

Briefing · October 2024

Finding economic value in nature beyond carbon

Key points:

- Rates of biodiversity loss and nature degradation are alarming, with regions around the world at risk of long-term economic instability, worsened climate change and weakened natural systems.
- Though hard to quantify because of the complexity of natural systems, ecosystem services – the benefits humans receive from nature, such as food and climate regulation – are estimated to be worth more than USD 150 trillion a year, or around one and a half times global GDP, emphasising the value of nature.
- Biodiversity loss is currently costing the global economy more than USD 5 trillion a year. USD 5 trillion is roughly the same amount it would cost Europe to transition to renewable energy by 2050.
- Economies around the world are highly dependent on nature. China, the EU and the US have the highest absolute GDP exposed to nature loss – a combined USD 7.2 trillion.
- Conservative estimates suggest that a collapse of essential ecosystem services, including pollination, marine fisheries and timber provision in native forests, could result in annual losses to global GDP of USD 2.7 trillion by 2030.
- The negative consequences or costs associated with the destruction of nature can be greater than any economic benefits or value added from activities causing the destruction.
- The destruction of nature in one region can ripple across natural systems, with far-reaching consequences beyond local borders. For example, deforestation causes droughts and elevates temperatures far beyond the site of deforestation, threatening food security and economies in other regions.
- Nature adds ‘free’ value to society by providing essential ecosystem services that support life and economic activity without direct costs. For example, conserving natural habitats near farms boosts production.
- Fortunately, estimates suggest that conserving biodiversity and ecosystems is much more affordable than destroying them.
- Restoring and preserving biodiversity is substantially less expensive than building a net-zero emissions energy system – the required annual investment in biodiversity is only 15% of that needed for energy system transition.
- The funding gap for biodiversity conservation is approximately USD 830 billion per year, comparable to the size of the global tobacco market.

Human societies are fundamentally dependent on nature

Nature provides a host of valuable ‘ecosystem services’ – the benefits humans receive from natural ecosystems, such as food, medicine, resources, clean air, climate regulation,

climate change mitigation and disease control. These services are essential for sustaining life.

Biodiversity – the variety of species, genes and ecosystems on earth – is [key to supporting nature's ecosystem services](#) and the value they bring. Biodiversity helps maintain ecosystem balance by supporting species interactions that regulate nutrient cycling, water filtration and climate regulation. It ensures resilience to environmental changes, since diverse ecosystems are better able to recover from disturbances such as extreme weather events. Biodiversity is also important for preserving the genetic diversity that is crucial for the adaptation and evolution of species.

[Rates of biodiversity loss and nature degradation are alarming](#) – 50% of natural ecosystems are in decline, over 85% of wetlands are lost, and 25% of species are at risk of extinction. More than three-quarters of essential ecosystem services have decreased over the past 50 years. Additionally, there has been a significant decline in per person 'natural capital' – the world's stocks of natural assets. [The stock of natural capital per person declined by almost 40%](#) between 1992 and 2014, while produced capital per person doubled over the same period.

Nature-related risks like deforestation, habitat destruction and resource depletion can lead to long-term economic instability, worsened climate change and weakened natural systems resilience. For example, the diversion of rivers for cotton farming has depleted the Aral Sea in Central Asia, [causing an economic crisis](#) as well as [increased local and regional temperature extremes](#) due to the impact on the sea's climate regulating function.

Nature-related risks are interconnected, meaning that a disruption in one area can amplify risks in other areas. For example, moisture from the Amazon helps generate rainfall in the region and in surrounding areas. [Deforestation reduces this function, causing drought in neighbouring regions](#) and impacting agriculture, water availability and [overall climate stability across most of South America](#).

[Five human-caused drivers are responsible for 90% of nature loss over the last 50 years:](#) land- and sea-use change, climate change, natural resource use and exploitation, pollution and alien invasive species.

It pays to protect nature

Financial value of nature

Though hard to quantify because of the complexity of natural systems, ecosystem services globally are estimated to be valued at more than [USD 150 trillion a year](#), or at least one and a half times global GDP in 2023. The ocean economy alone has a value of [up to USD 3 trillion a year](#), or 3% of global GDP.

