GLOBAL FUTURES

ASSESSING THE GLOBAL ECONOMIC IMPACTS OF ENVIRONMENTAL CHANGE TO SUPPORT POLICY-MAKING

February 2020

Summary report for government and business decision-makers

WWF

IN PARTNERSHIP WITH

GTAP Global Trade Analysis Project

natural capital PROJECT

This report summarises the headline results and policy recommendations from the Global Futures project. A full description of the project background, objectives, methodology, results and conclusions is provided in the accompanying Technical Report, available here. The report is based on a project concept developed and funded by WWF.

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EXECUTIVE SUMMARY

This report summarises the first results of the Global Futures initiative – a partnership between WWF, the Global Trade Analysis Project and the Natural Capital Project – which has developed an innovative new model to calculate the impacts of nature's decline on the world's economies, trade and industry. The research is timely and poses a stark warning to us all – that unless we reverse nature loss, trillions of dollars will be wiped off the world's economies, industries will be disrupted and the lives of millions will be affected.

From climate change, extreme weather and flooding, to water shortages, soil erosion and species extinctions, evidence shows that our planet is changing faster than at any other time in history. The way we feed, fuel and finance ourselves is destroying the planet's life-support systems upon which we depend. As we enter a new decade, we are not just in an environmental crisis – we're heading for an economic crisis too.

The research considers the benefits that nature provides to all nations and industries through 'ecosystem services' – such as the pollination of crops, protection of coasts from flooding and erosion, supply of water, timber production, marine fisheries and carbon storage. The model then assesses how the natural assets[1] that provide these services (such as forests, wetlands, coral reefs and fish stocks) would change under various future development scenarios and, in turn, how the consequent changes in ecosystem service supply would affect economic outcomes (including GDP, trade, production and commodity prices).

The results show that in a 'Business-as-Usual' (BAU) scenario, reduced supply of these six ecosystem services alone would lead to a drop of 0.67% in annual global GDP by 2050 (compared to a baseline scenario in which there is no change in ecosystem services by 2050). This would be equivalent to an annual loss of US$ 479 billion compared to the baseline scenario, assuming an economy of the same size/structure as in 2011 (the latest version of the GTAP database and base year for this analysis). Over the period between 2011 and 2050, the total cumulative loss would be US$ 9.87 trillion (3% discount rate).

-US$10tn

COST TO THE WORLD ECONOMY FROM THE LOSS OF NATURE IN A 'BUSINESS-AS-USUAL' SCENARIO BY 2050

1 Natural assets (or natural capital assets) consist of biological or living natural assets (habitats and species) as well as physical natural assets (such as minerals, water and the atmosphere), which provide services that benefit people. The focus of Global Futures is on biological assets which, if managed sustainably can renew themselves and continue to provide these services (or ecosystem services) in perpetuity, but which are increasingly under threat due to human pressures.

Global price hikes would also be expected for key commodities such as timber (+8%), cotton (+6%), oil seeds (+4%) and fruit and vegetables (+3%), as the world's agricultural sectors will be hardest hit by the loss of nature's benefits. Poorer countries would bear most of the costs, compounding the risks faced by millions in already vulnerable economies. Eastern and western Africa, central Asia and parts of South America would be hit particularly hard as a result of the changes in price, trade and production levels (with annual GDP losses of up to 4%). Countries like the USA, Japan, Australia and the UK would also see large losses due to loss of coastal infrastructure and agricultural land through flooding and erosion.

In contrast, in a 'Global Conservation' (GC) scenario – in which the world adopts a more sustainable development pathway and safeguards areas that are important for biodiversity and ecosystem services — annual global GDP would be 0.02% higher (US$ 11 billion) by 2050, than in a baseline scenario of no change in ecosystem services, generating an annual net gain of US$ 490 billion per year compared to the BAU scenario.

These figures are highly conservative and should not be considered an assessment of the total costs of nature's loss for several important reasons. The current model only considers six of the many ecosystem services provided by nature (those for which there is enough evidence to quantify). Nor does it account for the potential effects of 'tipping points' – thresholds beyond which habitats change rapidly and irreversibly, such as rainforests shifting to drier and more fire and drought-prone savannahs, making them vulnerable to catastrophic failure of ecosystem services. As future versions of the model address these issues, it is expected that the economic case will be further strengthened.

It's also important to note that the model is not designed to capture the economic impacts of all environmental changes that the planet is undergoing (e.g. climate change and water scarcity), just those associated with changes in specific natural assets. The results must therefore be considered as one part of the economic case for tackling the global environmental and climate crisis, pinpointing risk hotspots and vulnerable groups that could gain most from protecting nature.

This report comes at a critical time, marking the start of a landmark year for the future of our planet. During 2020, political leaders and negotiators will meet to discuss a series of important global policy outcomes regarding nature, climate and development. As last year's landmark global assessment from the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services (IPBES) warned, and this report underlines, current levels of ambition are not enough.

To reverse nature's decline, and for humanity to enjoy a sustainable and prosperous future, we urgently need transformational change across our economic and financial systems, so they are geared towards delivering long-term sustainable development, and the protection and restoration of nature. We need to agree a New Deal for Nature and People to reverse the loss of biodiversity by 2030 and put nature on a path to recovery for the benefit of people and planet. The ambition is that this report, alongside other evidence, will encourage and enable world leaders to take decisive action before it is too late.

+$490bn

ANNUAL NET GAIN IN GLOBAL GDP UNDER A 'GLOBAL CONSERVATION' SCENARIO

TO REVERSE NATURE'S DECLINE, AND FOR HUMANITY TO ENJOY A SUSTAINABLE AND PROSPEROUS FUTURE, WE URGENTLY NEED TRANSFORMATIONAL CHANGE ACROSS OUR ECONOMIC AND FINANCIAL SYSTEMS

THE AMBITION IS THAT THE RESULTS WILL BE CONSIDERED AND USED BY A WIDE RANGE OF ACTORS TO INFORM POLICY AND WIDER ECONOMIC AND DEVELOPMENT DECISION-MAKING IN 2020 AND BEYOND.

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INTRODUCTION

Global Futures is a first-of-its kind analysis of the consequences of nature's decline for the world's economies, trade and industrial sectors. Its purpose is to help build awareness among political and business leaders of the risks to economic prosperity of global environmental degradation, and to help catalyse global action to reverse nature's decline.

The report is the first major output from the project – a partnership between WWF, the University of Minnesota and Purdue University. It represents the culmination of over two years of research and development by a team of leading experts in the field, supported by advice and input from scientists, economists and policy experts from around the world.

The analysis is based on an innovative economic modelling approach that combines – for the first time – a global economic model with high-resolution land-use and ecosystem service models. This powerful analytical tool, which covers 140 regions / countries[2] and all key economic sectors, identifies the potential future global, national and sectoral economic impacts that will occur due to changes in the Earth's natural systems under a range of different global development scenarios.

The results paint a stark picture of the potential risks if we fail to tackle accelerating global environmental degradation and biodiversity loss – and make a compelling economic case for protecting and restoring nature for a more sustainable and prosperous future. The ambition is that they will be considered and used by a wide range of actors to inform policy and wider economic and development decision-making in 2020 and beyond.

140

COUNTRIES/REGIONS COVERED BY INNOVATIVE ECONOMIC MODELLING APPROACH

2 The GTAP database version 9 covers 140 regions. This was modified to 137 by aggregating several regions for use with the GTAP model.

