



# NATURE-POSITIVE RECOVERY

FOR PEOPLE, ECONOMY & CLIMATE

## Disclaimer

This document, produced by the Nature4Climate (N4C) coalition, is a compendium of existing data (from peer-reviewed and grey literature) that relates to the economic and societal contributions of nature-based solutions. Information relevant to a specific country or region is indented. N4C does not necessarily endorse the data or proof points in this document. For questions and queries regarding specific statistics, please contact the originator of the research. This document is 'open source', meaning that we are happy for you to take the narrative (part 1) and use it however it is most useful. The proof points can be sourced to the original authors. We note that at an aggregate level there remain gaps across the data set, and further refinement required within it, and thus if we are missing key research that would improve this compilation, please email [info@nature4climate.org](mailto:info@nature4climate.org). We have also collated a list of spokespeople for each section that we are happy to share on request.

# Nature for recovery

Principles for investing in nature-based jobs and initiatives to stimulate the post-COVID economy.

Our scientific understanding of nature's role in the fight against climate change has deepened in the past three years and is now well-established.<sup>1</sup> So too has our understanding of the full range of benefits that nature-based solutions deliver for people around the world: whether providing jobs, filtering water, reducing air pollution, providing resilience to extreme weather or regulating local climate.

However, the economic case for nature-based solutions remains poorly defined and understood. This presents the proponents of nature-based solutions with an acute challenge as enormous amounts of finance are currently being mobilized to address the economic fall-out of the COVID-19 crisis. While there is already much discussion about how economic stimulus measures can and should avoid provoking harmful long-term impacts, and rather hasten the transition to more resilient and sustainable societies, by and large this discussion overlooks nature-based solutions. In part, this is because their economic benefits have not been articulated and communicated effectively enough.

While the most immediate priorities of COVID-19 responses have rightly been health and economic well-being, the crisis has also created a new appreciation for how our encroachment on nature poses significant risks. There is, however, much more work to be done to help decision-makers recognize the significant benefits and opportunities that nature-based solutions can offer as part of their economic recovery plans.

N4C has reviewed scores of reports and research and has pulled together relevant information about the economic value of nature-based solutions in a single place for the first time. By doing so, we hope the collective weight of this information will begin to cultivate a new appreciation for nature-based solutions, and also help us identify evidence gaps that future work can help fill.

In preparing this document, N4C has identified **three key principles** for nature-positive recovery plans for people, economy and climate.

**The first principle is do no harm.** The worst-case scenario would be if stimulus packages drive further unsustainable land-use changes, increase CO<sub>2</sub> emissions or contribute to further environmental degradation. As countries find themselves with increased debt, depressed economies, foreign currency shortfalls and disrupted supply chains, they may be tempted to liquidate natural resources as a short-term solution to stimulate economic activity. Such an approach betrays a lack of understanding about the very significant risk this would pose to resilience, development and long-term prosperity. Put simply, the risk of destroying natural capital far outweighs any short-term gain.

Recent analysis by the Food and Land Use Coalition (FOLU) estimates that the ways we produce and consume food and use our land currently cost \$12 trillion a year in damage to our environment, health and development. If we do nothing, this will amount to more than \$16 trillion each year by 2050. This risk must be properly understood by decision-makers to avoid ill-informed, short-term decisions.

On the other hand, the economic argument for upholding environmental standards is clearer than ever. The same analysis found that new investment of \$350 billion a year in sustainable food and land use systems could create as many as 120 million new jobs and unlock up to \$4.5 trillion in new business opportunities by 2030.

*“The high-productivity economies of the future will be those that make the most of artificial intelligence and the technologies of the fourth industrial revolution, while also protecting and enhancing natural capital, such as ecosystems, biodiverse habitats, clean air and water, productive soils, and a stable climate.”*

*Lord Stern and Joseph Stiglitz*

**The second principle is to properly value the full range of benefits that natural ecosystems offer, and the role they play in building sustainable economies and communities.** Decision-makers must be armed with this knowledge to make appropriate policy decisions, but too often this information is lacking. For forests and other natural ecosystems, the greatest economic value generated is not from products but from ecosystem services, most of which are not currently recognized in economic analysis.

The benefits derived from biodiversity and ecosystem services are considerable, but are systematically undervalued or unvalued in day-to-day decisions, market prices and economic accounting. Conventional accounting approaches and measures of economic performance (such as GDP) provide only a limited picture of an economy's health, and generally, overlook the costs of ecosystem degradation.

There is, as yet, no standardised approach for factoring nature's value into GDP calculations, but the most comprehensive global estimate suggests that ecosystem services provide benefits in the magnitude of trillions of dollars per year. There is much more work required on this front, but decision-makers should immediately demonstrate the wisdom and foresight to explore how they can better factor nature's value into their economic deliberations during these difficult times.

Perhaps nowhere is the underappreciation of nature more apparent than in its link with health. Protecting natural ecosystems will in all likelihood reduce risks of new zoonotic diseases spreading to humans, mitigating the risk of another pandemic like COVID-19, which has brought the global economy to its knees. But forests and other natural ecosystems can also improve local and regional air quality. For example, at a cost of an average of \$4 per urban resident, trees could help cool cities while reducing life-threatening, and costly air pollution.

**The third principle is to appreciate the direct economic contribution of certain nature-based solutions, which of course have the added value of a full range of other benefits.**

According to the International Labour Organization (ILO), more than one billion workers worldwide are at high risk of a pay cut or losing their job as a result of COVID-19

—that is nearly half the global workforce<sup>2</sup>. Studies by economists have indicated that investments that could deliver the highest value in the form of job creation and long-term economic performance include commitments and policy decisions that protect and enhance natural capital. Large-scale ecosystem restoration efforts, usually supported by government programs, have enormous potential to create jobs, perhaps as many as 40 jobs for every \$1 million invested. In fact, evidence from the 2009-2010 stimulus showed that every million dollars invested in ecosystem restoration created 10 times as many jobs as investments in the coal or nuclear sector. With one-third of the planet's land degraded, a global effort to restore degraded lands either to natural forest or to productive use could generate major economic, employment, and climate gains.

*"As nature declines, the prospects for business success and future prosperity dwindle. Conversely, the business opportunities that await those committed to restoring natural ecosystems could be considerable."*

*Nature Risk Rising,  
World Economic Forum*

Real economic recovery will come in part from investing in nature—whether it be sustainable forest management, or other productive investments that can help rebuild carbon sinks. We have long-needed significantly enhanced financing for green nature-based infrastructure, sustainable agriculture and the circular economy, as well as investment in deforestation-free commodity supply chains.

At the very minimum, a 'do no harm' standard would ensure no further conversion of intact high-carbon, high-biodiversity ecosystems, as well as the adoption of minimum standards of sustainability in agricultural production.

Investing in nature-based solutions is about investing in people, jobs and the economy. The benefits that they offer will be expanded exponentially if we properly invested with an eye to the future and called upon nature's power to help build a more resilient future.

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1 There is also a substantial and growing body of research that quantifies nature's role in slowing the pace of climate change. By employing strategies to protect, restore and properly manage natural and agricultural systems we can lower global CO<sub>2</sub>e emissions by roughly 10 billion tonnes annually. Many of these strategies are inexpensive and, in most cases, can provide positive economic returns. In a review of 16 studies estimating the social cost of carbon (the financial impact of CO<sub>2</sub> emissions), researchers found that with a 2°C increase in global temperatures the average person would experience a 1% loss of income, with some models showing nearly a 10% loss.

2 ILO Monitor, [COVID-19 and the world of work](#) (2020)



# How to use this document

This is not a narrative document that is designed to be read from front to back, although you certainly can if you wish. Instead, we expect most users to be searching for information that relates to a specific topic or geography. Please use the Table of Contents below to help you navigate the document. Alternatively, use Ctrl-F (PC) or Command-F (Mac) to search the document for specific keywords. We also encourage you to explore the source material on your own. While we have combed through this to pick out key analysis and statistics, it is very likely that the source will have additional information relevant to your area of interest. Finally, we would like to repeat our appeal for your help in filling gaps, particularly at the national level, by passing along relevant research or case studies to [info@nature4climate.org](mailto:info@nature4climate.org).

As you review the information in this compendium report, and as you consider the associated economic opportunities, remember that for an action to be considered a nature-based solution, it must adhere to certain principles, which include being done in the right places in the right ways, with the full participation and support of local communities and Indigenous peoples and as part of a broader program of climate action. For further guidance on these topics, please consult the following resources: [NBS Guidelines](#), [ICUN Global NBS Standard](#), [N4C on tree planting](#).

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Tribal women of the Sundargarh district of eastern India's Odisha state have chosen to produce safe and nutritious food, achieving food security and a better livelihood through organic farming. Photo credit: © Basudev Mahapatra / LifeGate







Tea pluckers on a plantation, Haputale, Uva Province, Sri Lanka, Asia

### 3.1

## The Global Value of Nature

As national governments deal with the repercussions of COVID-19, many are locking in policies that will reverberate for decades. At this critical juncture, nature-positive recovery is both possible and sensible—for creating jobs, ensuring our future health and economic well-being, stabilizing our climate and protecting biodiversity.

#### HEADLINE STATISTICS:

- More than half the world's total gross domestic product (GDP)—at least \$44 trillion of economic value generation—is moderately or highly dependent on nature and its services.
- Forest resources support the livelihoods of more than 1.5 billion people around the world.
- New investment of \$350 billion per year in sustainable food and land use systems could create more than 120 million new jobs and \$4.5 trillion of new business opportunities by 2030.