The knock-on effects of current biodiversity loss are costing the global economy [more than USD 5 trillion a year](#). USD 5 trillion is roughly the same amount of investment needed for Europe to [transition to renewable energy by 2050](#). Conservative estimates suggest that a collapse of essential ecosystem services, including pollination, marine fisheries and timber provision in native forests, could result in annual losses to global GDP of [USD 2.7 trillion](#) by

2030.¹ Similarly, biodiversity loss is believed to be [costing the global economy 10% of its output every year](#).

The global economic costs of eroded ecosystem services between 1997 and 2011 alone resulted in [up to USD 20 trillion in annual losses to the value of these services due to land-use change](#), and as much as USD 11 trillion in losses due to land degradation.

A World Economic Forum (WEF) analysis suggests that [USD 44 trillion of economic value generation](#) – just under half the GDP of the world – is moderately or highly dependent on nature and its services and is therefore highly vulnerable to nature loss. Construction, agriculture, and food and beverages are the three largest sectors that are highly dependent on nature, the report said. These sectors generate a total of USD 8 trillion in gross value added (GVA) – about twice the size of the German economy.

Analysis of industry-wide GVA at national or regional levels reveals the extent to which economies depend on nature. In some of the world's fastest-growing economies, such as India and Indonesia, around [one-third of GDP is linked to nature-dependent sectors](#), while Africa generates 23% of its GDP from these sectors. Globally, larger economies including China, the EU and the US have the highest absolute GDP exposure to nature loss – a combined USD 7.2 trillion.

Cost of nature destruction exceeds value of exploiting it

The negative consequences or costs associated with the destruction of nature are in many cases greater than any economic benefits or value added from the activities causing the destruction. For example, [deforestation for palm oil production was a key driver](#) of fires in Indonesia in 2015, which on some days released [more carbon emissions than the entire US economy](#). These fires [cost the economy USD 16 billion](#) – more than the value added from Indonesia's palm oil exports in 2014 (USD 8 billion), and more than the entire value of the country's palm oil production in 2014 (USD 12 billion).

In Europe, fertiliser runoff is one of the most pressing environmental challenges, with nitrogen pollution from agricultural runoff estimated to cost the EU between [EUR 70 billion and EUR 320 billion annually](#). This is [more than double the estimated value that fertilisers add to EU farm income](#).

Commodity supply and demand can trigger different environmental impacts in different regions, where extraction might lead to deforestation in one area while consumption worsens pollution in another. In the Netherlands, much of the feed for intensive livestock systems comes from soy, predominantly [sourced from Brazil, including from regions linked to deforestation](#).

Demand for soy puts immense pressure on the Amazon's ecosystems, driving deforestation, which leads to biodiversity loss and a reduction in the forest's ability to capture and store carbon. This not only disrupts local ecosystems but has global consequences, as the loss of the carbon-sequestering capacity of forests accelerates climate change, while the degradation of biodiversity undermines global ecosystem stability. The environmental and health impacts of livestock farming in the Netherlands are estimated to cost [EUR 9 billion a year](#) – making the damage by the sector three times

¹ This model includes various [tipping points](#), which are changes in an ecosystem that push it into an entirely different state, such as the transition of forests into savanna due to land degradation and climate change, with potentially catastrophic changes for global climate regulation. The model baseline is a scenario where these services do not collapse.

higher than its added value. This estimate does not account for environmental impacts outside of the Netherlands.

Costs of inaction

Highly conservative estimates suggest that a reduction in six essential ecosystem services – namely pollination, coastal protection, water yield, timber, fisheries and carbon sequestration – could cost the global economy at least [USD 479 billion per year by 2050](#), or cumulatively almost USD 10 trillion,² with a 0.67% drop in global GDP every year.³ Land degradation, desertification and drought are anticipated to cost [the global economy USD 23 trillion by 2050](#).

