THE AMAZON WE WANT
Science Panel for the Amazon

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Statement to the UN Summit on Biodiversity

Urgent Action for the Amazon We Want

Preamble

We, scientists of the Science Panel for the Amazon, appeal to the United Nations Summit on Biodiversity and to Heads of State, and citizens of the world to commit to saving the Amazon from the compounding effects and exacerbating threats of extractive industries, destructive deforestation, forest and riverine degradation, fires, and climate change.

We met on September 2019 at the United Nations, on the eve of the Climate Action Summit convened by the UN Secretary-General and issued a Scientific Framework to Save the Amazon. We emphasized that the Amazon is a place of immense natural and cultural wealth, values and diversity. It is the greatest repository of biodiversity in the world, holding more than 10% of all species of plants and animals on Earth. It is also home to 35 million people and cultural diversity, including more than one million Indigenous Peoples, with their own identities, territorial effective management practices, and at least 330 different languages.

We emphasized the significant and multiple environmental services that the Amazon provides to the sovereign Amazonian countries and to the world, including the critical role it plays in the global water, energy, and carbon cycles. The basin holds 20% of the planet's non- frozen fresh water, the forest efficiently recycles water to the atmosphere, and the winds transport this moisture via rainfall to countries outside the basin.

The Amazon is also a critical buffer against climate change, absorbing between 13% and 20% of the 2.4 billion metric tons of carbon captured annually by the world's forests. The forests store more than 100 billion metric tons of carbon, roughly a decade's worth of global energy-related emissions. The Amazon rainforest and associated ecosystems are vital for the entire planet, and an irreplaceable heritage for all of humanity.

We warned that the Amazon is nearing a tipping point due to devastating trends that threaten the survival of both the forest and aquatic ecosystems which sustain it, and its inhabitants, especially Indigenous Peoples and local communities, whose rights must be respected if their knowledge and their role in conservation is to be sustained. Such threats are the result of the expansion of inefficient cattle ranching, low-productivity agriculture, the widespread use of toxic chemicals including mercury pollution, large infrastructure such as hydroelectric dams, illegal logging and mining, which cause deforestation and degradation of forest and

aquatic ecosystems. Close to 70% of protected areas and Indigenous territories are threatened by roads, mining, oil and gas development, illegal invasions, hydroelectric dams, and deforestation.

Today, COVID-19 is exacerbating this situation. Illegal deforestation, mining, and other clandestine activities have increased since the beginning of the pandemic. This has unveiled long-standing structural and economic inequities, including access to basic services like clean water, sanitation, healthcare, education, transportation, electricity, and broadband. COVID-19 is also having a devastating impact on Indigenous Peoples in the Amazon. As of September 23, 2020, an estimated 238 indigenous communities of the Amazon basin have been affected by COVID-19, with over 61,782 people confirmed to be infected and 1,878 deaths, many of them elderly, numbers that, in all likelihood, significantly underestimate the true spread of the virus and its devastation of dozens of cultures through high mortality among Indigenous elders in the region who hold vast traditional knowledge. The plight of Amazonian urban dwellers is no less dire. Iquitos, Leticia and Manaus have extremely high rates of infection.

Bioeconomy[1] is one of the most important frontiers of scientific and technological innovation. The Amazon, with the world's greatest biodiversity, has no doubt a significant bioeconomic potential by harnessing its biological and biomimetic assets, including those assets codified in the genomes of biodiversity.

Given that the Amazon is close to reach an irreversible tipping point of no return, the COVID-19 economic recovery plans cannot be based on expanded resource extraction. Rather, they should support the transition towards a more sustainable, and socially inclusive development of the Amazon, in both urban and rural settings. The resource-intensive export-oriented industrial development model adopted by most Amazonian countries for the past 50 years led to a massive destruction of the forest and to high inequity and poverty. It is essential to pursue a transition to an alternative economic model that no longer relies on deforestation and destructive extraction of commodities and raw materials, but, instead, could start with adding technological value to a sustainable production chain. Global cooperation should support local sustainable recovery plans from COVID-19.

We strongly recommend an economic recovery for the Amazon region with emphasis on green jobs and driven by investment in scaling up- recognition of the rights of Indigenous Peoples and local communities, in sustainable low-carbon green infrastructure, including health, education, and broadband. Special attention should be given to youth and children needs. We also call for the ecological restoration and fair use of degraded areas, and sustainable management of resources for a transition to a vibrant rights-based bioeconomy.

[1] The European Commission defines the bioeconomy as "the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. Its sectors and industries have strong innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge." Source: "Innovating for Sustainable Growth - A Bioeconomy for Europe" (2012). In the ecological context of Amazonia, the understanding of ***Bioeconomy*** is strictly limited to the sustainable use of standing-forest and water-based biological resources (including free-flowing rivers) to ensure forest and ecosystem conservation.

We acknowledge that the majority of Amazonian people are urban, and this trend towards urbanization is continuing. Development pathways in the Amazon so far have largely ignored the importance of achieving sustainable cities in the Amazon. That must change. Cities can grow even as their regional footprints stabilize.

We believe that an integrated cross-sectoral approach to land use, water, forests, fisheries, and infrastructure that secures and increases land under conservation, restores degraded lands, respects Indigenous Peoples, and invests in sustainable development pathways can save the Amazon.