## Nature-dependent value

- Research by the World Economic Forum (WEF) has estimated that \$44 trillion of economic value generation—more than half of the world’s total GDP—is moderately or highly dependent on nature and its services and is therefore exposed to nature loss. Industries that are highly dependent on nature generate 15% of global GDP (\$13 trillion), while moderately dependent industries generate 37% (\$31 trillion).<sup>3</sup>
  - The Global Commission on the Economy and Climate says that the global public goods benefits from forests, which would be in the order of trillions if properly counted, are obscured by the more tangible private benefits through priced goods—timber, land for agriculture—accruing to those able to seize them. A first-order priority, therefore, is to recognise the true economic value forests offer; and then to establish a ‘new forest economy’ which reflects that value.<sup>4</sup>
  - Together, the three largest sectors that are highly dependent on nature generate close to \$8 trillion of gross value added (GVA): construction (\$4 trillion); agriculture (\$2.5 trillion); and food and beverages (\$1.4 trillion). This is roughly twice the size of the German economy.<sup>5</sup>
  - Six additional industry groupings—chemicals and materials; aviation, travel and tourism; real estate; mining and metals; supply chain and transport; retail, consumer goods and lifestyle—with less than 15% of their direct GVA highly dependent on nature, still have “hidden dependencies” through their supply chains. More than 50% of the GVA of their supply chains is highly or moderately dependent on nature.<sup>6</sup>
  - The World Bank has found that well-managed natural infrastructure can provide sustained economic benefits, which are particularly important for low-income countries, where natural capital constitutes nearly half of the wealth.<sup>7</sup>
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## Forests, food and land use systems

- Forests are home to 350 million people around the world, while 60 million indigenous peoples almost wholly depend on them for their livelihoods. Some 70% of the world’s poorest people live in rural areas and depend on agriculture for their livelihoods, mostly in the tropics. In much of Africa, large parts of South Asia, and significant pockets elsewhere, the majority of the population are smallholder farmers or forest-dependent people living at the economic margin.<sup>8</sup>
- According to the FAO, close to 1.6 billion people—20% of the world’s population—rely on forest resources for their livelihoods and most of them (1.2 billion) use trees on farms to generate food and cash.<sup>9</sup>
- In addition to the direct benefits to people, forests (and especially intact forest systems) support a wide range of secondary benefits such as climate change mitigation, freshwater regulation, and human health.<sup>10</sup>
- Analysis by the Food and Land Use Coalition estimates that new investment of \$350 billion a year in sustainable food and land use systems could create more than 120 million new jobs and \$4.5 trillion in new business opportunities worldwide each year by 2030. This is at the same time as saving costs of \$5.7 trillion per year in damage to people and the planet, more than 15 times the investment cost of up to \$350 billion per year.<sup>11</sup>

- Research shows halting deforestation could boost the global economy by as much as \$80 billion per year, as well as make it more resilient to a changing climate by keeping nearly 3 billion tonnes of CO<sub>2</sub> emissions from entering the atmosphere annually.<sup>12</sup>
- Research commissioned by The Nature Conservancy (TNC) estimates that implementing natural climate solutions globally could contribute \$25-90 billion in annual value added by 2030—without factoring in a carbon price.<sup>13</sup> Additionally, the Economist Intelligence Unit says that the economic impacts of climate change are predicted to reduce global GDP by 3% by 2050.<sup>14</sup> By preventing nearly 10 billion tons of CO<sub>2</sub> emissions annually by 2030, natural climate solutions would help to reduce this economic burden.

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- 3 World Economic Forum, [Nature Risk Rising](#) (2020)
  - 4 The Global Commission on the Economy and Climate, [Unlocking the Inclusive Growth of the 21st Century](#) (2018)
  - 5 World Economic Forum, [Nature Risk Rising](#) (2020)
  - 6 Ibid
  - 7 World Bank, [The Changing Wealth of Nations 2018: Building a Sustainable Future](#) (2018)
  - 8 The Global Commission on the Economy and Climate, [The New Climate Economy: Better Growth Better Climate](#) (2014)
  - 9 FAO, [Forests and poverty reduction](#) (2015)
  - 10 Wildlife Conservation Society, [The Exceptional Value of Intact Forest Ecosystems](#) (2018)
  - 11 Food & Land Use Coalition, [Growing Better](#) (2019)
  - 12 The Global Commission on the Economy and Climate, [Seizing the Global Opportunity](#) (2015)
  - 13 The Nature Conservancy, [Lands of Opportunity](#) (2017)
  - 14 EIU, [Global economy will be 3 percent smaller by 2050 due to lack of climate resilience](#) (2019)





An aerial view showing deforestation for cattle ranching at São Félix do Xingu, a municipality in the Brazilian Amazon, that has one of the highest rates of deforestation in the country. Photo credit: TNC/Haroldo Palo Jr

### 3.2

## The Costs and Risks of Inaction

At a time when ‘normal’ has gone out the window, is it possible to change ‘business as usual’? Failing to make changes now risks trillions of dollars of damage to our ecosystems and our economies, while also endangering the health of millions of people.

#### HEADLINE STATISTICS:

- Some of the fastest-growing economies in the world are particularly exposed to nature loss: \$2.7 trillion in China, \$2.4 trillion in the EU, and \$2.1 trillion in the United States are in nature-dependent sectors.
- If we do nothing about the way we produce and consume our food, it will amount to damage estimated to cost \$16 trillion each year by 2050.

## Ecosystems and economic risk

- The OECD (Organisation for Economic Co-operation and Development) found that between 1997 and 2011, the world lost an estimated \$4-20 trillion per year in direct ecosystem services owing to land-cover change and \$6-11 trillion per year from land degradation.<sup>15</sup>
- Analysis by the FOLU determined that the ways we produce and consume food and use our land currently cost \$12 trillion per year in damage to our environment, health and development. If we do nothing, this will amount to more than \$16 trillion each year by 2050.<sup>16</sup>
- The Global Commission on the Economy and Climate says unchecked climate change might result in global economic losses in the order of trillions of US dollars. Given forests' vital role in climate regulation, the true economic benefits of reducing deforestation and forest degradation are of a similar magnitude.<sup>17</sup>
- The WEF says that some of the fastest-growing economies in the world are particularly exposed to nature loss. For example, around one-third of the GDP of India (33%) and Indonesia (32%) is generated in sectors that are highly dependent on nature, while the African continent creates 23% of its GDP in such sectors. In terms of global exposure, larger economies have the highest absolute amounts of GDP in nature-dependent sectors: \$2.7 trillion in China, \$2.4 trillion in the EU, and \$2.1 trillion in the United States. The WEF report accounts for construction, agriculture, food and beverages, which rely on either the direct extraction of resources from forests and oceans or the provision of ecosystem services such as healthy soils, clean water, pollination and a stable climate. This means that even regions with relatively lower shares of their economies at high exposure to nature loss hold a substantial share of the global exposure and therefore cannot be complacent.<sup>18</sup>
- Models suggest that if 20-25% of the Amazon forest is lost, this would lead to increased duration of droughts in the region and annual agricultural production losses of \$422 million in Brazil alone.<sup>19</sup> Brazil's contribution to global CO<sub>2</sub> emissions is significant. If left unchecked, deforestation alone will add 1 billion tonnes of CO<sub>2</sub> to the atmosphere annually by 2030.

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15 OECD, Biodiversity: [Finance and the Economic and Business Case for Action, report prepared for the G7 Environment Ministers' Meeting](#) (2019)

16 Food & Land Use Coalition, [Growing Better](#) (2019)

17 The Global Commission on the Economy and Climate, [Unlocking the Inclusive Growth of the 21st Century](#) (2018)

18 World Economic Forum, 2020, [Nature Risk Rising](#) (2020)

19 World Economic Forum, 2020, [Nature Risk Rising](#) (2020)





Mangwon Zone of riverside park alongside Seoul's Han River, designed for people to exercise in nature.

### 3.3

## Health

Never has there been a time when the planet is more focused on human health; it is critical during this intense period to recognize the links between human health and economic health, and understand the benefit investing in nature-based solutions will have on both.

#### HEADLINE STATISTICS:

- Natural environments in cities encourage exercise and can be part of the solution to addressing the global rise in noncommunicable diseases which account for 88% of European deaths.
- The OECD estimated the welfare cost from premature deaths stemming from exposure to outdoor fine particles and ozone at \$5.3 trillion globally in 2017.
- Urban greening strategies have been found to reduce mortality rates under projected average warm season and heat wave conditions in 2050, by approximately 50%, depending on models and conditions.



- Investment in nature has a range of human health benefits. Many of the benefits people get from nature affect their physical and mental health and the links between the impact of natural ecosystems on the physical environment (air, water and land) and downstream human health changes are not always drawn together in the same study.<sup>20</sup>
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### Urban areas and health benefits of nature

- Urban areas benefit from nature. They are home to 56% of the population today<sup>21</sup>, which is expected to increase to 68% by 2050.<sup>22</sup> International institutions such as the World Health Organization (WHO) have started recognizing the importance of protecting and creating urban natural environments.<sup>23</sup> Urban areas, if used for exercise<sup>24</sup>, can be part of a solution to address the global rise in non-communicable diseases, which account for 88% of European deaths.<sup>25</sup>
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### Benefits from ecosystems on health and well-being

- Being in natural environments has direct benefits for mental health. It reduces stress and provides restoration of cognitive fatigue. A nationwide study in the Netherlands covering more than 900,000 people found people who grow up with low levels of green space were 55% more likely to develop a psychiatric disorder independent from effects of other known risk factors.<sup>26</sup>
  - Trees can improve thermal comfort by providing shade from solar radiation and reducing air temperatures.<sup>27</sup> They can also help homeowners save money. The USDA Forest Service's Northern Research Station found that trees can clean the air and shade homes while delivering homeowners in the US more than \$7 billion in energy savings.<sup>28</sup>
  - Urban greening strategies were found to reduce mortality rates under projected average warm season and heat wave conditions in 2050, by approximately 50%, depending on models and conditions.<sup>29</sup>
  - Urban green spaces make it more attractive for people to undertake physical activity.
- 

### Improving air quality is good for human and economic health

- Forests can improve local and regional air quality. TNC reports that for an average of \$4 per urban resident, municipal tree planting and urban greening programs could help cool cities while reducing life-threatening air pollution and offering many other co-benefits for individuals and communities. Urban trees provide substantial pollution reduction services—the same TNC report values these services for the world's 10 megacities at \$482 million per year.<sup>30</sup>
- Research has estimated the value of services that trees within New York City provide, by removing fine particles from the atmosphere and thereby improving air quality and human health, at \$60.1 million per year.<sup>31</sup>
- The OECD estimated the welfare cost from premature deaths stemming from exposure to outdoor fine particles and ozone at \$5.3 trillion globally in 2017.<sup>32</sup>
- A 2011 study found that a value of a hectare of an urban forest was \$1,500 due to recreational opportunities, aesthetic enjoyment and environmental functions.<sup>33</sup>
- Conversely, nature loss can exacerbate the effects of air pollution, a major threat to health that causes between 3.4 and 8.9 million deaths every year.<sup>34</sup>