WHY THIS WORK MATTERS

The work has advanced the state of knowledge in the field of integrated modelling, providing a first-of-its-kind tool to calculate the impacts of nature's decline on the world's economies, trade and industry that can be used by governments, business and other actors to inform decision-making .

The research also fills a critical gap in the evidence base on the economics of global environmental change, providing a richer and much more detailed picture of the distribution of nature-related risks across the world's economies than ever before.

The work builds on the foundation provided by the first IPBES global assessment.[3] This reported extensively on how human-induced pressures are affecting nature and the ecosystem services it provides but did not consider in detail what these changes in turn mean for economic outcomes. It also complements other prominent global analyses such as The Economics of Ecosystems and Biodiversity (TEEB),[4] which provides a valuable understanding of the significance and value of nature's services. To date, however, no study has explicitly linked ecosystem services to macro-economic impacts at this scale and level of detail.

This report is primarily aimed at decision-makers in governments (e.g. heads of state, ministries of finance/planning, advisers) and the private sector (e.g. banks, businesses and investors). These actors are key to tackling the underlying drivers of nature loss and effecting change, but currently do not have access to the modelling tools and evidence they need in order to fully understand the likely economic impacts of global environmental change on countries, trade and specific sectors, nor to develop, prioritize and justify policy responses.

OVERVIEW OF THE MODELLING APPROACH

Global Futures is based on a new, cutting-edge integrated environment-economy modelling framework which links, for the first time, two world-leading modelling platforms:

1) The Global Trade Analysis Project (GTAP) Computable General Equilibrium (CGE) model, the world's most well-established and widely used global economic-trade model. Developed and hosted by Purdue University, it covers 140 regions / countries and all key industry sectors.[5]

2) InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs), a suite of 20 ecosystem service models extensively used around the world, developed by the Natural Capital Project (which is co-led by the University of Minnesota).[6]

THE RESEARCH FILLS A CRITICAL GAP IN THE EVIDENCE BASE ON THE ECONOMICS OF GLOBAL ENVIRONMENTAL CHANGE

3 https://ipbes.net/global-assessment-report-biodiversity-ecosystem-services
4 http://www.teebweb.org
5 www.gtap.agecon.purdue.edu/models/current.asp
6 www.naturalcapitalproject.stanford.edu/software/invest

At its core, the modelling approach is based on the established concept of ecosystem services – the benefits we get from nature and which underpin the world's economies and our own well-being. Examples include coastal protection, pollination, provision of water and timber, commercial fisheries and carbon storage (see figure 1).[7] Drawing on this concept, the model provides a framework for assessing how future changes in the natural assets that provide these services (such as forests, wetlands, coral reefs and fish stocks) would affect their supply – and in turn how this would affect economic outcomes (such as GDP, sector output, trade and prices).

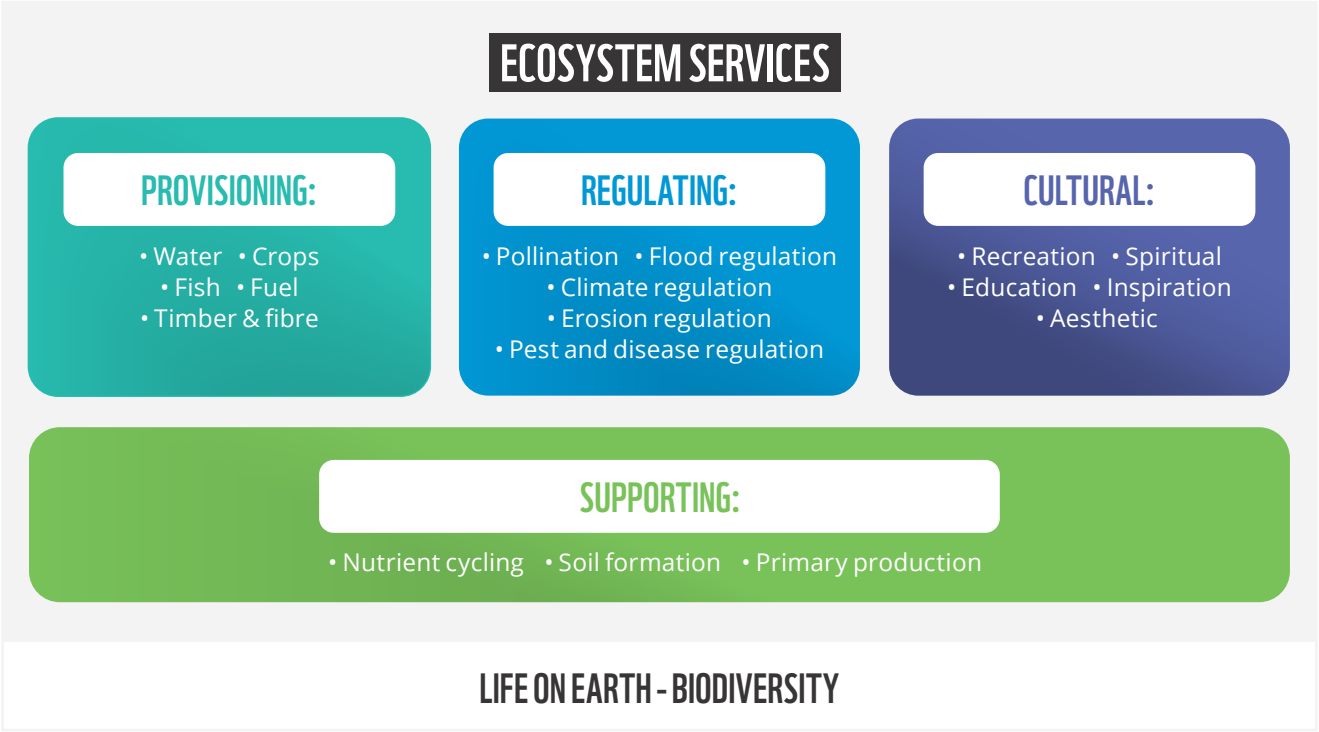


FIGURE 1:
ECOSYSTEM SERVICES

7 Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. www.millenniumassessment.org/en/index.html

The modelling process involves four discrete interlinked steps, as shown in figure 2. In step 1, scenarios are created to describe what the world could look like in 2050, based on a combination of assumptions regarding socio-economic drivers, climate change emissions, sea-level rise and changes in land-use and land-cover (LULC). Two of the scenarios were based on those used in the IPBES global assessment in order to maximise coherence with existing international modelling processes, whilst a third – an ambitious sustainability-oriented scenario incorporating improved protection and restoration of important areas for biodiversity and ecosystem services - was created specifically for this analysis (see next section).

FIGURE 2:
STEPS IN THE GLOBAL FUTURES MODELLING FRAMEWORK

In step 2, the InVEST model is used to quantify how the supply of ecosystem services would be affected in each 2050 scenario. In step 3, the outputs from InVEST are converted into a series of 'shocks' that serve as inputs into the GTAP model, such as changes in production factors, prices or resource inputs. The GTAP model is then run to assess how these shocks affect key economic metrics in each 2050 scenario (including GDP, prices, trade and production statistics at the national and sectoral level) in comparison to a 'baseline' scenario (which assumes no change in ecosystem services by 2050). When quantifying impacts, it is assumed that the 2050 economy is the same size and structure as in 2011, as this is the most recent year in the GTAP version 9 database.

