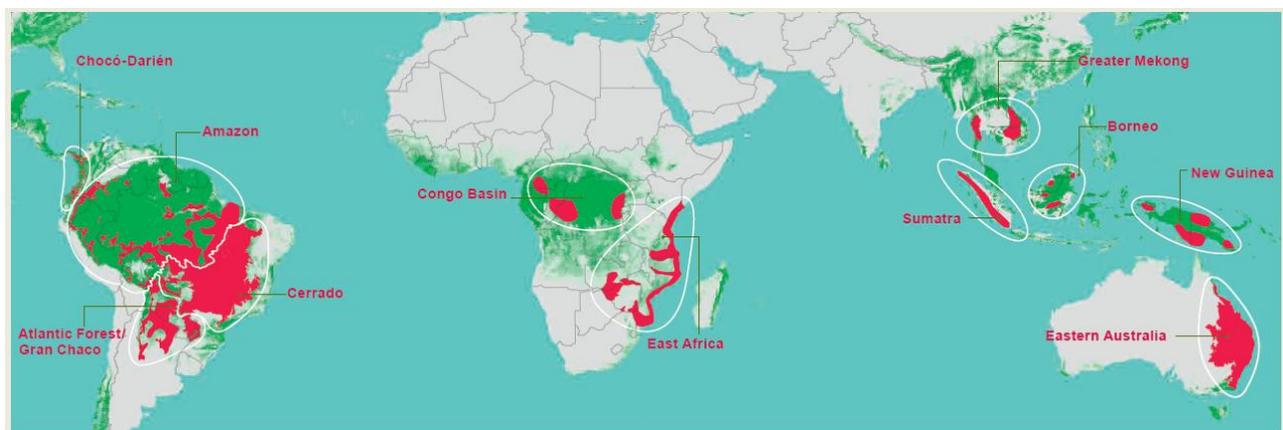


Figure 2: Extent of tropical forest (green) and projected deforestation 2010-2030 (red) (Source: Living Planet Report 2018 [4])

The ecological functions and services that are supported by biodiversity are critical to human wellbeing globally, so all of humanity will ultimately be affected by the degradation of nature and biodiversity loss. More immediately and directly, however, it is poor rural communities in developing countries who are the most dependent on nature to meet their day-to-day livelihood needs. To illustrate this point, the TEEB came up with the concept of 'GDP of the poor'. Using India as a case study, they showed that the value of forest services, such as fresh water, soil nutrients and non-timber forest products (NTFPs), to national GDP was approximately 7%. However, if the contribution of forest services to poor people only was calculated, it was more like 57% of GDP [49].

There are many other examples that highlight the specific contributions to livelihoods of natural ecological systems such as forests and fisheries – the productivity of which is underpinned by biodiversity – including [50]:

- A quarter of the world's poor and over 90% of people living in extreme poverty depend on forests for some part of their livelihoods.
- Forestry provides more than 10% of the GDP in many of the poorest countries and up to 20% of export earnings in several developing countries.
- The forestry sector in developing countries provides formal employment for 10 million people and informal employment for a further 30–50 million.

- Fisheries provide employment for over 38 million fishers in developing countries – the majority small-scale – and up to 150 million (particularly women) in associated processing and marketing.
- In low income, food-deficient countries, fish accounts for 22% of protein consumption.
- Fisheries products are the largest agricultural export from African LDCs.

Not only are the poor disproportionately dependent on nature and biodiversity for their livelihoods, they are also disproportionately vulnerable to losses because of their limited ability to pay for substitutes. Over a decade ago, the Millennium Ecosystem Assessment warned “...the harmful effects of the degradation of ecosystem services are being borne disproportionately by the poor, are contributing to the growing inequities and disparities across groups of people, and are sometimes the principal factor causing poverty and social conflict” [51].

Box 4: Why has biodiversity loss been largely ignored by the development community?

Much development has proceeded as if nature has no value, yet the annual revenue from nature-based resources has been estimated as worth 125 trillion US\$ [4]. Meanwhile much conservation has proceeded without taking local needs and knowledge into account, yet it is local communities who are the primary stewards of most of Earth’s biodiversity [52]. The result of this disconnect is that efforts to protect biodiversity are failing: since 1970s, there has been a 660% increase in protected area coverage yet a 60% decline in the global populations of most major animal groups [53]. Key reasons for this apparent disconnect include:

Communications. The biodiversity crisis is usually presented by the popular media in terms of potential extinctions of iconic species such as elephants and rhinos. The development community, understandably, fails to see the connection between the fate of these species and the fortunes of poor people – especially as conservation of such species generally fails to generate adequate benefits for poor people and often results in their disenfranchisement.

International environmental justice vs national sovereignty. Unlike climate change where the impacts of emissions generated in the North are felt in the South, the management of biodiversity has been perceived to be a local issue. But we see that biodiversity loss too is an issue of environmental justice. Northern consumption is driving the unsustainable use of natural resources through international corporate supply chains resulting in unjust losses of valuable local assets.

Time lags. It can take a long time for the impacts of biodiversity loss – both on people and on ecological systems – to become obvious. For example, recent work in Amazonia shows how forests that have lost a relatively small number of large-bodied fruit-eating mammal species through hunting, appear to be functioning (ie seem to be structurally intact), yet will be unlikely to have any valuable large, carbon rich timber species in the future [54]. While the impacts of climate change can be felt by everyone – especially in terms of increased extreme weather events – biodiversity loss is occurring all around us and yet the world keeps turning and the sky hasn’t fallen in.

It’s complex. Biodiversity is a complex, multi-faced concept. Unlike climate change where progress can be measure in terms of levels of emissions, amounts of carbon and degrees of warming, there is no one clear indicator for biodiversity to accurately quantify its loss, or success in its conservation. The indicators that have gained prominence, which focus on endangered species, fail to resonate with the development community.