## Disease and medicines

- Many of the drugs used today for health care and disease prevention were discovered from plant sources. Between 25-50% of pharmaceutical products are derived from genetic resources; and 70% drugs used for cancer treatment are natural or synthetic products inspired by nature.<sup>35</sup>
- Substitutes for natural medicines are often financially prohibitive: an estimated 4 billion people rely primarily on natural medicines for their healthcare, mostly in lower income countries. Although plants have been a major source of natural product drugs, only a fraction of the 400,000 plant species on Earth have been studied for their pharmacological potential. The untapped potential for future drug discovery and medical insights from biodiversity is vast but is diminishing because of biodiversity loss.<sup>36</sup>
- Although numbers vary, it's been reported that as many as 80% of people living in rural areas in developing countries rely on traditional plant-based medicines for basic healthcare.<sup>37</sup>
- With the world now acutely aware of the threat of animal-to-human disease transmission, we need to better understand the relationship between habitat degradation, biodiversity loss and human health. Adopting conservation and land management approaches that are holistic and consider the protection and restoration of natural and managed systems along with human wellbeing and pathogenesis are needed as populations rise.



### ASIA

#### Indonesia

- + The World Bank estimated that the haze from the 2015 forest fires in Indonesia caused \$151 million of immediate health costs alone, with long-term costs still unquantified.<sup>38</sup> Many of these fires were spurred by forest conversion and peatland drainage for rice and palm oil production. It is estimated that one billion tons of CO<sub>2</sub>e is released into the atmosphere every year due to these activities.<sup>39</sup>



### EUROPE

#### United Kingdom

- + The physical and mental-health benefits of natural environments (e.g. parks, woodlands and beaches) in the United Kingdom are estimated at GBP 2 billion (pounds sterling) per year.<sup>40</sup>



### NORTH AMERICA

#### United States

- + In the US, it is estimated that people who live within 0.6 miles of greenspace have lower rates of 15 major diseases, including heart disease (15% lower), diabetes (20% lower), and depression (25% lower). The same study estimated that greenspace can lower US health care costs by improving health, reducing the annual cost of cardiovascular disease (\$330 billion), diabetes (\$327 billion), and depression (\$210 billion).<sup>41</sup>
- + Trees and forests in the conterminous US removed 17.4 million tonnes of air pollution in 2010 alone, providing health benefits (avoidance of human mortality and incidences of acute respiratory symptoms) valued at \$6.8 billion.<sup>42</sup>

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- 20 Engemann et al, [Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood](#) (2019)
- 21 World Bank Group, [Population Estimates and Projections](#) (2018)
- 22 United Nations, [Revision of World Urbanization Prospects](#) (2018)
- 23 WHO Regional Office for Europe, [Urban green spaces: a brief for action](#) (2017)
- 24 Kaczynski & Henderson, [Environmental Correlates of Physical Activity: A Review of Evidence about Parks and Recreation](#) (2007)
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- 26 Engemann et al, [Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood](#) (2019)
- 27 Richards et al, [Differential air temperature cooling performance of urban vegetation types in the tropics](#) (2020)
- 28 USDA, [Trees Reduce Building Energy Use in U.S. Cities](#) (2017)
- 29 Stone et al, [Avoided Heat-Related Mortality through Climate Adaptation Strategies in Three US Cities](#) (2014)
- 30 The Nature Conservancy, [Planting Healthy Air](#) (2016)
- 31 Nowak et al, [Modeled PM2.5 removal by trees in ten US cities and associated health effects](#) (2013)
- 32 OECD, [The rising cost of ambient air pollution in the 21st Century](#) (2017)
- 33 Brander & Koetse, [The value of urban open space: Meta-analyses of contingent valuation and hedonic pricing results](#) (2011)
- 34 World Economic Forum, [Nature Risk Rising](#) (2020)
- 35 Hong-Fang et al, [Natural products and drug discovery. Can thousands of years of ancient medical knowledge lead us to new and powerful drug combinations in the fight against cancer and dementia?](#) (2009)
- 36 WHO, [Connecting Global Priorities: Biodiversity and Human Health](#) (2015)
- 37 Oyeboode et al, [Use of traditional medicine in middle-income countries: a WHO-SAGE study](#) (2016)
- 38 World Economic Forum, [Nature Risk Rising](#) (2020)
- 39 Griscom et al, [National mitigation potential from natural climate solutions in the tropics](#) (2020).
- 40 OECD, Biodiversity: [Finance and the Economic and Business Case for Action, report prepared for the G7 Environment Ministers' Meeting](#) (2019)
- 41 Morris & Thomas, [The Economic, Health, and Social Benefits of Conservation: A Report Prepared on behalf of The Coalition for Our Natural Interest](#) (2018)
- 42 OECD, Biodiversity: [Finance and the Economic and Business Case for Action, report prepared for the G7 Environment Ministers' Meeting](#) (2019)

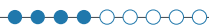




Apprentice forest engineers supervising a restoration and management project.

### 3.4

## Restoration and Management



We can protect restore and sustainably manage ecosystems while also growing our economy. As some national governments are already demonstrating in planning for a post-COVID world, investing in ecological restoration and management can create jobs and other economic benefits for the communities that need them most.

#### HEADLINE STATISTICS:

- For every dollar spent on nature restoration, at least \$9 of economic benefit can be expected.
- Initiating forest restoration of at least 350 million hectares by 2030, meanwhile, could generate \$170 billion/year in net benefits from watershed protection, improved crop yields, and forest products as well as climate change mitigation benefits through the sequestration of more than 5 billion tons of CO<sub>2</sub> each year.
- In the US alone, ecological restoration is a \$9.5 billion industry employing 126,000 people, and indirectly generates \$15 billion and 95,000 jobs.
- Restoring forests, peatlands, and mangroves globally has the potential to reduce global CO<sub>2</sub>e emissions by 10 billion tons annually with more than one-third included in carbon markets.

## Value of restoration

- With one-third of the planet's land degraded, a global effort to restore degraded lands either to natural forest or to productive use could generate major economic, employment, and climate gains.<sup>43</sup>
- Half of the world's GDP is highly or moderately dependent on nature. The United Nations Environment Programme has found that for every dollar spent on nature restoration, at least \$9 of economic benefits can be expected.<sup>44</sup>
- The opportunities for restoration are vast. Globally, up to 6 billion hectares of land are degraded (i.e. 20 times the size of France)<sup>45</sup> and some two billion hectares of the world's landscapes offer opportunities for restoration.<sup>46</sup>
- Ecological restoration as a set of economic activities does not consistently fit within any single traditional economic sector, since pertinent activities range from scientific research and project planning, to earth moving and tree planting. By focusing the restoration economy around the industries that contribute to these efforts, a landmark 2015 report defined restoration as being comprised of the set of economic activities that contribute to restoration, from:
  - + project planning;
  - + engineering and legal services;
  - + suppliers of inputs;
  - + on-the-ground earthmoving forestry, and landscaping firms.<sup>47</sup>
- A 2017 report found that restoring the 160 million hectares of degraded land committed by over 40 countries under the Bonn Challenge could provide an estimated \$84 billion in annual economic benefit worldwide.<sup>48</sup>
- Another 2017 study found that achieving the Bonn Challenge would generate a net benefit of between \$0.7 and \$9 trillion. The study found that €1 of investment in restoration yielded up to €27.38 in returns, depending on what social discount rate is applied today.<sup>49</sup>
- It is not commonly understood that without investments in large-scale ecosystem restoration, the negative effects of degradation are likely to greatly increase and compromise the well-being of present as well as future generations. Linked to this is a general under-appreciation of the benefits of investing in large-scale ecosystem restoration. Focusing solely on the economics, returns from ecosystem restoration are exceptionally high for society at large: approximately 50% for tropical forests, around 20% for other forests, about 42% for shrublands, and approximately 79% for grasslands over a 40-year time period.<sup>50</sup>
- US and British economists, including Joseph Stiglitz and Lord Nicholas Stern, argue that natural capital spending is fast-acting because worker training requirements are low, many projects have minimal planning and procurement requirements, and most facets of the work meet social distancing norms. Through their Nationally Determined Contributions (NDCs), many countries have already prepared "shovel-ready" projects, and in most lower-and middle-income countries (LMICs) these NDCs are heavily oriented towards infrastructure.<sup>51</sup>
- In the developing world, investments in restoration can create a variety of new income streams, including from the periodic sales of sustainably harvested wood (including for timber in buildings) and annual revenues from ecotourism. In 2014, research found that restoring 12% of degraded agricultural land could boost smallholders' incomes by \$35-40 billion per year and feed 200 million people per year within 15 years. It can also increase resilience to weather shocks and reduce greenhouse gas emissions by nearly 2 Gt CO<sub>2</sub>e per year.<sup>52</sup>

## Forest restoration

- Initiating forest restoration of at least 350 million hectares by 2030 could generate \$170 billion/year in net benefits from watershed protection, improved crop yields, and forest products as well as climate change mitigation benefits through the sequestration of more than 5 billion tons of CO<sub>2</sub> each year.<sup>53</sup>
- An assessment of 19 countries that have made commitments under the Bonn Challenge—including Brazil, El Salvador, Mexico, Rwanda and the US—has found that the benefits accruing from restoration activities include an additional 354,000 jobs, an average investment per hectare of at least \$235 and 1.379 billion tonnes CO<sub>2</sub>e sequestered.<sup>54</sup>
- Smarter ways of managing plantations and other working forests can improve their productivity, just as they can benefit the climate. Removing competing vegetation, more sensitive logging practices and longer cycles between harvests can promote tree growth. These and other enhanced natural forest management practices can be applied across the 1.9 billion hectares of production forest globally and annually remove 1.5 billion tons of CO<sub>2</sub> from the atmosphere.<sup>55</sup>