Finally, in step 4, the modelling outputs are aggregated, interpreted and presented to show the economic impacts globally, nationally and/or for key economic sectors, providing a rich picture of the overall impacts and distribution through the economy for different scenarios.

Scenario	Narrative description	Shared Socio-economic Pathway (SSP)	Representative Concentration Pathway (RCP)	Land-cover
Business-as-usual (BAU)	Continued increase fossil-fuel usage to support energy intensive lifestyles. High levels of market competition and integration of global markets through trade. Global population peaks in the middle of the 21st century and then declines. Land-use change is widespread and untargeted and climate change is an extreme problem.	SSP5 (Fossil fueled development)	RCP 8.5 (GHG emissions continue to rise through the 21st century)	Existing GLOBIO (300m) map
Sustainable pathway (SP)	Widespread shift to more sustainable practices at the national level within global environmental boundaries. Common-good resources are effectively managed. Widespread recognition of the costs of climate change lead to effective global mitigation. Land use change (e.g. from development and agricultural expansion) is more effectively managed, but it is not targeted to specific locations to enhance ecosystem services or biodiversity.	SSP1 (Sustainability)	RCP 2.6 (GHG emissions peak between 2010–2020)	Existing GLOBIO (300m) map
Global conservation (GC)	In addition to international coordination on climate change and land use (as per the SP scenario), society also implements more transformational polices to protect nature by targeting land-use change to avoid areas that are high in biodiversity and provide important benefits to people through ecosystem services.	SSP 1 (Sustainability)	RCP 2.6 (GHG emissions peak between 2010–2020)	New map created using SEALS* (300m)

TABLE 1:
SCENARIOS USED IN THE GLOBAL FUTURES PROJECT (DESCRIPTION AND DATA SOURCES)
** The Spatial Economic Allocation Landscape Simulator (SEALS) model, developed specifically for this project.*

MODELLING SCENARIOS

As set out in Table 1, three scenarios were used: 1) Business as Usual (BAU), 2) Sustainable Pathway (SP), and 3) Global Conservation (GC) . For brevity and ease of comparison, only the results from the BAU and GC scenarios are highlighted in this report (see the Technical Report for the full results for all scenarios).

The BAU and SP[8] scenarios were based largely on scenario 'building blocks' used in the IPBES global assessment (i.e. Shared Socio-economic Pathways (SSPs) and Representative Concentration Pathways (RCPs)), together with corresponding land-use, land-cover (LULC) maps and fishery productivity modelling data produced by other initiatives.

8 The Sustainable Pathway scenario was based on the 'Sustainable Development' scenario used in the IPBES global assessment. The name was altered because, as IPBES warned, this scenario would still involve further loss of biodiversity and many regulating services that nature provides. Moreover, results from this work show it would also lead to undesirable economic outcomes too. It cannot therefore be considered 'sustainable development', only a pathway towards sustainability.

The GC scenario also built upon the SSPs and RCPs, but was newly created for this research, by including new global LULC mapping based on assumptions regarding the protection and restoration of natural habitats. This yields insights that go beyond previous environment and climate modelling exercises, by revealing both the economic effects of achieving ambitious global environmental outcomes (or targets) and how a targeted approach to the management of land and natural resources (that takes into account nature's value) can maximise the societal gains of such policies.

ECOSYSTEM SERVICES INCLUDED IN THE MODEL

The model currently covers six ecosystem services (see table 2). These are selected because they are among the most economically important, with the connection to economic impacts clearly documented in the academic literature, and because robust global, high-resolution analysis is currently possible using landscape-scale models. Further services will be added in future versions of the model.

Ecosystem service	Description (economic benefit)	Natural assets providing this service
Pollination	Pollination of commercially important agricultural crops by insects	Forests, grasslands and other important feeding and shelter habitats for pollinating insects
Coastal protection	Protection of coastal infrastructure and agricultural land from erosion and flooding	Coral reefs, mangroves, seagrasses, saltmarshes that supply/anchor sediments, reduce/absorb wave energy and regulate flooding
Water yield	Water supply for agriculture / irrigation	Forests, wetlands and other habitats that store and influence the flow of water / evapotranspiration in catchments
Timber production	Supply of timber	Forests (natural and commercially planted) that provide timber for commercial / subsistence uses
Fish production	Supply of fish / fishery products	Marine habitats such as coral reefs, mangroves and seagrasses that sustain fisheries
Carbon sequestration	Absorption and storage of carbon	Forests, peatlands and other high-carbon habitats

TABLE 2:
ECOSYSTEM SERVICES CONSIDERED IN THE CURRENT GLOBAL FUTURES MODEL

CONSIDERATIONS WHEN INTERPRETING AND USING THE RESULTS

The impacts reported are highly conservative and should not be considered an assessment of the total costs of nature's loss, for several important reasons:

1) The current model only considers six of the many ecosystem services provided by nature, for which there is adequate scientific data (e.g. it does not include water/air quality regulation, nutrient supply, soil formation and cultural services).

2) For those six services, not all ways in which this affects the economy are quantified (e.g. for changes in water yield, only the impacts on agriculture/irrigation are considered, not the impacts on drinking water supply or human health).

3) The current model also does not take account of the potential effects of risk-multiplying 'tipping points' – thresholds beyond which habitats and/or species can incur rapid and irreversible changes (such as rainforests shifting to drier fire and drought-prone savannahs or the collapse of fish or pollinator populations), potentially leading to catastrophic ecosystem service failure.

The results already make a compelling economic case and highlight important distributional effects. However, as the number of ecosystem services is expanded and issues such as tipping points are considered in future versions of the model, it is expected that the magnitude of impacts will increase significantly.

However, it's also important to note that no model will ever capture all of nature's value, particularly where ecosystem services provide important intangible and/or non-market benefits (e.g. as is the case for cultural services). Nature also has intrinsic value irrespective of human measures of utility. As such, economic evidence such as this should always be considered as just one component of the evidence base when decision-making.

Finally, it's also important to note that the model is specifically designed to quantify the economic impacts of changes in ecosystem services, not the wider impacts of all environmental and climatic changes that the planet is undergoing.[9] This work aims to complement the extensive evidence that already exists on these wider topics,[10] by answering specific policy-relevant questions regarding the economic case for protecting nature.

THE TRUE IMPACTS OF NATURE LOSS (AND GAINS WE CAN SECURE FROM PROTECTING IT) ARE EXPECTED TO BE FAR HIGHER, AND IN SOME CASES POTENTIALLY IRREVERSIBLE

9 For example, it does not consider the effects of climate change on labour productivity and agricultural output.

10 For example, the four recent authoritative reports on climate change and biodiversity from the United Nations' Intergovernmental Panel on Climate Change (IPCC) and Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES), a synthesis of which can be found here.

MODELLING RESULTS

The analyses reveal a rich set of results on how changes in ecosystem services affect the global economy, trade and key commodities, as well as important insights into the likely distribution of impacts by region and across industry sectors.