Global GDP could contract by [USD 2.7 trillion as early as 2030](#) if the timber, pollination and fisheries industries partially collapse as a result of environmental destruction.⁴ Credit rating firm Moody's also identifies eight sectors, including protein and agriculture, with 'high' or 'very high' inherent exposure to natural capital and with almost [USD 1.6 trillion in rated debt](#). Increasing environmental pressures will erode the capacity of these sectors to pay their debts.

Companies involved in nature destruction face increasing financial risks. For instance, a palm oil company was [fined USD 18.5 million for fires that destroyed forested land](#) on its concession in Borneo in 2015. Similarly, the world's largest meat company JBS received [USD 7.7 million in fines in 2017 for sourcing cattle from deforested areas](#) in the Amazon.

New regulations and shifts in demand as societies respond to climate change could mean that [40 of the world's largest food and agricultural firms, together worth more than USD 2 trillion, lose up to 26% of their value by 2030](#). This equates to a loss to financial institutions connected to these firms of USD 150 billion – comparable to the value of financial institution losses following the 2008 financial crisis. A 2023 report found that the total financial impact of deforestation for [1,043 companies that disclosed their deforestation risks in 2022 is nearly USD 80 billion](#), emphasising the need for urgent and effective management of deforestation risks.

Nature has value beyond carbon

Natural systems, such as forests, are often valued primarily for their role in carbon capture and storage – [global forests are estimated to be worth at least USD 150 trillion, almost twice the value of global stock markets and over 10 times the worth of all the gold on Earth](#). While carbon sequestration accounts for a substantial portion of this value, [forests are invaluable beyond this](#).

Global human health is intricately tied to tropical rainforests, which host an immense variety of plant species, many with medicinal properties. Between the 1940s and 2006, almost half of anti-cancer pharmaceutical drugs [originated from products of natural origin](#).

It is estimated that every new pharmaceutical drug discovered in tropical forests is worth [USD 194 million to a pharmaceutical company and USD 927 million to society as a whole](#).

² Between 2011 and 2050.

³ This is under a 'Business-as-Usual' scenario, which is [a high-emissions scenario](#) aligned with the RCP8.5 pathway used in the IPCC's Sixth Assessment Report. The economic model [does not include impacts from tipping points, such as the collapse of rainforests or pollination](#).

⁴ As the analysis only considered a narrow set of risks, the authors of the report warn that this estimate should be viewed as a lower bound.

With almost 90% of pharmaceutical drugs originating from tropical forests still yet to be discovered, the total value to society could be as much as USD 303 billion.⁵

In the cosmetics sector, the supply of shea butter, used in various topical products, comes from a tree that is [threatened by deforestation and pollinator loss](#).

The value of nature extends beyond the extraction of goods. Mangrove forests, which are valued for their [vast carbon sequestration ability](#), also offer significant economic benefits from flood protection, including for the [US, China, India and Mexico](#). It is estimated that mangroves reduce damage to property from floods by more than [USD 65 billion per year and protect more than 15 million people](#).

The costs of nature destruction transcend borders

The destruction of nature in one region can ripple across natural systems, with far-reaching consequences beyond local borders. Deforestation in the Amazon, Congo and Southeast Asia has been linked to [significant reductions in both local and regional rainfall](#). This can negatively impact agriculture and hydropower generation, posing threats to food security and energy generation beyond local borders.

Deforestation in Brazil and Bolivia has altered regional rainfall patterns, exacerbating droughts in neighbouring regions. In Colombia, [the 2015–2016 megadrought was intensified by these disruptions in moisture recycling](#). This drought caused a national energy crisis as hydropower – responsible for over 70% of Colombia’s energy – became unreliable due to plummeting river water levels. As a result, energy prices soared [nearly tenfold](#), showcasing how environmental damage in one country can exacerbate economic consequences in another.

The impacts of deforestation go beyond drought. In Southeast Asia, logging and the conversion of forests to palm oil plantations causes soil erosion and results in increased soil sediment in rivers. This [sediment is carried downstream and is eventually released into the ocean](#) where it settles on coral reefs, threatening their survival. An estimated [41% of coral reefs globally are impacted by sediment export](#).