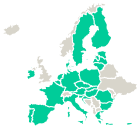
### ASIA

#### South Korea

- + Since the 1950s, South Korea's forest cover has nearly doubled while its economy has grown more than 25-fold in real terms; in 2013, the Korean Forest Service estimated that Korea's forests contributed 9% of GDP.<sup>56</sup>

#### China

- + In China, the Chinese Ministry of Water Resources and the World Bank worked together to produce two watershed rehabilitation projects spanning from 1994 to 2005, and between them mobilized \$298 million in Bank funds and \$193 million in Chinese government funding. The key elements of the projects were to halt the activities that led to degradation, in particular planting on steep slopes, tree-cutting, and free-range grazing of goats, and to actively encourage regeneration. The World Bank estimates that the projects lifted more than 2.5 million people out of poverty and boosted incomes from about \$70 to about \$200 per person per year through agricultural productivity gains and diversification.<sup>57</sup>



### EUROPE

- + The Natura 2000 network has been estimated to support 104,000 direct jobs in protected areas management and conservation activities and 70,000 more indirect or induced jobs. This is based on annual investment of €6 billion for management and restoration of the network. In the future, it is expected that biodiversity needs could generate up to 500,000 jobs.<sup>58</sup>
- + The benefits of the EU Natura 2000 nature protection network are valued at between €200-300 billion per year.<sup>59</sup>
- + In June 2020, the Wildlife and Countryside Link announced that there are 330 'ready-to-go' nature recovery projects across England that could generate some 10,000 jobs.<sup>60</sup>



## NORTH AMERICA



### United States

- + In the US, as of 2015, more than 200,000 jobs were linked to the restoration sector.<sup>61</sup>
- + In the US, researchers have found that every \$1 million invested in reforestation and sustainable forest management can support nearly 40 jobs<sup>62</sup>, including foresters, botanists to grow saplings in nurseries, technicians to operate machinery, and laborers to transport and plant new trees. In 2014, the domestic ecological restoration sector directly employed approximately 126,000 workers and generated around \$9.5 billion in economic output (sales) annually. This activity supported an additional 95,000 jobs and \$15 billion in economic output through indirect (business-to-business) links and increased household spending.<sup>63</sup>
- + The same research found that \$1 spent to restore forests in the US can deliver up to \$30 in economic benefits. Restoration projects also tend to create localized employment benefits, while creating relatively well-paying jobs compared to average wages; similar to the construction industry at large. Forest restoration alone could reduce US emissions by nearly 300 million tons per year or 5% of its total GHG emissions.<sup>64</sup>
- + According to the Second Bonn Challenge Progress Report, a comprehensive assessment of the number of jobs generated through forest landscape restoration (FLR) activities made under the Bonn Challenge undertaken by the US Forest Service and its partners was not yet available. However, the restoration work associated with the 23 projects under the Collaborative Forest Landscape Restoration Program (comprising roughly 10% of USFS contributions to the Bonn Challenge) has supported an estimated 5,500 jobs per year since 2012. This was estimated to contribute a total of \$1.5 billion in local labour income.<sup>65</sup>
- + US National Oceanic and Atmospheric Administration (NOAA) funding for coastal habitat restoration supports on average 15 jobs per million dollars spent and up to 30 jobs per million dollars spent on labour intensive restoration projects.<sup>66</sup> This level of job creation is on a par or higher than for oil and gas or transportation infrastructure investments.<sup>67</sup> These investments yield follow-on socio-economic benefits to communities that exceed construction costs in terms of the protection of lives and property from storms and flooding, recreational and commercial fishing, tourism, and other coastal businesses.<sup>68</sup>
- + A 2013 study, which examined the economic impact of the expenditures from the American Recovery and Reinvestment Act (ARRA) of 2009 that the National Oceanic and Atmospheric Administration (NOAA) administered for coastal habitat restoration projects around the United States. It found that the 50 ARRA projects administered by NOAA in the first year and half generated a total of 1409 jobs. These habitat restoration projects created, on average, 17 jobs per million dollars spent which is similar to other conservation industries such as parks and land conservation, and much higher than other traditional industries including coal, gas, and nuclear energy generation.<sup>69</sup>

### Canada

- + In Canada, Forests Ontario calculated a 3:1 return on investment for the government's annual investment in the 50 Million Tree Program and found that for every CAD\$1.80 that Forests Ontario spends to support tree planting, no less than CAD\$19.85 in ecosystem service value is derived. Ecosystem service value is derived from pollination and dispersal, recreation opportunities, aesthetic/amenity benefits and nutrient and waste regulation.<sup>70</sup>

- + Managing intact forests and natural areas for climate, biodiversity and cultural values is just as important as restoration. Indigenous peoples are the original stewards of the lands and waters and investing in Indigenous-led conservation and management can provide critical jobs to remote communities and support local, sustainable economic development.
- + An analysis of the Indigenous Guardian Watchmen programs on the British Columbia coast found a 10:1 return on investment annually for numerous social, cultural and economic Indigenous values. In the Great Bear Rainforest in BC, Coast Funds supports 27 First Nation stewardship programs and community economic development. In the last 10 years, Coast Funds has invested CAD\$77 million and leveraged another CAD\$190 million in new investments, which has produced 1,000 new jobs; and 100 new or expanded businesses. With only 18,000 people living in the region, the economic opportunity provided by Indigenous-led conservation and stewardship is enormous.<sup>71</sup>



## AFRICA

- + In Africa, the Green Wall of Africa initiative is a proven restoration project benefiting communities from Senegal in the West to Djibouti in the East. Since the birth of the initiative in 2007, life has started coming back to the land, bringing improved food security, jobs and stability to people's lives. According to the UN Commission to Combat Desertification, the ultimate goal is to complete the wall by 2030 and bring with it 50 million hectares of restored land, food security for 20 million people, access to climate change-resilient agricultural technologies for 10 million small farms and 350,000 jobs across the continent.

### Ethiopia

- + In Ethiopia, the Humbo Assisted Natural Regeneration Project increased local incomes and helped restore 2,700 hectares of biodiverse native forest, boosting carbon sequestration benefits. More tree cover also reduced local drought vulnerability.<sup>72</sup>

### Niger

- + In Niger, the Maradi and Zinder regions have interplanted nitrogen-fixing trees on cropland, or allowed roots and stumps to regenerate, increasing tree and shrub cover 10- to 20-fold. The strategy has significantly increased agricultural productivity on 5 million hectares of farmland and helped restore at least 250,000 hectares of severely degraded land that had been of little use for agriculture or forestry. At least one-quarter of producers in the area adopted improved natural resource management techniques. Biodiversity was increased and soil fertility improved measurably in the entire area. Gross real annual income in the region has grown by \$1,000 per household for over one million households, more than doubling real farm incomes and stimulating local non-farm services.<sup>73</sup>

### Rwanda

- + In Rwanda, a report from the Rwanda Water and Forestry Authority (RWFA) monitoring and evaluation officers for the year 2017–2018 identified 22,325 jobs created in the forestry sector. The data reported here cover total jobs within the forestry sector pertaining to forest landscape restoration (FLR) activity made under the Bonn Challenge but do not include employment statistics from different sectors that could also involve FLR interventions. Rwanda's Green Fund, FONERWA, indicated that 137,562 green jobs were created in 2013–2018 under 36 of the 44 Barometer projects evaluated.<sup>74</sup>

### Ghana

- + In Ghana, multiple programmes under the Bonn Challenge, such as Ghana's Labour for Youth in Afforestation module, have created close to 90,000 jobs.<sup>75</sup>

### Kenya

- + Komaza in coastal Kenya is a company enabling small-scale farmers to participate in industrial wood markets. It partners with rural farmers to plant woodlots that are collectively managed as 'virtual plantations'. Komaza's model offers a new income stream to smallholder farmers, while reducing pressure on virgin forest and increasing the area of reforested land. To date, Komaza has 4,000 hectares planted with 14,000 farmers—with aims to scale to 30,000 hectares.<sup>76</sup>

### Malawi

- + The government spends 1.5% of its annual budget to mobilize Malawi's youth to protect and plant trees across 50,000 hectares. In the first 18 months of the program, 11,283 youth from 472 youth groups have been employed.<sup>77</sup>



## LATIN AMERICA AND THE CARIBBEAN

- + WRI found that bringing life back to degraded lands in Latin America and the Caribbean would yield \$23 billion in net benefits over 50 years. Its analysis shows that on average, farmers who restore their land can earn an extra \$1,140 per hectare in net economic value from restoration.<sup>78</sup>

### Costa Rica

- + Between 1986 and 2005, Costa Rica's forest cover increased nearly 20% while its economy grew 2.5-fold in real terms.<sup>79</sup>

### Brazil

- + For 2018, prior to current setbacks, the government of Brazil reported an area of 9,424,802 hectares under natural regeneration in the Amazon as progress towards achieving its Bonn Challenge target. Restoration interventions are mainly natural regeneration, but also planted forest and woodlots, watershed protection and agroforestry. The benefits associated with restoration efforts across the country include on average 151,000 jobs generated per year and total carbon sequestration of 1.2 billion tonnes of CO<sub>2</sub> (tCO<sub>2</sub>).<sup>80</sup>

### El Salvador

- + In El Salvador, approximately 12,235 full-time equivalent (FTE) short-term jobs were provided by implementation of national and sub-national forest landscape restoration pledges made under the Bonn Challenge, while the management of the restored landscape created 2,715 FTE long-term jobs. The main findings can be summarised as follows: 1) Sustainable forest management practices, specifically fire prevention, have been implemented the most (29% of the total area), creating the majority of FTE short-term jobs. 2) Long-term jobs were mostly supplied through conservation agriculture and the agroforestry system with staple grains. This is due to the high labour needs for land management associated with these two techniques, while forest fire management is typically less labour intensive.<sup>81</sup>

### Mexico

- + In Quintana Roo State, Mexico, analysis estimates the creation of jobs as 0.1–0.37 job per hectare, depending on the forest landscape restoration (FLR) activity made under the Bonn Challenge. [ROAM](#) analysis for Quintana Roo indicates that a total of 22,480 jobs directly related to FLR activities may have been created from 2011–2017. This number is based on estimates of labour required to carry out specific technological packages related to each restoration category implemented.<sup>82</sup>



## OCEANIA

### Australia

- + According to analysis done by TNC in Australia, an investment of \$100 million will rebuild shellfish reefs in 60 locations, and create 850 jobs in maritime construction, aquaculture, fisheries and tourism service sectors.<sup>83</sup>



## ASIA

### Pakistan

- + During the COVID-19 crisis, millions of labourers have been made unemployed leading the government to announce a scheme to redeploy them in reforestation work as part of the country's 10 Billion Tree Tsunami program, creating an estimated 65,000 jobs.