Figure 3 sets out some of the headline results (for the full results please see the Technical Report). Under the BAU scenario, annual global GDP would be 0.67% lower by 2050 due to continued reduction in the supply of ecosystem services, in comparison to a baseline scenario with no change in ecosystem services by 2050. Assuming the same size and structure of the 2011 economy (base year for the analysis), this would be equivalent to a reduction of US$ 479 billion in annual global GDP – and a total cumulative loss between 2011 and 2050 of US$ 9.87 trillion.[11]

The BAU scenario would also lead to a reduction in the global supply of a many important commodities by 2050 (the exceptions being coal, oil and gas and other non-renewable natural resources, extraction of which would continue). Worst hit would be food and agricultural sectors, and price hikes would be expected for commodities such as timber (+8%), cotton (+6%), oil seeds (+4%) and fruit and vegetables (+3%), due to changes in supply and other factors.[12]

In contrast, under the GC scenario – in which the world adopts a sustainability-focussed development agenda and manages land and sea use carefully to avoid further loss of areas that are important for biodiversity and ecosystem services – the world would see substantial economic gains, including a 0.02% increase in annual global GDP in 2050. In 2011 base year terms this would be equivalent to an increase in annual global GDP of US$ 11 billion, and a cumulative increase of US$ 0.23 trillion between 2011 and 2050 (i.e. a cumulative net increase of over US$ 10 trillion in global GDP compared to the BAU scenario)

The GC scenario would also generate an increase in global output and lower prices for many key commodities compared to under the BAU scenario, particularly fish, timber, cotton, oil seeds, and fruit and vegetables. In particular, the marine fisheries sector stands to gain significantly under the GC scenario, with a 3% increase in global output (quantity of fish catches) as fisheries are returned to management at sustainable levels, and a commensurate drop in world prices of 22%.

-0.67%

FALL IN GDP EVERY YEAR BY 2050 UNDER A BUSINESS AS USUAL SCENARIO

11 Assuming a linear increase in the ecosystem service change between 2011 and 2050 and a discount rate of 3%.

12 More research is needed to explore interaction between these effects, for example price fluctuations could be driven by changes in supply, substitution of commodities due to increased competitiveness of alternatives, and other factors.

FIGURE 3: SELECTED HEADLINE RESULTS FROM THE GLOBAL FUTURES PROJECT

POTENTIAL IMPACTS OF FUTURE CHANGES IN ECOSYSTEM SERVICES BY 2050

All results show impacts due to changes in ecosystem services under BAU and GC scenarios by 2050, compared to a baseline scenario of no change in ecosystem services by 2050, assuming the economy is the same size/structure as in 2011 (latest year of the GTAP version 9 database).

SCENARIOS:

BUSINESS AS USUAL

ENERGY/MATERIAL INTENSIVE CONSUMPTION

NO CONSERVATION (FURTHER LOSS OF BIODIVERSITY)

CONSIDERABLE LAND-USE CHANGE

GHG EMISSIONS CONTINUE TO RISE

GLOBAL CONSERVATION

SUSTAINABLE CONSUMPTION / PRODUCTION

PROTECTION OF IMPORTANT HABITATS FOR BIODIVERSITY AND ECOSYSTEM SERVICES

STABILIZATION OF LAND-USE CHANGE

GHG EMISSIONS PEAK BETWEEN 2010 AND 2020

ECONOMIC OUTCOMES:

BUSINESS AS USUAL		GLOBAL CONSERVATION
-$9.87tn	**GLOBAL GDP** (cumulative change between 2011-2050, 3% discount rate)	+$0.23tn
-0.67%	**GLOBAL GDP** (% change in annual global GDP)	+0.02%
-$478.9bn	**GLOBAL GDP** (actual change in annual global GDP)	+$11.3bn
-1.14%	**GLOBAL OUTPUT - FISHERIES** (% change in annual global output quantity)	+3.2%
-$26.6bn	**GLOBAL OUTPUT - PROCESSED FOODS** (actual change in annual global output value)	+$9.2bn
FISH-5.38%, FOREST PRODUCTS +7.87%, COTTON+5.51%, OILSEEDS+3.83% FRUIT & VEGETABLES+3.35%	**GLOBAL COMMODITY PRICES - GREATEST DIFFERENCE BETWEEN BAU & GC** (% change in prices)	FISH-21.54%, FOREST PRODUCTS-6.17%, COTTON-2.39%, OILSEEDS-3.67% FRUIT & VEGETABLES-1.94%
TOGO-3.37%, COTE D'IVOIRE-1.76%, SRILANKA-2.48%, URUGUAY-2.54%, GUINEA-1.24%	**NATIONAL GDP - GREATEST DIFFERENCE BETWEEN BAU & GC** (% change in annual national GDP)	TOGO+1.67%, COTE D'IVOIRE+1.83%, SRILANKA +0.43%, URUGUAY +0.14%, GUINEA +1.30%
-$21.1bn	**NATIONAL GDP - UK** (actual change in annual national GDP)	-$9.3bn
+$5.4bn	**NATIONAL GDP - CHINA** (actual change in annual national GDP)	+$43.1bn
-$82.5bn	**NATIONAL GDP - USA** (actual change in annual national GDP)	-$39.7bn

Beneath this global picture, the results also show some important distributional patterns. Figure 4 highlights that low and middle-income countries will bear the greatest cost of nature loss under the BAU scenario (in terms of national GDP), compounding the risks faced by millions in already vulnerable economies. Eastern and western Africa, central Asia and parts of South America will be hit particularly hard, as a result of the changes in price, trade and production levels.

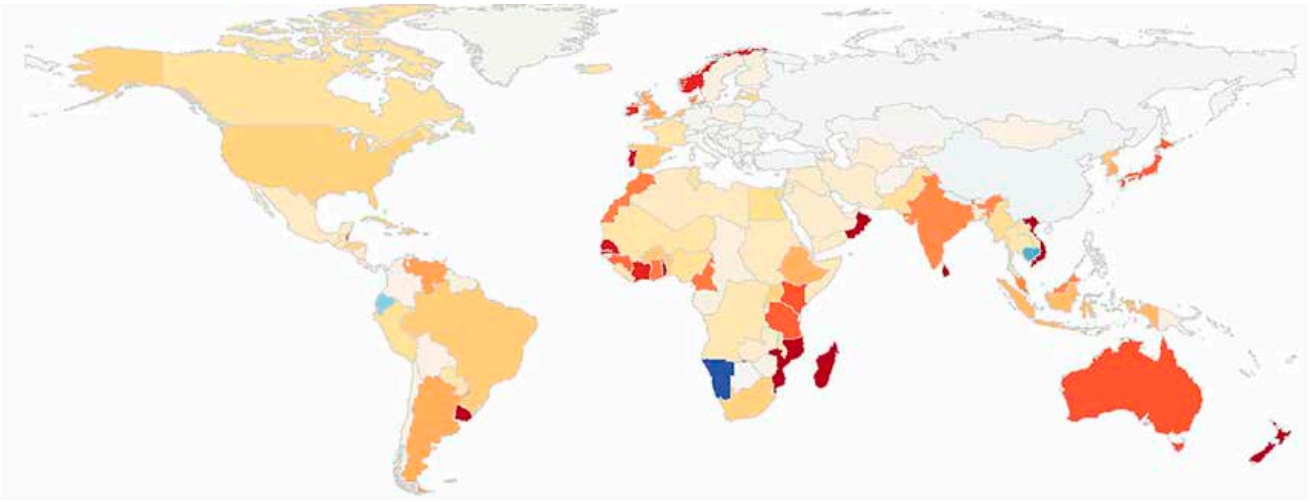
As shown in figure 3, countries including Togo, Cote d'Ivoire, Sri Lanka, Uruguay and Guinea also stand to gain the most from improved nature protection under a GC scenario by 2050 when compared to outcomes under the BAU scenario. However, no country is immune to these changes. Larger economies such as USA, Japan, UK India and Australia would also see significant annual GDP losses under the BAU scenario by 2050, primarily due to increased exposure of coastal infrastructure and agricultural land to climate change-induced flooding and erosion.