We recognize the traditional knowledge of Indigenous Peoples, who have sustainably managed the standing forest and associated ecosystems for over 12,000 years. Close to 45% of the best conserved areas are Indigenous lands. And there is a growing appreciation of their knowledge as especially relevant for advancing a sustainable economy, as well as restoration of degraded areas.

The advanced economies have a deep responsibility to provide financing and support due to their role as primary consumers of products such as soybeans and meat that contribute to deforestation, and their historical cumulative greenhouse gases (GHG) emissions.

Movements across political, corporate, academic, and civil society spheres are surging to stop deforestation and to mobilize action for the sustainable development of the Amazon.

Given the urgency of COVID-19 crisis, and the continued forest destruction and fires, we urge the Biodiversity Summit to help the sovereign nations of the Amazon basin protect, what is also a heritage of global humanity. We insist especially on the protection and recognition of the Indigenous Peoples' rights, who are the rightful first stewards of the Amazon. We must mobilize urgent medical care, telemedicine, protective equipment, fire prevention programs, and enhanced enforcement against illegal mining and logging and forest clearing.

Urgent local, national, and global action is needed, and we appeal to governments, businesses, financial institutions, civil society, academia, scientists, the media, faith-based communities and people of good will everywhere to join in a common effort to save the Amazon and invest in its long-term sustainable development.

Science Panel for the Amazon
UN Summit on Biodiversity Statement

Urgent Action

On the verge of reaching a tipping point in the Amazon

Research shows that dry seasons in the Amazon have become warmer and longer[2] as part of the intensification of its hydrological cycle[3]. This, combined with invasive grass species introduced by cattle ranching, is augmenting the flammability of the system[4] and increased forest degradation. Fires and long-term forest degradation[5] are reducing the quality of the soils[6], releasing GHGs, escalating tree mortality[7], and reducing the Amazon's ability to function as a carbon sink. If tree mortality continues to rise, recent analyses predict that old-growth Amazonian forests, wetlands and associated grasslands will shift from a carbon sink to a carbon source by 2035[8]. Forest loss further harms the hydrological cycle, reducing the moisture that supports the rainforest. This generates a cascading event, in which the climate becomes even warmer and drier.

These trends trigger unpredictable consequences for ecosystems and biodiversity. Complex webs of interconnections link species, with the loss of one or a few having dramatic implications for others. Recurrent cutting and burning along with reduced soil fertility narrow down the pool of species able to colonize and grow, favoring species with fire-resistant seeds, higher sprouting ability and lower nutrient demand[9]. Among new trees, drought-tolerant varieties have already

[2] Fu, R., Yin, L., Li, W., Arias, P.A., Dickinson, R.E., Huang, L., Chakraborty, S., Fernandes, K., Liebmann, B., Fisher, R., Myneni, R.B. (2013) Increased dry-season length over Amazonia. Proceedings of the National Academy of Sciences Nov 2013, 110 (45) 18110-18115; doi: 10.1073/pnas.1302584110
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[7] Brando, P.M., Balch, J.K., Nepstad, D.C., Morton, D.C., Putz, F.E., Coe, M.T., Silvério, D., Macedo, M.N., Davidson, E.A., Nóbrega, C.C., Alencar, A., Soares-Filho, B.S. (2014) Proceedings of the National Academy of Sciences, 111 (17) 6347 6352; doi: 10.1073/pnas.1305499111
[8] Hubau et al. (2020) Asynchronous carbon sink saturation in African and Amazonian tropical forests. Nature, 579, pages 80–87
[9] Jakovac et al. (2016) Land use as a filter for species composition in Amazonian secondary forests. Journal of Vegetation Science. 27(6):1104-16.

become more abundant[10]. This reduces the natural heterogeneity of the Amazon system, and has cascading effects across the ecosystem, reducing nutrient cycling and affecting plant-animal interactions. Climate change and deforestation combined could contribute to a 58% decline in the species richness of Amazonian trees[11]. The Amazon is very near a tipping point in which the tropical forest may give way to savannah-like degraded ecosystems[12] for over 60% of the basin[13].

Knowledge and understanding of the distinct thresholds and levels of resilience of the diverse Amazon ecosystems are important to identify priority and urgent actions for restoration, remediation and conservation.

The Amazon and the Andes form a human-natural coupled system of hydrological, climatic, biogeochemical, and social interactions[14]. The tropical Andes have been identified as the most imperiled hotspot for biodiversity on Earth[15,16], due to human encroachment, deforestation, land use/land change for agriculture, mining, and extensive cattle ranching[17,18]. Increases in average temperatures brought about by climate change, combined with deforestation and land use/change are disturbing the natural reservoirs of hundreds of thousands undiscovered microorganisms and zoonotic viruses, favoring the spatiotemporal distribution of vector borne diseases and increasing the risk of future epidemics as well as global pandemics[19]. The Amazon's unparalleled biodiversity could make the region the world's largest pool of zoonotic viruses with pandemic potential[20]. As an example, the Andes, which are experiencing an intensification of glaciers' melting and the shrinkage of fragile *páramos* ecosystems, are also witnessing an increase in mosquito-borne