### India

- + The Indian Government has directed a higher percentage of central tax revenues to states based on their efforts to protect or increase forest cover, with a decision to increase the 'weightage' given to forest cover from 7.5% to 10%. In its formula for tax devolution, the government is hoping to mobilize additional billions of dollars in recognition of the central role forests play in the country's sustainable development, tackling climate and supporting livelihoods.<sup>84</sup>



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A safari group observes a lioness on the Busanga Plains of Kafue National Park, Zambia.  
Photo credit: TNC/Kenneth K. Coe

### 3.5

## Tourism



The travel and tourism industries represent 10% of global GDP and support one-tenth of our global workforce; of that, 3.9% is for ‘wildlife tourism’, which equals almost 22 million jobs—and these industries have been hit particularly hard by the COVID-19 crisis. Nature plays a key role in sustaining both the tourism economy and conservation work in many countries around the world. By investing in protecting and enhancing nature, we can help tourism-based economies recover, while creating millions of new ecological restoration jobs.

#### HEADLINE STATISTICS:

- While the travel and tourism sectors account for 10.4% of global GDP as a whole, wildlife tourism represents 3.9% of this figure, or \$343.6 billion—a figure equivalent to the entire GDP of South Africa or Hong Kong.
- Globally, 21.8 million jobs or 6.8% of total jobs sustained by global travel and tourism in 2018 can be attributed to wildlife.
- People enjoy forests for hiking, camping, hunting, bird-watching, and other forms of recreation. Tourism to protected areas, for example, generates an estimated \$600 billion annually, compared to (est.) \$10 billion spent on protecting these sites, providing a 60:1 return on investment.

## Nature-based tourism

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## Coral reefs and mangroves

- Coral reefs alone generate \$36 billion per year for the global tourism industry.<sup>87</sup>
- The most popular mangrove sites attract hundreds of thousands of visitors per year and may generate millions of dollars in visitor expenditure.<sup>88</sup> Globally, mangroves support a multi-billion-dollar recreation and tourism industry.<sup>89</sup>
- Ocean tourism is valued at \$390 billion globally and is the source of millions of jobs, in many developing nations.<sup>90</sup>



### ASIA

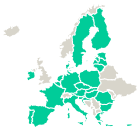
In the Asia-Pacific region more than 10 million jobs rely on wildlife tourism.<sup>91</sup>

#### China

- + In China, forest-based recreation and tourism in forest parks generates about \$3.3 billion in entry fees alone.<sup>92</sup>

#### Vietnam

- + A 2013 study estimated the value of mangrove tourism in Vietnam to be over \$100 million per year.<sup>93</sup>



### EUROPE

- + In the EU, 1.2–2.2 billion visitor days to Natura 2000 sites generate recreational benefits worth €5-9 billion annually.<sup>94</sup>
- + The tourism sector employs 12 million people in Europe. Of these, 3.1 million have links to protected areas such as Natura 2000.<sup>95</sup>





## NORTH AMERICA

### United States

- + It is estimated that the Great American Outdoors Act, which passed the Senate in June 2020, will create as many as 100,000 new jobs.<sup>96</sup>
- + In the US, recreation and tourism in national forests alone contribute \$2.5-3 billion per year to national GDP.<sup>97</sup>
- + Wildlife tourism supports 500,000 jobs.<sup>98</sup>
- + Local public park and recreation agencies generate \$154 billion in economic activity and support 1.1 million jobs every year.<sup>99</sup>
- + National parks generate \$21 billion in visitor spending and support 340,500 jobs.<sup>100</sup>
- + National Heritage Areas are estimated to generate \$12.9 billion annually, support 148,000 jobs, and provide \$1.2 billion in federal taxes.<sup>101</sup>
- + Proximity to national parks and national monuments brought clear economic benefits; national parks generated \$35.8 billion for gateway communities in 2017, and employment and per-capita income improved in regions adjacent to national monuments.<sup>102</sup>
- + Almost 2.4 million people are employed in ocean-based tourism in the recreation sector, earning approximately \$58.7 billion in annual wages. The industry grew by 73,000 jobs (6.3% growth) between 2015-2016, three times faster than the US economy as a whole.<sup>103</sup>
- + In 2016, the US Fish and Wildlife Service reported 103.7 million Americans participated in wildlife-related recreation, generating \$156.9 billion.<sup>104</sup>
- + Outdoor Industry Association (OIA) has conducted research and analysis for each state to determine the contribution of outdoor recreation.

### Canada

- + In 2019 Canada's national parks and historic sites saw 25.1 million visitors. Canada's population that same year was 39.6 million people.<sup>105</sup>
- + The Province of British Columbia stated in its 2020 Emerging Economy Task Force Report that "B.C.'s natural environment, cultural experiences, and its reputation of being safe, diverse and wild are competitive advantages attractive to tourists". In 2017, BC tourism revenue was CAD\$18.4 billion, an 8.4% increase from the previous year contributing over CAD\$9 billion (3.6%) to provincial GDP and employing 138,000 people in over 19,000 businesses.<sup>106</sup>
- + In 2009 Canada's federal, provincial and territorial parks contributed CAD\$4.6 billion to GDP, representing 2.0% of provincial/territorial GDP and 2.5% of federal GDP. Parks contributed CAD\$2.9 billion in labour income and employed 64,050 full time equivalents.<sup>107</sup>
- + In 2012, a national survey concluded Canadian adults made an estimated CAD\$41.3 billion in expenditures for nature-based activities during the year, with the greatest amount dedicated to non-motorized, non-consumptive activities. Expenditures included: nature-

based leisure CAD\$6.2 billion; non-commercial fishing \$2.2 billion; and non-commercial hunting and trapping CAD\$1.8 billion.<sup>108</sup>

- + Indigenous Peoples' territories represent much of the natural lands and waters in Canada and tourism plays a critical role in local economies. In 2019 Indigenous tourism was a 1.9 billion industry in direct GDP, with 20% annual growth rate, 40,000 employees and 19,000 businesses across Canada.<sup>109</sup>



## AFRICA

- + In Africa, it is estimated that 80% of tourism trips are 'nature-based'.<sup>110</sup> The World Travel and Tourism Council estimates that 8.8 million people are employed in the nature-based tourism industry, worth \$29 billion in 2018.<sup>111</sup>

### Kenya

- + In Kenya, the tourism sector, which is almost exclusively nature-based tourism focused on wildlife, earns an average of \$1 billion annually.<sup>112</sup> International tourism receipts contribute 2% to GDP and contributes significantly to employment.<sup>113</sup>

### Namibia

- + In Namibia, nature-based tourism based in community conservation contributed \$488 million in 2018 to net national income and created 5,147 jobs from 1990 to 2016. Namibia's GDP in 2018 was \$14.2 billion.<sup>114</sup>

### Uganda

- + In Uganda, gorilla nature-based tourism contributes \$34 million to the local economy.<sup>115</sup>

### Botswana

- + In Botswana, nature-based tourism is the second most important industry: 3% of GDP is from international tourism receipts and 76,000 jobs—7.6% of total employment (combined indirect and direct) from tourism overall.<sup>116</sup>

### Tanzania

- + In Tanzania, nature-based tourism employs 467,000 people employed directly, and more than 1 million indirectly, constituting 12% of total employment.<sup>117</sup>



## LATIN AMERICA AND THE CARIBBEAN

### Costa Rica

- + In Costa Rica, forests have underpinned the country's tourism industry growth, which at 7.4% in 2011 was the strongest in the Americas, with ecotourists representing more than half of the 2 million international visitors to the country each year.<sup>118</sup>

### Mexico

- + In Mexico's Gulf of California and Baja California Peninsula (GCBP), marine ecosystems support tourism activities in many communities—each year nature-based marine tourism in the GCBP results in 896,000 visits, \$518 million in expenditures and at least 3,575 direct jobs from formal operations.<sup>119</sup>

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Colombian farmers collecting coffee beans and harvesting the crop.

3.6

## Agriculture

The number of people suffering from chronic hunger—estimated at well over 800 million before the COVID crisis—is poised to increase dramatically. Only urgent, coordinated action will prevent the pandemic from becoming a global humanitarian crisis. Adopting sustainable land-use systems and agricultural practices can help reduce this immediate threat, while also improving food security and generating significant economic benefits.

### HEADLINE STATISTICS:

- Agriculture accounts for almost 70% of total employment in low-income countries worldwide, which means that increasing yields and incomes will play a fundamental role in boosting rural livelihoods and ensuring country-wide economic development.
- New sustainable agriculture opportunities could generate almost 80 million jobs by 2030, with more than 90% of them located in developing countries. That includes roughly 21 million jobs in Africa, 22 million jobs in India, 12 million jobs in China, and 15 million jobs in the rest of Asian developing countries.
- Transforming food and land use systems could create new business opportunities worth up to \$4.5 trillion a year by 2030.