China stands to gain significantly under the GC scenario by 2050, with an increase in annual GDP of US$ 43.1 billion. This is primarily because it has a significant share of its economy in pollinator-dependent oil crops. Increased pollination services under the GC scenario would increase China's competitive advantage in this sector, driving down costs through greater production efficiency, and ultimately leading to greater oil crop supply, and thus lower prices.

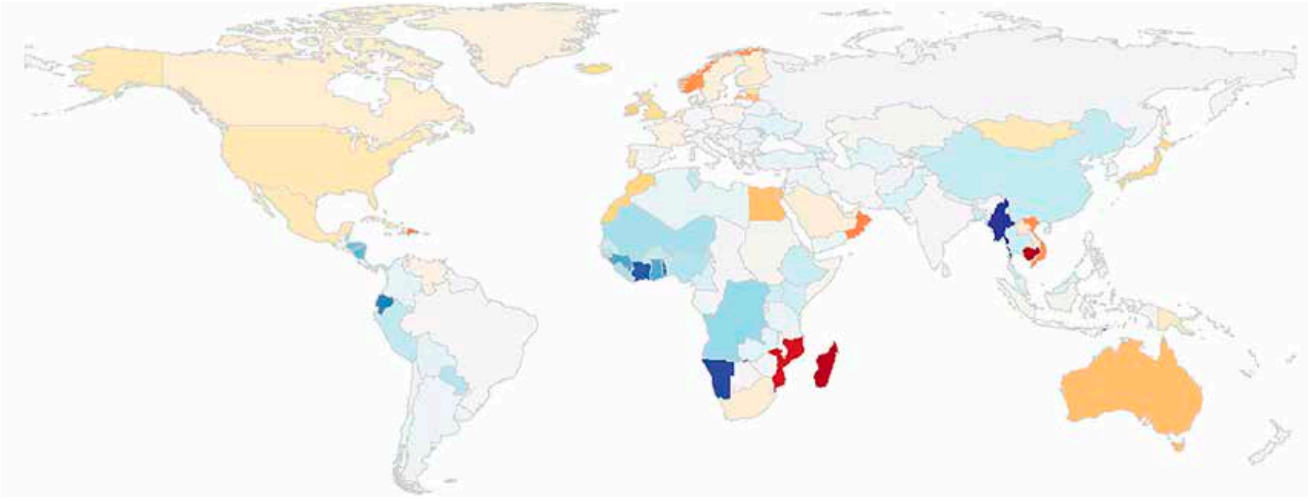
+$43.1bn

INCREASE IN ANNUAL GDP OF CHINA DUE TO IMPROVED PROTECTION AND RESTOTATION OF ECOSYSTEMS

BUSINESS AS USUAL



GLOBAL CONSERVATION



Percent Change in GDP

<-2.1 0 2.1<

FIGURE 4:

IMPACT ON ANNUAL NATIONAL GDP % OF CHANGES IN ECOSYSTEM SERVICES UNDER BUSINESS-AS-USUAL AND GLOBAL CONSERVATION SCENARIOS BY 2050 (COMPARED TO A BASELINE SCENARIO OF NO CHANGE IN ECOSYSTEM SERVICES BY 2050)

The results also reveal valuable information about which ecosystem service changes are most important in driving these impacts. As shown in table 3, it's clear that, of those ecosystem services modelled, loss of coastal protection and carbon storage services present by far the greatest risks to future global GDP under the BAU scenario.

Reduction in coastal protection services alone – as will occur if, for example, we continue to lose mangroves, coral reefs, seagrasses and saltmarshes – would reduce annual global GDP by 0.46% by 2050 due to the impacts of flooding and erosion on coastal cities and agricultural land (equivalent to an annual loss of US$ 327 billion). Coastal damages still occur under the GC scenario due to the effects of climate change induced sea-level rise and extreme weather, but they are substantially lower (US$ 134 billion reduction in annual global GDP) than under the BAU scenario, due to the increased level of protection provided by coastal/marine habitats.

Ecosystem service	Business as usual		Global Conservation	
	%	US$ Billion	%	US$ Billion
Pollination	-0.02%	-15.3	+0.06%	+41.7
Coastal protection	-0.46%	-326.9	-0.19%	-134.2
Water yield	-0.03%	-18.6	-0.02%	-13.6
Forestry productivity	-0.01%	-7.5	+0.01%	+8.4
Fish productivity	+0.02%	+17.1	+0.08%	+57.3
Carbon storage	-0.18%	-127.7	+0.07%	+51.6
All ecosystem services	***-0.67%***	***-478.9***	***+0.02%***	***+11.3***

TABLE 3:
IMPACT ON ANNUAL GLOBAL GDP DUE TO CHANGES IN DIFFERENT ECOSYSTEM SERVICES UNDER BUSINESS-AS-USUAL AND GLOBAL CONSERVATION SCENARIOS BY 2050 (COMPARED TO A BASELINE SCENARIO OF NO CHANGE IN ECOSYSTEM SERVICES BY 2050)

ANALYSIS

The research paints a clear picture of the potential risks to our prosperity if we fail to tackle nature's decline – and of what we can gain by protecting and restoring nature's life support systems. Continuing with business as usual will not only be catastrophic for nature, it will also lead to highly undesirable economic effects. In contrast, ambitious efforts to protect and restore nature will dramatically improve economic outcomes.

The results provide several other important insights:

- **Loss of coastal protection services is among the most significant nature-related risks to economies:** Loss of marine and coastal habitats (e.g. corals, mangroves, seagrasses and saltmarshes) exposes infrastructure and high-value agricultural land to storms, erosion and flooding. Around half of the world's corals have already been lost in the last 30 years and up to half the world's mangroves in the last 50.[13,14] Given future climate change predictions, and with some 40% of the world's population living on the coast and billions of dollars' worth of infrastructure situated in coastal cities (with further substantive investment expected over the next decade), the ingredients are in place for significant economic damages if we continue to degrade our natural coastal defences. Losses are expected to be particularly significant in high-income countries such as the USA, Japan and the UK.
- **Global forest loss is a growing threat to climate and economy:** Under the BAU scenario, forests would be among the greatest casualties due to land clearance for livestock, agriculture, mining, infrastructure development and other pressures.[15] The tropics lost 12 million hectares of tree cover in 2018, including 3.6 million hectares of primary rainforest, the fourth-highest annual loss this century.[16] Among the most important ecosystem services provided by these forests in economic terms is carbon storage, the loss of which generated the second largest economic cost of those modelled.
- **Nature loss will significantly affect food systems:** Nature loss inhibits food production, for example, through reduced pollination of commercial crops (due to loss of pollinator feeding and shelter habitats) and increased damage to coastal agricultural land from flooding and erosion (due to loss of protective coral reefs and mangroves). Reduced production will push up commodity prices, affecting producer margins and consumer prices. In worst hit areas, price hikes could be expected for certain basic foodstuffs (e.g. grains, oils, fruit and vegetables, processed foods etc.) with implications for food security where communities are already vulnerable. However, as the GC scenario shows, it is possible to deliver more food at lower prices and restore nature at the same time, generating multiple economic and social gains.
- **Poorer countries bear most of the costs of nature loss:** Under the BAU scenario, low-income countries are worst affected in terms of the percentage change in annual national GDP from reduction in ecosystem service supply (see figure 5), compounding the risks faced by millions in already vulnerable economies. However, under the GC scenario, low-income countries in Sub-Saharan Africa, Central America and Southeast Asia see particularly significant improvements in annual national GDP due to improved pollination services, forestry and fishery yields. Protecting nature is thus a pro-poor strategy, supporting multiple social development goals.
- **Business and supply chain risks are high in some key sectors:** Loss of ecosystem services has potentially significant risks for economic sectors that are highly dependent on them (e.g. food and agriculture). However, in interconnected economies, all sectors are affected through knock-on economic effects (e.g. the service sector and manufacturing also see adverse impacts). Increases in global prices for key commodities (e.g. timber, cotton, oil seeds, fruit and vegetables) could lead to supply chain disruptions and reduced margins for producers. Increased costs (e.g. for raw materials, insurance and infrastructure repair) and reduced profitability could also affect returns and the confidence of investors, lenders and insurers in certain sectors.