Coral reefs provide a wealth of ecosystem services, such as coastal protection, food and recreation. By reducing wave energy by up to 97%, [they protect up to 5.3 million people on coastlines and USD 109 billion in GDP per decade](#) from flooding and erosion impacts. Coral reefs are an important food source, with global reef-associated fisheries [valued at USD 6.8 billion](#).⁶ Additionally, coral reef tourism is valued at USD 36 billion a year, which is more than [9% of total coastal tourism value in the world’s coral reef countries](#).

Forests keep people and the atmosphere cool both locally and regionally by providing shade and releasing water vapour, acting as a natural air conditioner and [alleviating heat illness](#). In the Amazon, deforestation can increase temperatures by [up to 4.4°C](#)⁷ as far as 100 km away. [Similar estimates have been made](#) for other forested regions around the world.

⁵ Values have been adjusted from 1995 values to 2024 values based on the Consumer Price Index and have not taken into account any industry-specific changes such as changes in market dynamics or production costs.

⁶ In 2010.

⁷ Note that absolute temperature change can be expressed in Kelvin (K). A change of 1°C is equal to a change of 1 K.

Pollution, such as fertiliser and animal waste runoff from unsustainable farming, can have widespread impacts on nature. Runoff from agricultural fields flows into water bodies, leading to excessive nutrient levels, which depletes oxygen in water and harms aquatic life. The Gulf of Mexico's dead zone – an area of low to no oxygen that can kill marine life – occurs every summer and is mostly caused by [nutrient runoff from excessive fertiliser application and livestock on Midwestern US farms](#), carried to the gulf via the Mississippi River and its tributaries. In August 2024, the dead zone reached approximately 6,705 square miles – an area almost the size of Kuwait – potentially making [4 million acres of habitat unavailable to marine species](#).

The yearly costs of the dead zone to fisheries and the marine environment were [estimated at up to USD 2.4 billion](#) between 1980 and 2017. Studies have found that the dead zone reduces the size of large shrimps relative to small shrimps, with [prices for large shrimps driven up](#) as a consequence, impacting consumers, fishers and seafood markets.

Pollinators ensure our food security

The agriculture and food and beverage sectors are highly dependent on pollination – a critical ecosystem service of immense economic value that is essential for human well-being through its impact on agricultural production and food security. Pollinators impact about [35% of global crop production by volume](#), with 87 out of 115 major crops worldwide depending on pollination by animals, such as insects, birds and bats, to some extent. The contribution of pollinators to global agricultural production and food security is estimated at [USD 235 billion to USD 577 billion annually](#). In the UK alone, the value of pollination services from nature is [GBP 430 million](#).⁸

Pollinators are facing a significant [threat from habitat loss, pesticide use and land-use changes](#). [More than 40% of insect pollinators worldwide are facing extinction](#). In the short-term, the costs of a 'pollinator collapse' are valued at a [mid-point range of USD 1 trillion](#) or around 1-2% of global GDP.

[Native bumblebees in North America are critical pollinators of blueberries](#). The value of fresh cultivated and wild blueberry exports from the US in 2023 [exceeded USD 127 million](#), with key export markets in [Canada, Taiwan, Japan and South Korea](#). Yet [bumblebees are in decline in North America due to habitat loss, pesticide use and climate change](#), posing a threat to blueberry production.

Pollinator loss is anticipated to continue on an upward trend in the future, with projections indicating that pollinator decline could cause annual crop production losses of more than [USD 50 million for the US, around USD 125 million for Brazil, and around USD 225 million for China](#) by 2050.

Nature adds 'free' value

Nature adds 'free' value to society by providing essential ecosystem services that support life and economic activity without direct costs. [These services are often overlooked in economic calculations, yet they are fundamental to human well-being and environmental sustainability](#). The destruction of these natural systems can lead to significant financial costs in the long run as humans are forced to replace or mitigate these services.

In Northern California, wild bee species were found to [significantly increase tomato production](#) both in terms of size and numbers. Tomatoes are able to self-pollinate, meaning

⁸ In 2011.

they don't rely on pollinators to produce fruit, but this example demonstrates the added value from pollination services in nature.