[10] Esquivel-Muelbert, A., Baker, T. R., Dexter, K.G., et al. (2019) Compositional response of Amazon forests to climate change. Global Change Biology 25, 1, 1 2019, doi: https://doi.org/10.1111/gcb.14413
Esquivel-Muelbert et al. 2018
[11] Gomes, V. H., Vieira, I. C., Salomão, R. P., & ter Steege, H. (2019). Amazonian tree species threatened by deforestation and climate change. Nature Climate Change, 9(7), 547-553.
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[18] Poveda, G., J.C. Espinoza, M.D. Zuluaga, S.A. Solman, R. Garreaud, and P.J. van Oevelen (2020). High impact weather events in the Andes. Frontiers in Earth Science, Section Hydrosphere, 8:162. doi: 10.3389/feart.2020.00162.
[19] Val, A.L. (2020) Biodiversity – the hidden risks. Annals of the Brazilian Academy of Sciences 92(1): e20200699. Doi: 10.1590/0001-3765202020200699
[20] Val, A.L. (2020) Biodiversity – the hidden risks. Annals of the Brazilian Academy of Sciences 92(1): e20200699. DOI 10.1590/0001-3765202020200699

diseases, such as malaria, dengue, and zika due to climatic and socio-environmental factors[21,22,23,24].

Amazon deforestation threatens the water supply for hundreds of cities and towns along the Andes and southeastern South America, as well. Furthermore, reductions in rainfall driven by deforestation and climate change, combined with productivity loss due to reduced soil quality and increased CO_2 levels, could significantly reduce agricultural productivity of the southern cone and South America's GDP. Given that around 40% growth of the world's food supply in 2050 might originate in South America and that this supply relies on predictable rainfall patterns, maintaining the stability of the Amazon's ecosystem services function is of paramount importance[25]. At the same time, the Amazon's urban areas are suffering more frequent and intense flooding, as rainfall comes in less frequent, but more damaging events.

In 2019, more than 1.7 million hectares of Amazonian primary forest were lost in Bolivia, Brazil, Colombia, Ecuador, and Peru, according to figures from the MAAP project, which monitors a large area of the Amazon. Further, during the first six months of 2020, deforestation in Brazil increased by 26% compared to 2019, according to official data from the Brazilian National Institute for Space Research (INPE).

Fluvial ecosystems are disrupted by hydroelectric dams, which affect the connectivity of river systems and fish migrations, and modify the natural streamflow regime impacting biodiversity, ecosystem services and food webs in floodplains downstream the hydropower plants[26], compromising the livelihoods of thousands of Amazonian residents that depend on these fisheries as their main source of income of protein. Some species might in peril of becoming extinct including large fish that are extremely important for the food supply in lowland Amazonian regions.

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[26] Assahira C, Piedade MTF, Trumbore SE, Wittmann F, Cintra BBL, Batista ES et al. (2017) Tree mortality of a flood-adapted species in response of hydrographic changes caused by an Amazonian river dam. Forest Ecology and Management 396: 113-123.

COVID-19 and Green Recovery in the Amazon

The societal disruption from the COVID-19 pandemic opened up more opportunities for illegal deforestation, mining, and other clandestine activities, which have surged in 2020. It has also exacerbated long-standing structural and economic inequalities in the region[27], such as lack of access to services, including access to clean water, sanitation, healthcare, education, transportation, electricity, and broadband. As an example, some of the most remote villages do not have the infrastructure to care for critically ill patients, and internet and telephone connectivity can be precarious, making evacuation of ill patients very challenging.

COVID-19 is severely impacting Indigenous Peoples and local communities in the Amazon. By September 23, 2020, approximately 238 Indigenous Peoples of the Amazon basin have been affected by COVID-19, with over 61,782 people infected and 1,878 deaths[28]. In Brazilian Amazon the rate of infection by COVID-19 among Indigenous people is 150% higher than the national average rate[29]. The plight of Amazonian urban dwellers is no less dire, with cities like Manaus (Brazil), Iquitos (Peru) and Leticia (Colombia) presenting extremely high infection rates[30,31].

The long duration of the pandemic coincided with the dry seasons and spikes of forests fires in most of the Amazon, particularly over the southern region, which experienced a very severe dry season. Consequently, smoke and soot particles suspended in the air put further stress on the respiratory system, increasing the susceptibility to COVID-19.

The pandemic puts into stark relief the fragility and complexity of the systems' dynamic social-ecological equilibrium. Global and regional warming, along with anthropogenic deforestation activities, has been shown to contribute to the spread of vector-borne diseases, from wild reservoirs to domestic animals and humans[32]. Historical socio-economic activities in the region, such as changes in land use, the construction of roads and hydroelectric dams; mining and extractive activities; and poorly planned urbanization, cause ecosystem fragmentation, leading to more frequent human-pathogen contact, and facilitating the spillover of pathogens to humans.