13 Van Hooidonk, R., Maynard, J. A., Manzello, D. and Planes, S. 2013. Opposite latitudinal gradients in projected ocean acidification and bleaching impacts on coral reefs. Global Change Biology 20: 103-112

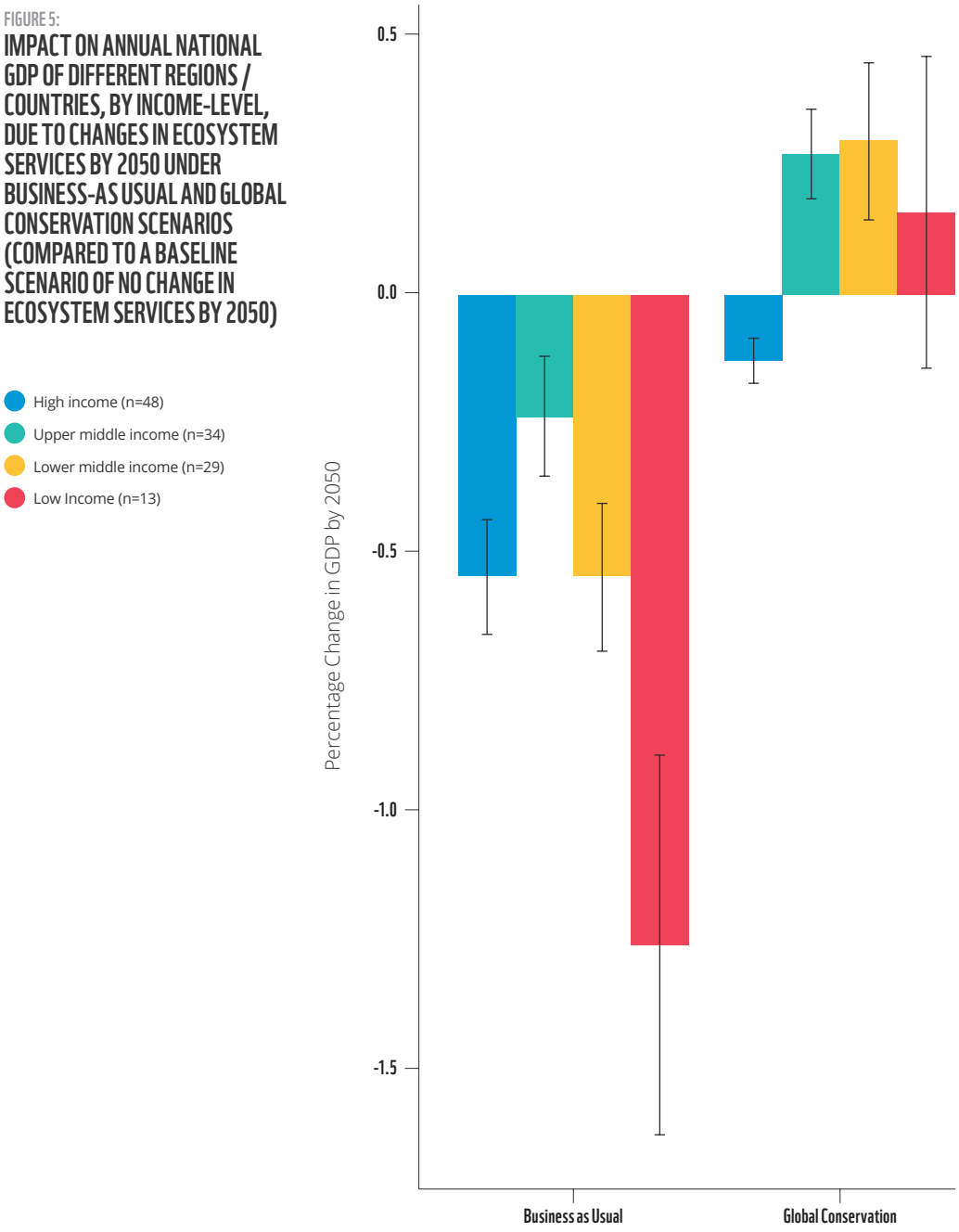
14 Donato, D. C. et al. 2011. Mangroves among the most carbon-rich forests in the tropics. Nature Geoscience 4: 293

15 https://wwf.panda.org/our_work/forests/deforestation_fronts2

16 https://blog.globalforestwatch.org/data-and-research/world-lost-belgium-sized-area-of-primary-rainforests-last-year

FIGURE 5:

IMPACT ON ANNUAL NATIONAL GDP OF DIFFERENT REGIONS / COUNTRIES, BY INCOME-LEVEL, DUE TO CHANGES IN ECOSYSTEM SERVICES BY 2050 UNDER BUSINESS-AS USUAL AND GLOBAL CONSERVATION SCENARIOS (COMPARED TO A BASELINE SCENARIO OF NO CHANGE IN ECOSYSTEM SERVICES BY 2050)



As discussed above, the results are conservative and represent just a fraction of the costs we could be facing if we fail to tackle nature's decline. Future versions of the model, which will include more ecosystem services and other factors such as the risk-multiplying effects of tipping points, are likely to further reinforce the economic imperative for investing in nature.

CONCLUSIONS AND POLICY RECOMMENDATIONS

The world is waking up to the need to reverse nature's decline if we are to have a sustainable future. Yet current levels of ambition fall far short of what's needed to achieve this, and continued population, economic and consumption growth is putting ever increasing pressures on our natural environment.

IPBES has warned that, even in its most optimistic scenario, global biodiversity and many of the economically important 'regulating' services that nature provides (like coastal protection, crop pollination, soil protection, nitrogen retention, pest control and carbon storage) will continue to decline. This study shows that we need to go further in actively reversing the loss of nature, and that this will have substantial economic benefits. We hope these results will raise ambition and help to identify critical policy priorities.

This work has made substantial methodological advances, providing a means to better understand the interlinkages between environmental change and economic outcomes. The research findings also help to demonstrate the wide ramifications of nature's decline and scale of the future risks we're facing.

30%

OF ALL LAND, INLAND WATERS AND OCEANS SHOULD BE CONSERVED IN EFFECTIVELY MANAGED PROTECTED AREAS

EXPANDING GLOBAL PROTECTED AREA NETWORKS

This work has shown the substantial economic gains that could be realised from avoiding further loss of areas that are important for biodiversity and ecosystem services. In this sense, it also makes a compelling economic case for a global effort to expand coverage of protected areas (PAs) to ensure these critical areas are off limits to future development and continue to provide benefits to economies and people in the future.