In Costa Rica, [pollinators from forests increased coffee yields by 20% within 1 km of forests and improved coffee quality by reducing poor-quality berries by 27%](#). The study estimated that pollination services from two forest patches generated around USD 62,000 per year for a single coffee farm, representing approximately 7% of its total income. For both the coffee and tomato examples, simply being in close proximity to forested or natural habitats benefitted production on farms.

The natural flood control function of wetlands offers another example. During Hurricane Sandy in 2012, which devastated the Caribbean and east coast of the US, wetlands are estimated to have saved more than [USD 625 million in avoided flood damage](#).

Solutions and distractions

Conserving biodiversity and ecosystems is estimated to be much more affordable than destroying them. By 2030, [an estimated USD 996 billion](#)⁹ annually will be required to sustainably manage biodiversity and maintain ecosystem integrity. This represents less than 1% (0.7-0.9%) of global GDP in 2023. It is also substantially less than the amount spent annually on subsidies that accelerate the production or use of natural resources or that undermine ecosystems, which are estimated at [USD 1.8 trillion](#) to [USD 6 trillion – or around 6% of global GDP](#). Nature-smart policy interventions, which already have demonstrated success and could achieve further impact and value, can substantially reduce the risk of ecosystem services collapse by 2030, with [economic gains of up to USD 150 billion](#).

Protecting and restoring biodiversity is crucial to achieving net-zero goals – it enhances ecosystem resilience, supports agricultural systems and increases carbon sequestration. At the same time, estimates suggest that restoring and preserving biodiversity is substantially less expensive than building a net-zero emissions system – the annual funding needed to protect and preserve biodiversity is [only 15% of the investment needed to transition to a net-zero emissions energy system](#).

Biodiverse ecosystems like forests, wetlands and grasslands store significant amounts of carbon, helping to offset emissions. They also provide critical services such as regulating the water cycle, supporting pollination and improving soil health, all of which are necessary for sustainable agriculture and climate resilience. It is estimated that a transition to deforestation-free operations, entailing a 75% reduction in deforestation rates by 2025 and the restoration of 300 million hectares of forests, could [result in an economic gain of USD 895 billion by 2030 through a reduction in annual environmental costs of USD 440 billion](#).

Closing the funding gap

The funding gap for biodiversity conservation is approximately USD 830 billion per year, [comparable to the size of the global tobacco market in 2022](#). About 73% of the funding is needed to manage productive landscapes and seascapes, with a significant focus on transitioning agriculture to sustainable practices.

There are various financial mechanisms for closing this funding gap for biodiversity conservation. Public finance presently plays a significant role, with government budgets and tax policies supporting biodiversity projects. It is estimated that [80% of biodiversity](#)

⁹ In 2021 USD.

[financial flows](#) – around USD 133 billion per year¹⁰ – are from domestic and international public finance.

The private sector contributes around [USD 29 billion per year](#) to biodiversity through various sustainable debt products. The largest contributor is payments-for-ecosystem services, where financial incentives are given to landowners or resource managers to adopt practices that conserve or enhance ecosystem services that derive value from nature. These schemes contribute around [USD 9.8 billion a year](#). However, they are often vaguely defined and suffer from issues such as payment volatility and high project costs.

Debt-for-nature swaps allow countries to cancel portions of their foreign debt in exchange for committing to fund local conservation projects. Estimates suggest that as much as a [third of the USD 2.2 trillion of developing country debt](#) could be eligible for debt-for-nature swaps. However, the impact of this on debt levels has been very small: [between 1987 and 2023, these swaps offset only around 0.11% of debt payments](#) by low- and middle-income countries. Critics also argue that these swaps sometimes [commodify nature and could undermine the sovereignty of local communities if not properly managed](#).

Carbon offsets and credits aim to compensate for greenhouse gas emissions and environmental impacts by investing in projects that reduce or remove carbon from the atmosphere, such as reforestation or afforestation. However, they have been criticised for allowing companies to continue emitting carbon while [relying on offset projects that may not always deliver long-term or verifiable climate benefits](#).

¹⁰ Value is from a 2022 report.