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[27] Dávalos LM, Austin RM, Balisi MA, Begay RL, Hofman CA, Kemp ME, Lund JR, Monroe C, Mychajliw AM, Nelson EA, et al. (2020) Pandemics' historical role in creating inequality. Science, 368:1322.
[28] REPAM
[29] Fellows M., Paye V., Alencar A., Nicácio M., Castro I., Coelho M.E., Moutinho P. (2020). They Are not Numbers. They Are Lives! COVID-19 threatens indigenous peoples in the Brazilian Amazon. Amazon Environmental Research Institute (IPAM); Coordination of the Indigenous Organizations of the Brazilian Amazon (COIAB); https://ipam.org.br/wp-content/uploads/2020/06/NT_COVID-english.pdf.
[30] https://www.sciencenews.org/article/coronavirus-covid-19-brazil-city-manaus-herd-immunity.
[31] https://www.bbc.com/mundo/noticias-america-latina-52578619
[32] Daszak P., Olival KJ., Li H. (2020) A strategy to prevent future epidemics similar to the 2019-nCoV outbreak. Biosaf Health. 2020; 2: 6-8

With the rising threat of zoonotic diseases, governments are moving towards policies that take a "One Health" approach, which considers human, environmental, and animal health in an integrated way[33]. In the Amazon basin, the One Health approach includes halting deforestation and degradation, consolidating conservation areas, supporting Indigenous territorial management improving sanitation and health infrastructure, and promoting safe practices in the animal trade and animal food production, particularly fish and cattle. The total cost of permanently protecting all tropical forests is small compared to the value this would provide in mitigating pandemic risk. Forest-protection policy models that economically outcompete deforestation, can achieve a 40% reduction of deforestation of areas with highest risk for virus spillover at a cost of USD 9.6 billion. By widely adopting the Brazilian policy model that decreased deforestation in the Amazon by 70% during 2005-2012, we could achieve the same reduction in deforestation for only USD 1.5 billion annually through elimination of subsidies that favor deforestation, limitation private land clearing, and support of territorial rights of indigenous peoples[34].

To put this in context, COVID-19 pandemic will likely end up costing between USD $8.1 and $15.8 trillion globally[35], and this does not take into account the income losses for future generations of young people due to lack of educational attainment, which is estimated at USD 10 trillion[36]. However, spillover prevention, and global zoonotic virus early warning systems implementation, are significantly more cost-effective than response[37]. Of paramount importance is designing and implementing an Amazon-wide zoonotic virus early warning system connected to the region's public health authorities.

Post-pandemic economic recovery plans should support the transition towards more sustainable and inclusive development of the Amazon basin. Economic recovery cannot be based on further unsustainable resource extraction; rather, public investments should support the transition to a low-carbon, resilient, and inclusive bioeconomy rooted in the Amazon socio-biodiversity and spur complementary private investment.

Economic recovery plans should mobilize investment in sustainable infrastructure, including access to clean water, health, education, electricity, and broadband; in the restoration of degraded areas; and in science, technology, and innovation to sustainably manage resources. Global cooperation is needed to support such recovery plans, as the COVID-19 response represents a global development and recovery paradigm[38].

[33] Ellwanger, J.H. et al. (2020) Annals of the Brazilian Academy of Sciences, *Beyond diversity loss and climate change: Impacts of Amazon deforestation on infectious diseases and public health.*
[34] Dobson, A.P. et al. (2020). Ecology and economics for pandemic prevention. Science, 369:6502.
[35] https://www.weforum.org/agenda/2020/08/pandemic-fight-costs-500x-more-than-preventing-one-futurity/
[36] http://pubdocs.worldbank.org/en/798061592482682799/covid-and-education-June17-r6.pdf
[37] https://reliefweb.int/sites/reliefweb.int/files/resources/ZP.pdf
[38] Oldekop et al. Global Development (2020), *COVID-19 and the case for global development*

A portfolio of COVID-19 related metrics should be developed to track the economic recovery, health systems response, and a number of socio-economic and environmental indicators. Further, data should be disaggregated to ensure equitable outcomes, especially for Indigenous Peoples, local communities, and the urban poor.

Standing forests, flowing and healthy rivers: Transformative sustainable development

According to the latest WWF Living Planet report, the world witnessed an average 68% decrease in population sizes of vertebrates globally with a 94% reduction in the tropical subregions of the Americas, over the last 50 years[39]. Reversing declines in biodiversity will require an integrated strategy of landscape and watershed-level governance that enhances the area of land and water under conservation, restores forests in degraded deforested and abandoned lands, improves land titling and regularization, and invests in sustainable development pathways such as a vibrant bioeconomy.

Amazonian is a complex highly connected set of ecosystems along the continuum from highlands to lowlands, as well as the strong reciprocal links between forests and aquatic systems. Understanding these connections, as well as the important role played by Indigenous and local knowledge systems in the management and conservation of these linked social-ecological systems is vital to establish conservation targets and protected areas, develop an integrated aquatic-terrestrial management approach, and implement bioeconomic strategies. An integrated basin management approach that considers these connections will be critical for conserving the Amazon while also maximizing the services these ecosystems provide to the economies and people of the Amazon.

It is important to highlight that close to 46% of the Amazon Basin's natural areas (389.8 million hectares) are under some type of protection by Protected Areas and Indigenous territories. Additionally, 99.3 million hectares of the Amazon Basin are in 12 Biosphere Reserves and 32 Ramsar Sites, and nearly half of these areas overlap with Protected Areas or Indigenous territories[40]. However, 68% of Protected Areas and Indigenous territories also overlap with planned infrastructure projects and investment plans[41].