WWF and others recommend that at least 30% of all land, inland waters and oceans should be protected in comprehensive, ecologically coherent and effectively managed networks of PAs.[17, 18] As the results of the GC scenario show, targeting the location of PAs carefully – based on analysis of the spatial distribution of biodiversity and ecosystem services across land and seascapes – can help to maximise both the environmental and economic gains. Such information can also be used to inform the development of PA management strategies and sustainable financing mechanisms (for example, by identifying ways to enable those benefitting from PAs to contribute to their long-term management costs).

INTEGRATING NATURE'S VALUE INTO LAND-USE AND MARINE PLANNING

In addition to establishing PAs, taking steps to protect and restore nature in other areas (e.g. in cities, agricultural areas and across seascapes) is also essential for maintaining functioning ecosystems and the services on which we all depend. The gains from a spatially-targeted approach under the GC scenario highlight the importance of effective spatial planning (e.g. land-use planning and marine spatial planning) which takes account of the value of nature, both by integrating PAs into plans, and by driving improved biodiversity protection and sustainable human activities elsewhere.

17 https://presspage-production-content.s3.amazonaws.com/uploads/1763/jointstatement-905923.pdf?10000

18 https://advances.sciencemag.org/content/5/4/eaaw2869

THE LOSS OF NATURE WILL IN FACT UNDERMINE FOOD PRODUCTION, PUSHING UP PRICES FOR BOTH FOOD AND OIL CROPS

Businesses also need to support and engage in land-use planning processes, working with other stakeholders and acting as influential champions on the need for sustainable management and improved production and consumption processes that minimise society's impact on nature. Many tools now exist for businesses to assess their impacts and dependencies on nature, such as those which have been brought together under the Natural Capital Protocol,[19] and which can provide valuable inputs into planning processes and business decision-making.

The model can also help explore trade-offs between different land uses at the global level, and how best to allocate land to achieve the Sustainable Development Goals, feed a growing global population, tackle climate change and leave space for nature. The results of this study show that these are not simple trade-offs: the loss of nature will in fact undermine food production, pushing up prices for both food and oil crops. All of this highlights the importance of understanding and incorporating the value of nature and the ecosystem services it provides into countries' growth, development and land-use planning processes.

INTEGRATING NATURE-BASED SOLUTIONS INTO CLIMATE CHANGE STRATEGIES

The interlinkages between nature and climate are already well established, and this work further underlines the economic case for nature protection as a critical component in tackling climate change. Based on this analysis, using the social costs of carbon, loss of habitats that provide carbon storage services (and consequent release of stored GHGs) is among the greatest costs to the global economy among the ecosystem services modelled. Protecting and restoring nature as part of climate change mitigation strategies makes economic sense.

This work also showed that loss of coastal protection services is an even bigger risk. Given future predictions for climate change induced sea-level rise and extreme weather, this is a risk we cannot ignore. Investment in protecting and restoring our natural sea-defences can play a significant role in reducing these costs and adapting to climate change alongside other measures (e.g. man-made coast defences).

These dual climate-change benefits should be reflected in government and business decision-making at all levels. Governments need to develop coherent policy frameworks and develop improved approaches for managing these vital natural assets that consider their multiple benefits. For example, nature's contribution to tackling climate change needs to be fully incorporated into countries' national climate change action plans.

A growing number of businesses are adopting science-based targets to guide their action to tackle their climate change impacts,[20] but more work is needed to develop and implement similar science-based targets for their impact on nature and ecosystem services. The Science Based Targets Network is working with companies on developing these methodologies.[21] This study demonstrates that it is critical to incorporate impacts on nature in company strategies including how they can deliver emissions reductions through nature-based solutions.

19 https://naturalcapitalcoalition.org/natural-capital-protocol/

20 http://sciencebasedtargetsnetwork.org/

21 the Science-Based Targets Network is now looking to develop nature-based targets. http://sciencebasedtargetsnetwork.org/news/companies-support-new-targets-to-protect-earths-life-support-systems.html

TRANSFORMING THE ECONOMIC SYSTEM TO INCENTIVISE SUSTAINABLE DECISION-MAKING

In order to allow space for protected areas, and for us to pursue lifestyles that are consistent with the finite environmental limits of the planet, we need to transform the way we live. As IPBES concluded, this will require reform of our economic and financial systems at all levels. Sustainable decisions must become the norm so that planning, development and investment are all geared towards driving the transition of the global economy to a resource efficient, low-carbon and nature restorative model.

It will require reform of public finance and economic policies, for example by eliminating environmentally damaging subsidies, ensuring that public spending and foreign investment is nature-positive, and using green procurement to boost markets for sustainable goods and services.

To provide a more accurate picture of the health of economies, governments also need to develop new metrics to complement GDP that take account of the interactions between economy and environment. At the national level, the development of natural capital accounts can play a vital role in helping governments to track changes in natural assets and ecosystem services, and help to identify associated risks, liabilities and investment requirements. Annual budgetary statements should report on progress against these wider metrics. Ministries of Finance and Economy should include sustainability within their mandate and appoint a Minister for Sustainability to oversee this.

Economic and financial sector policies need to provide much stronger incentives for the private sector to take account of nature's value in their decision-making. Clear long-term science-based targets are needed for business, and strong legal and regulatory frameworks are needed to hold businesses to account for meeting them and for mitigating, compensating for and/or offsetting their impacts.

SUSTAINABLE DECISIONS MUST BECOME THE NORM SO THAT PLANNING, DEVELOPMENT AND INVESTMENT ARE GEARED TOWARDS DRIVING THE TRANSITION OF THE GLOBAL ECONOMY

Governments should also take steps to ensure that businesses assess and manage their impacts and dependencies on nature, and associated risks. The creation of a new Taskforce for Nature-related Financial Disclosures (akin to the Taskforce for Climate-related Financial Disclosures) would be another important step, helping to catalyse global action on nature-related financial disclosure among finance institutions, asset owners, banks and investors.[22]

Governments, businesses and civil society should work together to identify and advocate the systemic changes and economic reforms required to drive this transition, including through initiatives such as the Business for Nature coalition, which has proposed a set of recommendations which are highly aligned with those in this report.[23]

22 https://wwf.panda.org/our_work/finance/?346755/Into-the-Wild-integrating-nature-into-investment-strategies

23 https://www.businessfornature.org/policy

REDUCING OUR GLOBAL FOOTPRINT

In today's globalised economy, we are all at risk from global biodiversity loss through our dependence on supply chains. Yet our current production and consumption systems are exacerbating the problem. The recent IPBES global assessment discussed the issue of telecoupling – where resource extraction and primary production occur in one part of the world to satisfy the needs of consumers elsewhere, who tend to be unaware of and take no responsibility for the environmental damage caused.

To help address this problem, governments need to ensure that countries take responsibility for the impact (or footprint) that their international supply chains have on nature around the globe and commit to reducing them over time. Otherwise countries can simply shift domestic environmental damages to other countries as their own regulations are tightened.

This is neither ethically acceptable, nor in anyone's interests. Unless this issue is addressed, global competition and conflict over natural resources will intensify, posing serious challenges to the achievement of the Sustainable Development Goals, and threatening economic prosperity and food security globally.