## Agricultural shifts and economic opportunities

- Agriculture is the world's largest employer and plays a critical role in supporting the livelihoods of an estimated 1.3 billion people living in rural poverty. If the responses of governments, businesses, and farmers to significant climate risks and ecological scarcities are not well informed, then we run the risk of significant and potentially devastating upheavals in jobs and livelihoods for decades to come.<sup>120</sup>
- Agriculture accounts for almost 70% of total employment in low-income countries worldwide, which means that increasing yields and incomes will play a fundamental role in boosting rural livelihoods and ensuring country-wide economic development.<sup>121</sup>
- Yet, transforming food and land use systems could create new business opportunities worth up to \$4.5 trillion a year by 2030.<sup>122</sup>
- FAO predicts that shifting towards more sustainable forms of agriculture and land use could add an additional 2.3 trillion in productive growth to the global economy, providing a strong opportunity for job creation with the generation of 200 million full-time jobs by 2050.<sup>123</sup>
- In 2017, OECD countries provided \$228 billion in support to farmers, of which \$116 billion (i.e. 51%) is considered most environmentally harmful in comparison to other types of support. While this percentage of overall support to farmers identified as potentially most environmentally harmful has declined considerably since 1990, it has remained relatively constant over the past decade.<sup>124</sup>
- Across developed and developing countries, government subsidies for agriculture and fisheries are currently running at over \$700 billion a year with only around 15% targeted at public goods.<sup>125</sup> These public subsidies, in addition to being economically inefficient, often lead to negative outcomes for the climate and environment, such as increased deforestation due to agricultural expansion in rainforest areas.<sup>126</sup>
- The world's 1.5 billion smallholder farmers have the highest incidence of poverty amongst all sectors of the global economy. Better technology in smallholder farming through aggregation, extension services, access to capital and other levers could increase yields and productivity, which would lower poverty rates.
- The *Valuing the SDG Prize in Food and Agriculture* report shows that the food and agriculture sectors sustainably could unlock 14 major business opportunities worth \$2.3 trillion annually by 2030.<sup>127</sup>
- Each opportunity has an estimated value range: from cattle intensification where sustainable improvements could increase value by \$15 billion a year and increase carbon sequestration by 148 million tons per year,<sup>128</sup> to reducing food waste in value chains worth \$405 billion to the private sector.<sup>129</sup> Reducing food waste preserves the land and waters needed to produce that food and can reduce GHG emissions by 2.3 million tons per year.<sup>130</sup>
- With an annual investment of \$320 billion, fully pursuing these sustainable opportunities would deliver a seven-fold return on investment.<sup>131</sup> These 14 opportunities could also generate almost 80 million jobs by 2030, which represents around 2% of the forecasted labour force.
- However, land grabs and involuntary removals have seen some communal lands acquired by agribusinesses without any notable local benefits or jobs being created.<sup>132</sup>

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## Silvopasture

- Globally, silvopasture is currently practised on 550 million hectares of land but could expand to 720-772 million hectares by 2050. Of the 823 million hectares theoretically suitable for silvopasture, carbon dioxide emissions can be reduced by 26.6-42.3 gigatons. Farmers could realize financial gains from revenue diversification of \$1.7-2.3 trillion, on investment of \$206-273 billion and lifetime operational cost of \$2-3 trillion to implement.<sup>133</sup>

## Gender

- If women farmers had access to the same financial and technical resources as men, the resulting rise in output could rescue an estimated 150 million people from hunger.<sup>134</sup> There are important efforts underway to increase women's access to knowledge, technology, and resources in the food and land use sector.<sup>135</sup>

## Public health

- For public health, shifting diets from those heavy in animal-based and processed foods—and especially away from beef—towards more plant-based diets could result in global public health benefits, health-related cost savings of almost \$1 trillion per year by 2050,<sup>136</sup> as well as significant positive environmental impacts.

## Food loss and waste

- Reducing food loss and waste is a major economic prize, as well as a moral obligation. Saving just one-quarter of the food currently lost or wasted would be equivalent to the amount of food needed to feed 870 million people annually.<sup>137</sup>
- Laboratory-based alternative protein technologies may be potentially the most disruptive. The insect protein market is also becoming established and has now reached an estimated worth of almost \$1 billion.

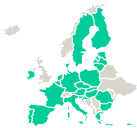


### ASIA

#### India

- + On the Indo-Gangetic Plains, wheat farmers using zero- and minimum tillage have reaped the benefits of higher grain yields and enhanced conservation of soil and water. Zero-tillage is considered the most successful resource-conserving technology on the plains. As well as increasing average yields by 7%, it has saved farmers 21 to 30 days of labour and \$52 in land preparation costs per hectare and increased their average net incomes by \$97 per hectare.<sup>138</sup>

[\(See China in restoration section\)](#)



### EUROPE

- + For agriculture, 1.3 million of the 9.6 million farming jobs in the EU are linked directly or indirectly to Natura 2000.<sup>139</sup>



### NORTH AMERICA

#### United States

- + In 2018, 22 million full- and part-time jobs were related to the agricultural and food sectors—11% of total US employment. Agriculture, food, and related industries contributed \$1 trillion to US GDP in 2017; the output of America's farms contributed \$132.8 billion of this sum—about 1% of GDP.<sup>140</sup>



- + The Nature Conservancy, in its report, “reThink Soil,” estimates that for each one percent of cropland in the U.S. that adopt an adaptive soil health system, annual economic benefits translate into \$226 million of societal value through increased water capacity, reduced erosion and nutrient loss to the environment, and reduced GHG emissions, as well as \$37 million of on-farm value through greater productivity. In the most optimistic case, it estimates soil health solutions could address up to \$50 billion in social and environmental impacts annually across the U.S.<sup>141</sup>



## AFRICA

### Rwanda

- + Africa Improved Foods (AIF) produces locally nutritious food products (mineral and vitamin-rich porridge, for example) for local populations, especially pregnant and lactating mothers and stunted children, from locally sourced crops. By improving access to nutritious food, AIF is trying to address stunting and malnutrition, particularly in Rwanda, where almost 40% of children under five suffer from stunted growth, which costs Rwanda 11.5% of GDP.<sup>142</sup> Further along the value chain, the company’s factory generates jobs, increases demand for regionally sourced packaging, equipment and services, and increases the value of Rwanda’s exports. According to Chicago University, AIF will contribute approximately \$750 million to the economic development of Rwanda.<sup>143</sup>

### Niger

- + In Niger, farmer-managed natural regeneration efforts generate \$280 million per year in ecosystem benefits, 4 million tons of emission reductions,<sup>144</sup> and yield increases, which provide food for 2.5 million people.<sup>145</sup>

[\(See Niger in restoration section\)](#)

[\(See Komaza, Kenya in restoration section\)](#)



## LATIN AMERICA AND THE CARIBBEAN

### Colombia

- + Colombia has demonstrated that combining grazing and agriculture with tree cultivation can coax more food from each acre, boost farmers’ incomes, restore degraded landscapes, and make farmland more resilient to climate change. The plan seeks to reduce pastureland from 38 million hectares (94 million acres) to 28 million hectares (70 million acres), while increasing cattle numbers from 23 million head to 40 million at a cost of between \$1,000 and \$2,000 per hectare, depending on the mixture of trees and shrubs. Farmers usually achieve a 100% return on investment within two years due to increases in milk production and weight gain in their cattle.<sup>146</sup>
- + Approximately one-third of all food intended for human consumption in Colombia is lost or wasted between the farm and the fork each year. This equates to nearly \$5.4 billion in economic losses, at a time when more than half of Colombian households do not have enough food to live a healthy and active life. At the same time, rates of malnutrition and obesity cost the state at least \$1.5 billion per year in lost economic activity.<sup>147</sup>

[\(See El Salvador in restoration section\)](#)

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Russell Shippey, a timber faller, cutting a corridor to pull out trees in second growth forest at the Ellsworth Creek Preserve in Washington state. Photo credit: TNC/Chris Crisman

3.7

## Forest Industry



Forest-based industries employ tens of millions of people and contribute an estimated \$450 billion to annual national incomes globally—including more than \$250 billion per year to economies in developing countries. Investing in science-based reforestation strategies and sustainable forest management can help ensure the long-term economic viability of forest industries in both the developed and developing world.

### HEADLINE STATISTICS:

- Forest industries contribute an estimated \$450 billion to annual national incomes globally and more than \$250 billion per year to developing country economies.
- Commercial activities related to the production of forest products provide employment for more than 50 million people and almost 30 million forest owners benefit from economic activities in the sector.
- The total number of people employed in the formal forestry sector is around 13 million, but those employed in the informal sector total 45 to 50 million.



## Forest economy

- In 2013, the United Nations Forum on Forests found that forest industries contribute an estimated \$450 billion to annual national incomes globally and more than \$250 billion per year to developing country economies.<sup>148</sup>
- The total number of people employed in the formal forestry sector is around 13 million, but those employed in the informal sector total 45 to 50 million.<sup>149</sup>
- The FAO has estimated that the timber, pulp and paper sectors account for \$247 billion in global trade exports.<sup>150</sup>
- Demand for sustainable wood is set to double or even triple through to 2050.<sup>151</sup> Of the over 80,000 tree species, less than 1% have been studied for potential use.<sup>152</sup>
- As timber extraction is expected to increase, researchers have shown how Reduced Impact Logging for Climate (RIL-C) techniques can reduce emissions in logged tropical forests by as much as half. Techniques such as reduced wood waste, low-impact extraction and the use of narrow roads can prevent 834 million tons of CO<sub>2</sub> from entering the atmosphere.<sup>153</sup>
- Presently, the FAO estimates that commercial activities related to the production of forest products provide employment for over [50 million people and almost 30 million forest owners](#) benefit from economic activities in the sector.<sup>154</sup> In 2015, it was estimated that about 1.6 billion people of the world depend on forests for their living.<sup>155</sup>
- Forests provide a range of other products that can be used as food (including wild fruits and nuts), source material for medicines (such as the cancer treatment drug Taxol), dietary supplements (such as ginseng), traditional arts and crafts, landscape products (such as wood chips and pine needles for mulch and bedding), and more. The estimated economic value of non-timber forest products was around \$88 billion in 2011.<sup>156</sup>