[39] https://f.hubspotusercontent20.net/hubfs/4783129/LPR/PDFs/ENGLISH-FULL.pdf
[40] Instituto Socioambiental (2019). Available at: https://www.amazoniasocioambiental.org/pt-br/publicacao/amazonia-2019-areas-protegidas-e-territorios-indigenas/
[41] https://crossroads.amazoniasocioambiental.org/?lang=en

There is also significant potential for land restoration in the Amazon. In Brazil, the Law on Native Vegetation Protection (LPVN in Portuguese, Law Nº 12,651/2012)[42], requires restoration within rural properties that: i) do not maintain native vegetation in Permanent Preservation Areas (APP, specific locations such as riparian forests that needs to be preserved) and/or ii) do not reach the minimum percentage of the native vegetation to be preserved as a Legal Reserve (RL, 80% of the rural property in the Brazilian Amazon). Combining APP and RL areas to be recovered under the current legislation, 7.2 million hectares could be restored in the Brazilian Amazon[43].

Sustainable development pathways in the Amazon require cross-sectoral and landscape-wide approaches involving land use, forests, rivers, fisheries and aquaculture, agriculture, cattle breeding, mining and urbanization, while systematically addressing climate change, biodiversity loss, human rights, and sustainable development concerns.

The resource-intensive industrial development model adopted by most Amazonian countries for the past 50 years has led not only to massive destruction of the rainforest, but also to widening inequality and poverty across the basin. This model has historical roots in the colonial occupation of the Americas and is premised on importing old models of the 'agricultural green revolution' with practices based on monocultures and drylands, which ignore the extreme heterogeneity of the Amazon system.

A better approach entails synergistically, by addressing climate change and biodiversity loss, while generating investment in the sustainable use of resources, and integrating Indigenous and local knowledge.

Recognizing both cultural and biological diversity is key for the sustainable management of the Amazon: solutions can leverage the diversity of cultures and institutions, be based on the high biodiversity of the region, and be informed by a range of institutional, socioeconomic and political contexts. Local populations are increasingly valuing nature's contribution to the people's well-being, recognizing the interconnections between humans and the environment, and are advocating conservation of forests and aquatic ecosystems[44].

A shift in the development paradigm should mobilize investment for a vibrant and socially inclusive bioeconomy that improves the well-being of Amazonian populations, integrates local

[42] Brasil (2012) Lei nº. 12.651 de 25 de maio de 2012. Lei de Proteção da Vegetação Nativa. Brasília, DF. Available at: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm
[43] Brasil/Ministério do Meio Ambiente (2017). Planaveg: Plano Nacional de Recuperação da Vegetação Nativa / Ministério do Meio Ambiente, Ministério da Agricultura, Pecuária e Abastecimento, Ministério da Educação. Brasília, DF: MMA, 73 p. Available at: https://www.mma.gov.br/images/arquivos/florestas/planaveg_plano_nacional_recuperacao_vegetacao_nativa.pdf
[44] De Brito et al., (2020) Perception of Nature's Contribution to People in Rural Communities in the Eastern Amazon. Sustainability. doi: 10.3390/su12187665

knowledge for a resilient and sustainable management of the forest, and promotes multiple-levels of governance arrangements that take into account the growing connectivity and interdependence of the regions inter-urban networks, agricultural lands, Indigenous and protected areas, and watersheds.

Investment in human development, harnessing science, technology and innovation

Conservation of the Amazon requires scientific information on multiple biodiversity dimensions, including taxonomic, functional, or trait based, and phylogenetic, together with species abundances, biogeographic distributions, interactions, and studies on biocultural diversity, which focuses on the interactions between cultural, linguistic and biological diversity. Urgent investments are needed to leverage existing taxonomic and ecological knowledge and capacity, to study cryptic but taxonomically diverse and ecologically important groups that drive biogeochemical processes, and to allow the continuity of evolutionary processes across the Amazon basin. For example, both regional and local selection for developing plant varieties used as sources for food has been a common denominator among human communities in the Amazon. The current vestiges show that many crops have resulted in products that are currently widely distributed and not only benefit South America, but the world.

Crops, forest products, livestock, forestry and agroforestry, fisheries, and aquaculture provide direct livelihoods to both urban and rural people in the Amazon, and to an increasing worldwide population[45]. However, climate change and anthropogenic drivers of deforestation and degradation are rapidly degrading the region's productive capacity, from both terrestrial and aquatic ecosystems. This is a direct threat to the food security of millions of people in the region, which is already impacted. Farmers and fishers need support to increase resilience in the food system so that it can adapt to changing environmental and socio-ecological conditions, and continue securing nutrition for Amazonian people now, and into the future.

There is a clear need for regional fishing policies that guarantee food security of people living in the Amazon and that address mercury and other pollutants and toxic contamination in fisheries which has severe impacts in the health of local populations.

The sustainable use of the ecosystem services is a strategy that helps people adapt to the adverse effects of climate change, deforestation and degradation of forests, and aquatic ecosystems, while ensuring human-environmental well-being, conservation, and sustainable development.

[45] IBGE 2018 Report

It is essential to develop an alternative socio-economic model that no longer relies on the supply of commodities or raw materials, but instead is founded on the sustainable management of resources, adding technological value through transformation and innovations using existing and new technologies and, particularly, value aggregation that brings benefits for local and state economies and increase employment. Very limited public resources (e.g. technical support and credit) have been allocated to supporting the development and expansion of these complex systems that combine management of diverse resources, and as a result many rural workers have been forced into temporary or urban employment, while large ranchers and farmers have appropriated land and resources. Expansion of monocultural and livestock systems and problems in land tenure and violence, as well as a more complex portfolio of livelihood strategies have driven urbanization in Amazonia. Around 70-75% of its populations lives in towns and cities[46,47]. These urban dwellers rely extensively on rural and peri urban resources.