Some countries are starting to act. For example, the UK government has established a Global Resource Initiative to consider actions the UK can take to green its international supply chains and leave a lighter footprint on the global environment.[24] This model could be scaled up into a multilateral initiative enabling countries to work together collaboratively to address these issues.

GOVERNMENTS NEED TO ENSURE THAT COUNTRIES TAKE RESPONSIBILITY FOR THE IMPACT THAT THEIR INTERNATIONAL SUPPLY CHAINS HAVE ON NATURE AROUND THE GLOBE

Similarly, businesses should take responsibility for assessing their nature-related risks and dependencies in their supply chains and report on and address any risks. Companies should also commit to avoiding activities and investments that damage protected or unprotected areas that are important for biodiversity and ecosystem services (e.g. tropical forests, mangroves, wetlands and coral reefs) and eliminating Illegal, Unreported and Unregulated (IUU) activities from their supply chains. They should also back this with clear operating procedures, third party verification and transparent reporting on progress.

24 https://www.gov.uk/government/news/global-resource-initiative-taskforce-greening-the-uks-environmental-footprint

SUMMARY OF KEY RECOMMENDATIONS

To address the issues identified in this report, governments need to:

1. Agree a New Deal for Nature and People, that incorporates a strong post-2020 framework for global biodiversity protection, to halt and reverse the global loss of biodiversity by 2030 and put nature on a path to recovery for the benefit of all people and the planet.[25, 26]
2. Incorporate the value of nature and ecosystem services into land-use planning, growth and development strategies, and climate change action plans, and align public spending and economic policies, for example by eliminating environmentally damaging activities.
3. Implement national natural capital accounting and use this information in annual budget statements and expand economic performance metrics beyond GDP to better measure long-term economic health and incentivise the protection of nature.
4. Incentivise sustainable private sector decision-making through the implementation of science-based targets for business, market-based and financial incentive mechanisms, legal and regulatory frameworks that hold businesses to account for their impacts on nature, and the establishment of a Taskforce for Nature-related Financial Disclosures.
5. Take responsibility for the international environmental footprint of countries and commit to reducing negative impacts over time, establish a multilateral Global Resources Initiative to promote sustainable supply chain management, and ensure coherence with trade and development policies.

The private sector needs to:

1. Engage in and champion the New Deal for Nature and People, and the post-2020 framework for global biodiversity protection, helping to build support for nature within and across economic sectors, producers and consumers.
2. Commit to ensuring that their business operations and investments are aligned with international environment and climate goals, avoid damages to protected or unprotected areas that are important for biodiversity and ecosystem services (e.g. tropical forests, mangroves, wetlands and coral reefs), and to maintaining resource use within scientifically agreed limits.
3. Commit to eliminating environmentally damaging activities (especially to critical habitats such as tropical forests, mangroves, wetlands and coral reefs) and eliminating Illegal, Unreported and Unregulated (IUU) activities from their supply chains, and back this with clear operating procedures, third party verification and transparent reporting on progress.
4. Identify, evaluate and report on the nature-related impacts and dependencies of their business and supply chains, and associated risks, and take steps to avoid, mitigate, compensate for and/or offset any adverse impacts on nature.
5. Work with other businesses, governments and civil society to identify and implement the economic and financial sector reforms needed to incentivise sustainable decision-making, and engage in national economic, development and spatial planning processes to help ensure that nature's value is considered.

25 https://explore.panda.org/newdeal

26 https://www.cbd.int/article/2020-01-10-19-02-38

THE TIME TO ACT IS NOW

This report comes at a critical time, marking the start of a landmark year for the future of our planet. During 2020, political leaders and negotiators will be delivering a series of important global outcomes on nature, climate and development, and establishing an overarching New Deal for Nature and People that incorporates a strong post-2020 framework for global biodiversity protection.[27, 28]

There will also be new evidence and recommendations being developed on how to address these issues, including for example through the forthcoming Dasgupta Review on the Economics of Biodiversity, commissioned by the UK Treasury.[29]

As IPBES and other global reports have warned, and this report corroborates, current levels of ambition are not enough. To reverse nature's decline, and for humanity to enjoy a sustainable and prosperous future, we urgently need transformational change across our economic and financial systems. Gearing these systems towards delivering long-term sustainable prosperity will incentivise the protection and restoration of nature.

We hope that this report, alongside other evidence, will encourage and enable world leaders to take decisive action before it is too late.

27 https://explore.panda.org/newdeal

28 https://www.cbd.int/article/2020-01-10-19-02-38

29 https://www.gov.uk/government/collections/the-economics-of-biodiversity-the-dasgupta-review

TO REVERSE NATURE'S DECLINE, AND FOR HUMANITY TO ENJOY A SUSTAINABLE AND PROSPEROUS FUTURE, WE URGENTLY NEED TRANSFORMATIONAL CHANGE ACROSS OUR ECONOMIC AND FINANCIAL SYSTEMS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ABBREVIATIONS AND ACRONYMS

BAU	Business as Usual (scenario)
CGE	Computable General Equilibrium
ES	Ecosystem Services
GC	Global Conservation (scenario)
GDP	Gross Domestic Product
GTAP	Global Trade Analysis Project
InVEST	Integrated Valuation of Ecosystem Services and Trade-offs
IPBES	Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
RCP	Representative Concentration Pathways
SP	Sustainable Pathway (scenario)
SSP	Shared Socioeconomic Pathway
TEEB	The Economics of Ecosystems and Biodiversity

GLOBAL FUTURES PARTNERS

WWF is the world's largest conservation organisation at the heart of international efforts to address the world's most important environmental challenges. WWF works with governments, businesses and communities to promote sustainable patterns of development so that both people and nature can thrive. Together, we're safeguarding the natural world, tackling climate change, and promoting prosperous and resilient economies.

The Global Trade Analysis Project (GTAP) was founded in 1992 and has since grown into a global network of 17,000+ individuals in 170+ countries, all contributing to and/or using a common database and modelling framework to assess the economy-wide impacts of trade and environmental policies. GTAP has expanded into environmental issues including analysis of global land use and the assessment of climate impacts and mitigation activities on food security and poverty.

The Natural Capital Project (NatCap) is a partnership of four world-class academic institutions – Stanford University, the Chinese Academy of Sciences, the University of Minnesota, and the Stockholm Resilience Centre – and two of the world's largest NGOs, The Nature Conservancy and WWF. NatCap developed InVEST, a suite of 20 ecosystem service models used widely around the globe to assess how ecosystem services are affected by socio-economic drivers and policies. InVEST has been used for several high-profile global and regional assessments, including the IPBES global assessment and work with World Bank on developing a Natural Capital Index, among others.

Global Futures is an innovative science-policy partnership between WWF, the Global Trade Analysis Project (founded and hosted by Purdue University) and the Natural Capital Project (co-founded by the University of Minnesota). Based on a new first-of-its-kind global environment-economy modelling framework, its aim is to generate compelling new quantitative evidence on how and under what circumstances changes in the Earth's natural systems will affect the world's economies, trade and industry. The ambition is that governments, businesses and other actors will use this information in order to support more sustainable decision-making, improving long-term outcomes for nature and people.

WWF®

GLOBAL FUTURES: ASSESSING THE GLOBAL ECONOMIC IMPACTS OF ENVIRONMENTAL CHANGE TO SUPPORT POLICY-MAKING

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