Responses to biodiversity loss to protect development gains: some first steps

Nature-proof development investments. It is important to understand the risks of biodiversity loss and build biodiversity safeguards into development interventions, particularly investments in infrastructure, extractive industries and large-scale agriculture. Lack of attention to biodiversity can result in significant costs when things go wrong. In Zambia, for example, an outbreak of army worm in 2016 affected 20% of the national, monoculture maize crop, and cost the government over US\$ 3 million in pest control [26]. Some of the multilateral finance institutions include standards and safeguards for biodiversity management (eg International Finance Corporation (IFC) Performance Standard 6⁴ and the analogous World Bank Environmental and Social Standard 6). Similarly the EU has developed guidance on biodiversity-proofing⁵ its investments in order to minimise harmful impacts and maximise biodiversity benefits. But not all development interventions are, however, currently subject to a 'nature-proofing' process. For many years now, development professionals have recognised the need to climate-proof their investments as they have realised that climate change has the potential to undermine development interventions. The same is true for nature and biodiversity and a similar approach to that used for climate-proofing would be a good first step in better integrating biodiversity considerations into development policy and practice.

Invest in biodiversity for development. While the *abundance* of natural resources has long been valued by those in international development, the *diversity* of the ecosystems that support them has not. This has resulted in, for example, support for low-cost monocultures (plantations involving single, usually non-native species) over diverse natural ecosystems or agroforestry. This is a problem because while a monoculture might currently provide the main resource needed (food, timber, carbon storage or flood control), science informs us that it is unlikely to continue doing so into the future, for example when the climate changes or when a pathogen (disease) invades [12,13]. Moreover, monocultures can increase the risk of drought [55]. A worrying development under the Paris Agreement is that most nature-based pledges (Article 5.2) involve afforestation without pledging to use diverse and indigenous species, and this can lead to the establishment of monoculture plantations of fast-growing species, including exotics [56, 57]. Although in the short term this may lead to increased forest coverage and carbon storage benefits, there is concern for their ability to continue doing so in a rapidly changing world. Investment in biodiversity needs to emphasise diversity not just abundance, and needs to emphasise the establishment and maintenance of multifunctional landscapes where nature can flourish alongside humans – not one at the expense of the other [58]. Biodiversity directly supports export earnings, GDP and jobs in a wider variety of economic sectors from niche ecotourism to mainstream agriculture. The role of biodiversity in contributing to – and sustaining – development priorities needs to be better recognised and investments targeted to reflect that recognition.

Invest in biodiversity conservation *and* restoration in ways that empower rather than disenfranchise the poor. State owned, strict protected areas have been a cornerstone of international conservation policy for the last century, but a huge literature exists documenting the negative impacts that many of these have had on neighbouring rural communities in the form of evictions or restricted access to land and resources. Furthermore, their effectiveness in tackling biodiversity loss is questionable. Indigenous people and local communities own or manage an estimated 25% of the world's land area [59] – far greater than the amount of land under formal protected areas – yet they often are unable to protect these areas due to weak rights and tenure regimes, inadequate resources and lack of economic opportunities. Supporting and strengthening policy and practice that recognise rights, enhance equity and

⁴www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps6

⁵<http://ec.europa.eu/environment/nature/biodiversity/comm2006/proofing.htm>

draw on local knowledge and stewardship, are key to achieving advances in human wellbeing through conservation. Both the Paris Agreement and the emerging post-2020 global biodiversity framework⁶ place increasing emphasis on restoration of degraded lands. This can be an effective way of creating jobs (for example South Africa's well known Working for Water programme)⁷ or reducing reliance on man-made infrastructure (for example through restoring wetlands or forests for water management) while at the same time enhancing biodiversity.

Invest in those components of biodiversity and those sites that are important to poor people. While the world's attention is focussed on charismatic megafauna – particularly those that are the targets of illegal wildlife trade – it is also important to prioritise the uncharismatic species that matter most to poor people, for example pollinators, soil microbes, traditional crop varieties and species that are important for food or fibre or medicines.

Encourage effective collaboration between research, conservation and development sectors. As this paper has demonstrated, there is growing evidence that biodiversity underpins ecosystem productivity and resilience. Much remains unknown about the impact of biodiversity loss, and the development of practical and focused biodiversity research programmes will help with identifying priorities and risks. But what we do know is that good conservation requires full consideration of the needs, knowledge and priorities of local stakeholders – and particularly disadvantaged communities – and that for development outcomes to be truly sustainable, they must ensure a 'net positive impact' on biodiversity.

A new deal for nature *and* people, or, making development sustainable again

In 2020 the international community will agree a new 10-year framework for biodiversity management. Developing this new framework into one that works for both biodiversity *and* for people requires much more coordinated thinking and action than has happened to date. Many of the drivers of biodiversity loss – agriculture and infrastructure – are also drivers of development gains, but in the long term, biodiversity loss threatens to undermine these gains. The biodiversity crisis is thus a development crisis and demands an engaged response from the development community. In 2015 the global community agreed the Sustainable Development Goals, setting a policy framework for development to 2030. Pursued in isolation, some of the SDGs could have serious negative impacts on biodiversity while some biodiversity conservation or restoration strategies could undermine achievement of the SDGs. Concerted efforts are required to strengthen coordination between responses to biodiversity loss, climate change and sustainable development rather than treating them in isolation. Now is the time to put the word 'sustainable' back into the development agenda, but also to make sure people are included in any new agenda for nature and biodiversity.

⁶www.cbd.int/post2020/

⁷www.environment.gov.za/projectsprogrammes/wfw

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