Historically, products derived from genetic resources and germplasm from the Amazon have been developed and marketed outside the region. This is an under-explored opportunity for sustainable business innovation to add the value locally and increase their share in the trade of these resources.

Despite the immense richness of the Amazon, products from the forest are underutilized or unknown to national global and even local markets. High valued forest products, such as açaí (*Euterpe oleracea*), Brazil nut (*Bertholletia exelsa)*, cacao (*Theobroma cacao)*, and cupuaçu (*Theobroma grandiflorum)*, to less valued known products such as andiroba (*Carapa guianensis)*, copaiba (*Copaifera* species), buriti or moriche (*Mauritia flexuosa)*, tucumã (*Astrocaryum aculeatum)*, patuá or ungurahua (*Oenocarpus bataua*), form part of the solution to maintain forests while generating sustainable development opportunities.

There also remains great, yet unexplored, potential in using advanced genomics, computational biology and synthetic biology to leverage the region's immense potential of the Amazon's digital genetic sequencing information (DSI), and chemical diversity[48], considering the hundreds of thousands of species that could have biomimetic potential.

A bioeconomy-based development strategy, preserving standing forest and flowing and healthy rivers, will require investment in health, education, science, technology, and innovation, as well as a commitment to fair and equitable benefit-sharing and digital regulatory technology infrastructures. As a simple illustration of the potential, it is worth highlighting that the Human

[46] Padoch, C. et al. (2008) *Urban Forest and Rural Cities: Multi-sited Households, Consumption Patterns, and Forest Resources in Amazonia*. Ecology and Society. 13(2):2.
[47] IBGE, 2010.
[48] Saporito, R.A., Donnelly, M.A., Spande, T.F., Garraffo, H.M. (2011) A review of chemical ecology in poison frogs. Chemoecology 21:1–10.

Genome Project that decodified our own species genome had a federal investment of about USD 3.8 billion and has enabled the generation of more than USD 796 billion in economic output, with a return on investment to the U.S. economy of 141 to 1, meaning that every $1 of investment has helped to generate $141 dollars in the economy[49].

Decision-making should be guided by scientific evidence, science- based targets, reliable data and lessons learned from past policies and decisions. It is critical to mobilize massive investment in education, science, technology, and innovation, as highlighted by the Leticia Pact, adopted in September 6, 2019[50]. The region has a poor track record of investing in research, science, technology and innovation, as well as in maintaining financing initiatives once they have deployed; for instance, Brazil's main research institution for the Amazon has an annual budget of around US $15 million, in comparison with universities in OECD countries that have research budgets ranging from hundreds of millions to billions of dollars.

The Potential of a *Standing Forests, Flowing Rivers* Bioeconomy

Globally, bioeconomy is one of the most important frontiers of scientific and technological innovation. In the United States only, it represents a trillion-dollar sector[51], and the European Union is implementing policies to expand its bioeconomy[52]. Currently, over 50 countries have established policies to support development in this sector, overwhelmingly based on researching temperate-zone corps[53]. This includes, green plastics and other biotechnologies aimed at improving agriculture and animal health.

The great paradox of contemporary bioeconomy is the relative absence of tropical forest socio-biodiversity both in the scientific literature and in business models and practices through value chains where raw materials are primarily exported and rarely transformed into quality products and services; and if they are, they are largely elaborated and processed outside the region.

The Amazon, with the world's greatest biodiversity, has without a doubt, a significant potential. Governments, the private sector, academia, and financial institutions should support the development of a bioeconomy that conserves standing forests and flowing, healthy rivers.

[49] Tripp, S. and Grueber, M. 2011. Batelle Memorial Institute. https://www.battelle.org/docs/default-source/misc/battelle-2011-misc-economic-impact-human-genome-project.pdf?sfvrsn=6
[50] Paragraph 13 of the Leticia Pact states: "Promote research, technological development, technology transfer and knowledge management processes with the purpose of guiding the appropriate decision making and promoting the development of sustainable environmental, social and economic enterprises."
[51] https://www.nap.edu/catalog/25525/safeguarding-the-bioeconomy
[52] https://ec.europa.eu/commission/news/new-bioeconomy-strategy-sustainable-europe-2018-oct-11-0_en
[53] https://ec.europa.eu/knowledge4policy/publication/bioeconomy-policy-part-iii-update-report-national-strategies-around-world_en

The Box below illustrates the current annual value for some tropical products produced and traded globally and show the existence of a well-established market for tropical products. The Amazon countries could benefit of those markets by expanding diversified bioindustries and value-added products. Additionally, there are several products from the native forest, which have economic potential, that are underutilized or unknown to markets and the industry as a whole.

Box 1. Some tropical forest products (total Global production value estimate) being produced and traded globally.

- Cocoa and chocolate: USD 49,400 million in 2020 and are expected to reach USD 63,600 million in 2024[54].
- Rubber: USD 39,720 million in 2020 and is expected to reach USD 68,480 million by the end of 2026[55].
- Sweet potato: USD 32,020 million in 2020 is expected to reach USD 37,350 million by the end of 2026[56].
- Açaí berry: Açaí berry market size was worth USD 720 million in 2019, and it is estimated to reach a valuation of USD 2,090 million by the end of 2025[57].