### ASIA

#### India

- + In forest villages, about 300 million local people depend on forest for their subsistence and livelihood and about 70% of India's rural population depends on fuelwood to meet domestic energy needs. For about 100 million of these people, forests are the main source for livelihood and cash income—from fuelwood, non-timber forest products or construction materials.<sup>157</sup>
- + More than half of India's more than 100 million tribal people (8.6% of India' population) reside in forests and are dependent on them for survival.<sup>158</sup>
- + About 170,000 villages, equal to about 27% of India's villages, are in proximity of forests (forest fringe villages). Forests play an important role in the socio-economic and cultural lives of people in these villages.<sup>159</sup>
- + In India, while forest ecosystems contribute only 7% to national GDP, they contribute 57% of rural Indian communities' livelihoods.<sup>160</sup>



- + Forest-based enterprises provide up to 50% of income for 20-30% of labour in India.<sup>161</sup> Timber and non-timber forest products provide direct employment of 350 million-man days. Bamboo contributes to the subsistence needs of more than 2.5 billion people, providing livelihood to tribal and forest dwellers. The livelihood of about 2 million traditional artisans in India depends on harvesting, processing and selling bamboo products.<sup>162</sup>
- + Given that three-quarters of moderately and extremely poor people live in rural areas in India, the loss of natural assets and ecosystem services has a profound effect on global poverty and development.<sup>163</sup>



## NORTH AMERICA

### United States

- + In the US, working forests support more than 2.4 million jobs and contribute \$115 billion towards GDP.<sup>164</sup>
- + Harvesting timber generates \$200 billion of economic activity each year and directly supports one million jobs.<sup>165</sup>
- + Since 1990, the Forest Legacy Program (FLP) has helped conserve over 1.2 million acres of forest and generated more than \$34 million in recreation expenditures in Maine, New Hampshire, Vermont, and New York. These protected working lands employ over 2,500 workers in the recreation, timber, and syrup industries, generating in excess of \$495 million in economic output.<sup>166</sup>
- + In the Midwest, the FLP has helped conserve almost 274,000 acres in northern Wisconsin and the Upper Peninsula of Michigan, and thousands more in Michigan's lower peninsula. These protected working lands employ 553 workers in the recreation and timber industries generating more than \$145 million in economic output.<sup>167</sup>



## AFRICA

Across Ethiopia, Malawi, Nigeria, Tanzania, and Uganda, tree products provide 6% of total annual income for all rural households and 17% for households that specifically cultivate trees.<sup>168</sup>

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Volunteers planting young mangrove trees at the swamps near Saphan Hin public park, Thailand, as a means of flood defense.

3.8

## Ecosystem Services and Green Infrastructure

The value of the services provided to human society by nature—ranging from cleaner water to reduced flooding to life-sustaining food and medicine—are immense. However, the benefits derived from these “ecosystem services” are systematically undervalued in day-to-day decisions, market prices and economic accounting. It is vital for global policy makers to account for the economic value of nature when making decisions about the shape of our post-COVID economic recovery.

### HEADLINE STATISTICS:

- The most comprehensive global estimate suggests that ecosystem services provide benefits of \$125-140 trillion per year i.e. more than one-and-a-half times the size of global GDP.
- If today’s mangroves were lost, 18 million more people would be flooded every year (a 39% increase) and annual damages to property would increase by 16% (\$82 billion).
- Leading forest specialists and economists estimate that conserved and sustainably managed forests generate more than \$6,000 per hectare per year in aggregate value, with values varying between forests and coming mainly from non-remunerated ecosystem services.

## Ecosystem services

- The Global Commission on the Economy and Climate says that for forests and natural ecosystems, the greatest economic value generated is not from products but from ecosystem services, most of which are not currently traded in markets. The benefits derived from biodiversity and ecosystem services are considerable, but are systematically undervalued or unvalued in day-to-day decisions, market prices and economic accounting. Conventional accounting approaches and measures of economic performance (such as GDP) provide only a limited picture of an economy's health, and generally overlook the costs of ecosystem degradation. Thousands of valuation studies are available at the local, regional and global scales, providing estimates of the benefits delivered by biodiversity and ecosystem services (e.g. pollination, climate regulation and water purification).<sup>169</sup>
- The OECD says that although economic valuation of biodiversity continues to face some methodological limitations, it remains a useful and necessary tool for integrating biodiversity values into policy making, as they are otherwise effectively priced at zero. The decisions of ministries responsible for national development strategies and budget allocations, for example, are informed predominantly by interests such as economic growth, competitiveness, food security, and other issues that are politically weightier or perceived to be more pressing. Putting a monetary value on ecosystem services can help convey their importance, and ultimately lead to more efficient, cost-effective and equitable decisions.<sup>170</sup>
- Estimates of the value of ecosystem services provided by forests are typically very large, and mostly need to be derived from models and related calculations, as opposed to being observed in a marketplace.<sup>171</sup> The most comprehensive global estimate suggests that ecosystem services provide benefits of \$125-140 trillion per year i.e. more than one-and-a-half times the size of global GDP.<sup>172</sup> A 2011 update of a landmark 1997 estimated that forests alone in 2011 provided ecosystem services worth \$16.2 trillion in 2011 prices.<sup>173</sup>
- Leading forest specialists and economists estimate that conserved and sustainably managed forests generate more than \$6,000 per hectare per year in aggregate value, with values varying between forests and coming mainly from non-remunerated ecosystem services.<sup>174</sup>
- The World Bank argues that widespread loss of forestland can have significant, potentially irreversible effects that are not fully accounted for in the monetary value of forests included in the wealth accounts—for example, adverse impacts on water regulation, loss of protection from natural hazards, and reduced biodiversity and carbon storage. The conversion of forestland to other uses may be far worse than the monetary accounts indicate because the accounts are largely based on market prices that do not fully reflect the loss of non-market ecosystem services and externalities.<sup>175</sup>

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## Green Infrastructure

- There is also increasing recognition that 'green infrastructure'—forests, wetlands, and mangroves for example—can perform better and at lower cost than 'grey infrastructure' for services such as flood management, water purification and storage and irrigation. The potential here is huge: the OECD estimates global financing needs for water supply infrastructure at \$6.3 trillion by 2030.<sup>176</sup>
- Investments in nature-based infrastructure have proven, multiple benefits; for example, reforestation projects in upper catchments sequester carbon, support nature, reduce flood risk, improve soil quality and improve local water supplies.<sup>177</sup> Other examples include coastal habitat restoration<sup>178</sup> to enhance protection from floods and storms whilst increasing the quality of local fisheries; wetlands systems that provide sustainable urban drainage; and peatland restoration programmes that reduce carbon emissions, restore biodiversity and reduce the speed of run-off to local rivers.<sup>179 180</sup>



- The worsening impacts of climate change could force over 140 million people to move within their countries, due to a series of growing problems that could be addressed by restoring degraded lands into productive and healthy ecosystems.<sup>181</sup>
- TNC has found that in the past 30 years, the amount of the world's GDP annually exposed to tropical cyclones has increased by more than \$1.5 trillion. Insurers alone have paid out more than \$300 billion for coastal damages from storms in the past 10 years.<sup>182</sup>
- The FAO argues that forests and mangroves play a key role in adaptation. They reduce economic losses and overall risk from floods and droughts, which caused \$1.5 trillion in damage worldwide between 2003 and 2013, which is expected to worsen with climate change.<sup>183</sup>
- If today's mangroves were lost, 18 million more people would be flooded every year (a 39% increase) and annual damages to property would increase by 16% (\$82 billion).<sup>184</sup> 32% more people would be flooded under 1 in 10-year events, and 16% more people would be flooded under 1 in 100-year events.<sup>185</sup>



## ASIA

### China

- + In the Upper Yangtze River Basin in western China, flood mitigation provided by forests saves an average of \$1 billion annually from avoided storm and flood damage.<sup>186</sup>
- + In China, mangroves protect 800,000 people from flooding and \$19 billion of property from flood damage.<sup>187</sup>

### South Korea

- + Over the past few decades, South Korea has restored more than 6 million hectares of degraded, sloping lands. The resulting erosion control and prevention of landslides have been valued at \$11.23 billion, and \$3.95 billion respectively.<sup>188</sup>

### Philippines

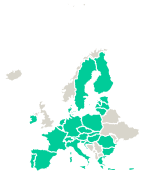
- + Restoring mangroves to their geographic coverage of the 1950s in the Philippines would deliver more than \$450 million per year in additional flood protection benefits.<sup>189</sup>
- + Also, in the Philippines, mangroves reduce annual flooding to people by 24%, providing direct benefits to more than 600,000 people every year, many of whom currently live in poverty. Mangroves reduce annual damage to residential and industrial property by 28%, providing more than \$1 billion in annual averted damages. They also reduce flooding from 766 km of roads annually. One hectare of mangroves in the Philippines provides on average more than \$3,200/year of direct flood reduction benefits. For catastrophic events, such as the 1-in-50-year storm, mangroves avert more than \$1.7 billion in property damages. Based on the Philippines's current population, the mangroves lost between 1950 and 2010 have resulted in increases in flooding to more than 267,000 people every year. Restoring these mangroves would bring more than \$450 million/year in flood protection benefits.<sup>190</sup>

### India

- + In India, mangroves protect 3.3 million people from flooding and \$9 billion of property from flood damage.<sup>191</sup>

### Bangladesh

- + In Bangladesh, mangroves protect 1.3 million people from flooding and \$2 billion of property from flood damage.<sup>192</sup>



### EUROPE

- + Ecosystem services provided by the EU's terrestrial Natura 2000 network and related socio-economic benefits amount to €200 to 300 billion a year.<sup>193</sup>
- + Protecting coastal wetlands in the EU could save the insurance industry around €50 billion annually through reducing flood damage losses.<sup>194</sup>

### Switzerland

- + In Switzerland, the benefits of protected forests are estimated at \$2-3.5 billion per year due to avoided costs of avalanches, landslides, rock falls and flooding.<sup>195</sup>