There is a significant potential market for the Amazon products, in addition to an underrealized potential for sustainable tourism, and the highly important and valuable ecosystem services provided by the Amazon. This enormous value is being destroyed for short-term benefits[58]. As an example, the price of the land under pasture in the Amazon has greatly increased in the last two decades, reaching values up to three times higher than those of the standing forest land[59].

A tropical forest bioeconomy is inherently an economy of diversity (of territories, peoples, knowledge, products, and markets); forest products and services can be scaled up, linking the forest to people and enterprises.

[54] Market Watch. Cocoa & Chocolate Market 2020. https://www.marketwatch.com/press-release/cocoa-chocolate-market-2020-top-countries-data-market-size-with-global-demand-analysis-and-business-opportunities-outlook-2024-2020-08-06
[55] Market Watch: Global Rubber Market 2020. https://www.marketwatch.com/press-release/global-rubber-market-2020-industry-analysis-size-share-trends-market-demand-growth-opportunities-and-showing-impressive-growth-by-2026-2020-08-15
[56] Sweet Potato Market 2020. https://www.marketwatch.com/press-release/sweet-potato-market-2020-global-industry-analysis-by-top-countries-data-with-size-share-segments-drivers-and-growth-insights-to-2026-2020-09-16
[57] Acai Berry Market 2020. https://www.marketdataforecast.com/market-reports/acai-berry-market
[58] Coomes O.T., Takasaki, Y. and Abizaid, C. (2020). Impoverishment of local wild resources in western Amazonia: a large-scale community survey of local ecological knowledge. Environmental Research Letters 15.
[59] FNP

The bioeconomy should stimulate local, diversified bioindustries and value-added products across the entire value chain, generating jobs and supporting social inclusion. It should be equitable, gender inclusive, and respect the rights of Indigenous Peoples and local communities.

The private sector can leverage the economic potential of the Amazon through existing local technologies and new technologies emerging from the Fourth Industrial Revolution, including digital technologies, biotechnologies, and material science. This may include combining scientific with Indigenous and local knowledge, and developing new business models, that are transparent and that internalize accountability for their social and environmental costs throughout supply chains. Equally important is developing new forms of production based on a combination of local knowledge and technologies that have evolved in synergy with the region's ecology, as well as "smart technologies" that can help to improve production while minimizing waste and environmental impacts.

Commodity companies, financial institutions, governments, academia, and civil society organizations should collaborate, prioritize actions, develop inclusive governance models and track and report progress on key metrics, including the reduction of deforestation and inequality.

Traditional knowledge is essential for a sustainable development in the Amazon

There is a growing appreciation of traditional knowledge and Indigenous ways of living that for over 12,000 years valued the standing forest[60]. Close to 45% of the best conserved areas are within Indigenous lands[61], which protect biodiversity, increase the diversity of cultivars and store carbon. Their knowledge, together with the holistic knowledge of nature from traditional communities such as *quilombolas* and *ribeirinhos*, is especially relevant for advancing a sustainable development model. Nevertheless, many indigenous territories remain untitled, facing illegal invasions, and should be recognized and protected.

Box 2: The Amazonian region is the cradle for the domestication of numerous crops of major global economic importance today, such as cocoa, manioc, capsicums, pineapple, papaya, and peanuts. Previous and existing Indigenous technologies can be deployed in a systemic way to build resilience and a sustainable economy, such as:

[60] Levis, C., Flores, B.M., Moreira, P.A., Luize, B.G., Alves, R.P., Franco-Moraes, J., Lins, J., Konings, E., Peña-Claros, M., Bongers, F. and Costa, F.R. (2018) How people domesticated Amazonian forests. Frontiers in Ecology and Evolution, 5, p.171.
[61] Fernandez Llamazares, A., J. Terraube, M. Galvin, A. Pyhala, S. Siani, M. Cabeza, E. S. Brondizio. (2020) Reframing the wilderness concept can bolster collaborative conservation. Trends in Ecology and Evolution. 2706: July 2020.

- **Traditional soil management practices** that enhance soil fertility, increase its ability to absorb carbon, and could transform marginal areas into productive sites.

- **Agroforestry management approaches** that utilize landscapes that are complex in structure and function, and multi-functional in nature, providing ecosystem services as well as livelihood products. Açaí and cocoa are current successful examples, generating high levels of employment in a sustainable system. Recent research indicates that pre-Columbian agroforestry systems integrated a large variety of trees and palms.

- **Aquatic agro-ecologies**: The western world sees agricultural production through a monoculture episteme. However, close to one third of the Amazon's ecosystems are found in seasonal wetlands and lakes. These systems are complex and require an ecological understanding of the aquatic systems. There are many examples of managed systems that are extremely productive and have been tested on long throughout time scales, including seasonal flood plain agriculture, the management of lakes for high valued fisheries such as arapaima (also known as pirarucu), and the collection of fruits such as camu and aguaje, which grow close to wet areas. Climate change is expected to increase flooding and drought events, depending on the location, so there is a clear need to learn from integrated terrestrial-aquatic management systems that maintain ecological, agroecological, and social complexity.

The importance of ethnobotany and medicine should also be noted. Plant secondary compounds represent an important contribution to pharmaceutical and medical treatments. The knowledge of indigenous people may be of great value for mankind and should not get lost.

Indigenous and local knowledge and practices can be combined with scientific knowledge to scale up sustainable development in the region. Capacity development policies to empower local communities with culturally appropriate education and health, and technical skills are essential. That would result in a vibrant and socially inclusive bio-economy, which would add value to many terrestrial and aquatic value chains and harness the vast biological and biomimetic assets in the region's rich biodiversity.

It is critical to have further investment in sustainable infrastructure in the Amazon, including access to clean water, renewable energy, sustainable fluvial transportation, sanitation, health, education, and broadband. Biopiracy and the respect of property and intellectual rights, especially the right of Indigenous Peoples to control how their traditional knowledge is used should be addressed through standardization of regulatory regimes in the Amazon countries. The Brazilian Law of Genetic Resources is an effort in that direction. Potential bioeconomy opportunities might

also be associated to engineering genomics data through computational biology and synthetic biology[62].

The transformation of the economic model in the Amazon should be based on ethical values. Its sustainable use must be governed and respected both for its biological diversity and for the richness of the spiritual and material culture of the peoples who live there.

Encouraging political, civil society and private sector movements to stop deforestation

Movements across the political, corporate, academic, media, faith-based, philanthropic and civil society spheres are surging to stop deforestation[63], alongside several initiatives to mobilize integrated action towards the sustainable development of the Amazon.

The recent launch of a Task Force on Climate-related Financial Disclosures (TCFD) for Nature in coordination with Financial Authorities[64] is of global significance.

On the business side, global investment funds released an open letter in June 2020 calling for an end to deforestation in the Amazon[65]. According to the letter, carbon emissions and the loss of biodiversity represent a systemic risk to their portfolios. The funds, which collectively manage close to US $4 trillion in assets, expressed their additional concern with the financial impact of deforestation and violations of the rights of Indigenous Peoples, which have reputational risks and threaten the operations of their clients and investors. The World Economic Forum 2020 risk report highlights biodiversity loss, climate change and other environmental challenges among the top five risks for businesses[66].

"Concertation for the Amazon[67]" is a group of owners and executives of large companies, banks, researchers, military leaders, economists, politicians, and environmentalists. The group came together to advocate for the sustainable development of the Amazon region and an end to deforestation.

[62] Philip, J. OECD Library. (2020) Digitalisation in the bioeconomy: Convergence for the bio-based industries. https://doi.org/10.1787/b9e4a2c0-en
[63] Abramovay, R. Floresta Amazônica: a sociobiodiversidade como valor universal. Available at: http://ricardoabramovay.com/floresta-amazonica-a-sociobiodiversidade-como-valor-universal/
[64] https://www.fsb-tcfd.org/wp-content/uploads/2020/03/TCFD_Booklet_FNL_Digital_March-2020.pdf
[65] https://noticias.uol.com.br/ultimas-noticias/rfi/2020/06/23/fundos-de-investimentos-estrangeiros-cobram-de-bolsonaro-fim-do-desmatamento-da-amazonia.htm?cmpid=copiaecola
[66] WEF Risk Report 2020. Accessible at https://www.weforum.org/reports/the-global-risks-report-2020
[67] https://valor.globo.com/brasil/noticia/2020/08/26/concertacao-reune-100-lideres-para-salvar-a-amazonia.ghtml

Governors from nine Brazilian states signed an Interstate Consortium for the Sustainable Development of Amazonia Legal in 2019[68]. The consortium was created with the objective of advancing sustainable development in the region and enhancing the economic competitiveness of the states.

The Forum of Former Brazilian Ministers of the Environment has released an open letter in defense of democracy and sustainability, in which they called on the Ministers of the Supreme Federal Court, members of the National Congress, Governors, Mayors, and the Attorney General of the Republic, to *inter-alia* ensure effective compliance with constitutional principles to preserve an ecologically-balanced environment, and to adopt appropriate legal measures in a firm and timely manner to stop environmental degradation[69].

The Heads of State and Heads of Delegation of Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, and Suriname gathered virtually on August 11th, 2020, to reaffirm their commitment to the Leticia Pact for the Amazon[70] and make all necessary effort to ensure its effective implementation. They also agreed to develop and adopt a Protocol for Forest Fire Management in the Amazon in 2020, and to identify options to work together, both at the bilateral and regional level, to address the COVID-19 pandemic, including defining next steps for economic recovery through the strengthening of conservation and the sustainable use of biodiversity.

With the continuous threat of climate change and deforestation, exacerbated by the current COVID-19 pandemic, we can no longer wait for action. We must mobilize globally and locally to deploy an integrated and cross-sectoral approach to ensure sustainability of the Amazon for future generations to come.

[68] http://www.mt.gov.br/documents/21013/11214400/Carta+de+Macapá+-+17+Fórum+de+governadores+da+Amazônia+Legal.pdf/fcb2c639-1431-aae2-c4cc-5d26dd4abc4a
[69] https://valor.globo.com/politica/noticia/2020/06/18/carta-de-ex-ministros-chama-governo-de-anticientifico.ghtml
[70] https://www.cancilleria.gov.co/sites/default/files/200810declarationoftheiipresidentialsummitoftheleticiapactfortheamazon.pdf