### NORTH AMERICA

#### United States

- + Forests supply drinking water for 180 million Americans in 68,000 communities, making forests the largest source of drinking water in the United States. Forests managed by the US Forest Service provide water to 66 million people in 3,400 communities across 33 states.<sup>196</sup> In 2000, the United States Department of Agriculture estimated the value of water from Forest Service lands at least \$3.7 billion per year.<sup>197</sup>
- + Studies across the US show the return on investment resulting from both public and private conservation dollars. The Federal Land and Water Conservation Fund (LWCF) estimated that for every \$1 invested in land conservation, \$4 is returned in natural goods and services such as drinking water protection and flood control.<sup>198</sup>
- + A US study found that drinking water treatment costs decrease as the amount of forest cover in the relevant watershed increases. The share of forest cover in a US watershed accounts for about 50-55% of the variation in water treatment costs.<sup>199</sup>
- + An analysis of options for improving water quality in Portland found that green infrastructure would be 51-76% cheaper (\$68-72 million cheaper) than water-filtration plant upgrades and would bring ancillary benefits (i.e. salmon habitat and carbon sequestration) estimated conservatively at \$72-125 million.<sup>200</sup>
- + A cost-benefit analysis conducted for Philadelphia estimated the net present value of low-impact "green" infrastructure for storm-water control (e.g. tree planting, permeable pavement, green roofs) at \$1.94-4.45 billion over a 40-year period. The net benefits for the grey-infrastructure alternative (e.g. storage tunnels) were much lower at \$0.06-0.14 billion.<sup>201</sup>
- + As of 2008, the total estimate of water infrastructure needs for the US included \$63.6 billion for combined sewer overflow control and \$42.3 billion for stormwater management. Green infrastructure projects are a cost-effective way to address this need.<sup>202</sup>

- + Spending \$100 million on green infrastructure in Lynchburg, Virginia would create about 1,400 jobs and for every dollar invested, an estimated \$3.15 of economic activity is generated.<sup>203</sup>
- + In the US, studies show that conserving and restoring wetlands, salt marshes, and mangroves is one of the most cost-effective ways to protect coastal areas. The National Oceanic and Atmospheric Administration estimates that major floods have caused an average of \$4.6 billion in damage per event since 1980.<sup>204</sup>
- + Scientists estimate that US coastal wetlands provide \$23.2 billion in storm protection services each year.<sup>205</sup>
- + An assessment of the value of coastal wetlands in the North-eastern US found that wetlands prevented \$625 million of flood damage from Superstorm Sandy in 2012 and lowered flood damage by 11% on average. A more localised study in the region estimated that properties located behind marshes in Barnegat Bay, New Jersey, suffered 16% less annual flood damage than properties that had lost their marshes.<sup>206</sup> Protecting coastal wetlands could save the insurance industry \$52 billion a year through reduced losses from storm and flood damage.<sup>207</sup>
- + A study in *PLoS One* found that nature-based solutions, such as wetland and oyster reef restoration, could prevent up to \$50 billion in losses from projected flooding increases along Florida's coast over the next decade. Such natural solutions also had a projected benefit-to-cost ratio of 3.5.<sup>208</sup>
- + In Massachusetts, the Department of Fish and Game, Division of Ecological Restoration (DER) has found that “for every \$1 million spent, the average economic output of DER projects generates a 75% return on investment and creates or maintains 12.5 full-time-equivalent jobs.” Restoration projects generate total economic outputs equal to or greater than other types of capital projects such as road and bridge construction and repair, replacement of water infrastructure, etc.<sup>209</sup>
- + During Hurricane Irma, mangroves averted \$1.5 billion in surge-related flood damages to properties, representing a 25% saving in counties with mangroves. Every hectare of mangroves with properties behind them provided, on average, \$7,500 in risk reduction benefits during Hurricane Irma.<sup>210</sup>
- + Coastal wetlands in the north-eastern US prevented more than US \$625 million in direct property damage during Hurricane Sandy, reducing damage by an average of 22% in over half the affected areas.<sup>211</sup>
- + The total economic value of coral reef services for the US—including fisheries, tourism, and coastal protection—is over \$3.4 billion each year.<sup>212</sup>

### Canada

- + Forests in Canada store over 200 billion tonnes of carbon dioxide and are home to more than one million First Nations indigenous people. A carbon management programme in Manitoba and Alberta aims to capture between 400,000 and 800,000 tonnes of carbon annually, generating economic benefits for indigenous communities.<sup>213</sup>



## AFRICA

### Ethiopia and Rwanda

- + Restoration in the Tigray region of Ethiopia and better land husbandry in Rwanda has enhanced farmers' resilience, water availability, and livelihoods in areas previously subject to poverty and desertification.<sup>214</sup>



## LATIN AMERICA AND THE CARIBBEAN

### Colombia

- + In Colombia, maintaining the forested lands of the Colombian Amazon held by indigenous communities could yield as much as \$123 billion to \$277 billion in total ecosystem benefits over a 20-year period.<sup>215</sup>

### Mexico

- + In Mexico, mangroves protect 300,000 people from flooding and \$9 billion of property from flood damage.<sup>216</sup>



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A drone hovers over a Red Mangrove forest, Haiti. The drone carries a camera used to survey the bottom topography. Photo credit: TNC/Tim Calver

3.9

## New Nature-Tech

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Moving into a more nature-rich world also heralds as yet untapped opportunities for the ‘Nature Tech’ sector. While this sector is currently small compared to the global market for low-carbon and environmental goods and services (estimated by the OECD to be worth \$5.5 trillion and growing at over 3% per year), there are signs [that a wave of new enterprise is on its way.](#)

- Today, we are seeing the contours of a ‘fourth agricultural revolution.’ Exciting innovations are emerging, which could reshape food and land use systems over the coming decade. Precision agriculture (and aquaculture), guided by big data and using robotics, gene-editing and powerful remote sensing devices, could unlock significant improvements in crop yields and nutritional content, improve crop resilience and increase livestock productivity while reducing agriculture’s environmental footprint. These trends have the potential to scale quickly (although from a low base—in 2017, \$16.9 billion of venture capital finance flowed into new food and ag-tech companies, five times the flow in 2012).<sup>217</sup> In parallel, regenerative approaches—no-till farming, winter crops, intercropping, agroforestry—are evolving and gaining traction.<sup>218</sup>
- By asking how the tech industry can accelerate and help progress the rapid deployment of nature-based solutions, it is not a huge leap to imagine what impact emerging technologies will have over the next decade—including artificial intelligence and machine learning, data-driven storytelling and design-thinking. These have the potential to deliver more efficient and effective path to conservation, management of ecosystems services and reduction in the impact of complex supply chains.
- For example, recently, Planet Labs, who specialize in real-time high-definition satellite monitoring, was valued at over \$1 billion. This represents the interest in companies’ investment in their supply chain monitoring. For example, Nestlé as part of its ‘No Deforestation’ commitment, is implementing 100% satellite monitoring coverage of its global palm oil supply chains.
- Significant investment in human capital, technology diffusion and the digital revolution would support the emergence of a new generation of young ‘nature tech’ entrepreneurs able to take advantage of the opportunities offered by the transformation of a nature-positive recovery. This presents an opportunity for more highly skilled jobs and the prospect of innovation, research and development, much of which would have strong connection to the rural economy.



## AFRICA

### Uganda

- + In Uganda, TechnoServe partnered with the Bill and Melinda Gates Foundation to pilot the use of drones in monitoring and optimizing agricultural interventions to improve practices, yields, and incomes. Through the partnership, TechnoServe helped seed company Equator Seeds to monitor the farming practices of their 30,000 contractor smallholder farmers.
- + The pilot delivered significant benefits for both farmers and Equator Seeds in increased yields and decreased input costs. Pesticide use declined by 60%, and there was an average \$2,150 increase in annual profits for the 270 pilot farms. Equator Seeds gained profits of \$6.5 million, delivering a return of \$20 for each \$1 of program investment.
- + A projected 100% increase in yields, coupled with the reduced spending on pesticides, means the 30,000 individual farmers in Equator Seeds’ sourcing network can expect returns of over \$3,000 and \$1,500 in their first year of maize and soy seed production, respectively. This would equate to a \$67 million increase in smallholder farmers’ income and \$300 million to Equator Seeds’ profits in just one year.<sup>219</sup>

### Ghana and Côte d’Ivoire

- + The cocoa sector, centred on Ghana and Côte d’Ivoire, is particularly sensitive to climate change-related disruption. In Ghana, lack of adaptation is predicted to create income losses to cocoa farmers of up to \$410 million a year. Companies along the value chain, therefore, have targeted the region for tech-driven, sustainable intensification projects to address productivity challenges, deforestation and requirements for better livelihoods and working conditions.

- + A concern is the lack of easily accessible and accurate weather data. An estimated 1.5 million farming households in key growing areas in West Africa cannot make data-driven agricultural management decisions. The CocoaCloud project, led by the World Business Council for Sustainable Development and Outputs Insights BV, seeks to fill this knowledge gap with a five-year pre-competitive data platform.
- + Data is collected from ground sensors across the region. CocoaCloud sends local weather forecasts and farm management alerts based on agronomic algorithms and location data. The platform also allows exchanges of knowledge and feedback between farmers and extension services. Today, CocoaCloud supports 7,500 cocoa farmers, community members and extension workers in Ghana's Western Region. The target is to make data available for more than 1 million smallholder farmers in Ghana and Cote d'Ivoire by 2024.<sup>220</sup>

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Nature4Climate (N4C) is an initiative of the United Nations Development Programme (UNDP), UN-REDD, UNEP, the Convention on Biological Diversity (CBD), the International Union for Conservation of Nature (IUCN), Conservation International (CI), The Environmental Defense Fund (EDF), The Nature Conservancy (TNC), Wildlife Conservation Society (WCS), Woods Hole Research Center, World Business Council for Sustainable Development (WBCSD), World Resources Institute (WRI), WWF, We Mean Business, the Food and Land Use Coalition and Youth4Nature. The secretariat is housed in TNC.

N4C aims to increase investment and action in nature-based solutions in support of the 2015 Paris climate agreement, working to catalyze partnerships between governments, civil society, businesses and investors based on the urgency to protect, restore and fund nature-based solutions. N4C believes in the importance of integrating nature into all government and private-sector decision-making.

We are looking for natural climate leaders all over the world. Please join the conversation [#naturenow](#) [#naturepositive](#) [@nature4climate](#) or [get in touch](#).

