THE AMAZON WE WANT
Science Panel for the Amazon

Panel Científico por la Amazonía

Declaración a la Cumbre de las Naciones Unidas sobre Biodiversidad

Acción urgente para alcanzar la Amazonía Que Queremos

Preámbulo

Nosotros, científicos del Panel Científico por la Amazonía, apelamos a la Cumbre de las Naciones Unidas sobre Biodiversidad, Jefes de Estado, y ciudadanos del mundo a que se comprometan a salvar la Amazonía de los impactos agravantes y las amenazas exacerbadas de la industria extractiva, la deforestación destructiva, la degradación forestal y fluvial, los incendios y el cambio climático.

En septiembre de 2019, nos reunimos en las Naciones Unidas, en vísperas de la Cumbre de Acción Climática convocada por el Secretario General de la ONU y emitimos un Marco Científico para Salvar la Amazonía. En dicho Marco Científico, destacamos que la Amazonía es un lugar de inmensa riqueza y valor, así como de diversidad natural y cultural. Es el mayor depósito de biodiversidad del mundo, con más del 10% de todas las especies de plantas y animales de la Tierra. También es el hogar de 35 millones de personas y además alberga una gran diversidad cultural, incluyendo más de un millón de Pueblos Indígenas, que cuentan con identidades y prácticas eficaces de gestión territorial propias, y al menos 330 lenguas diferentes.

Enfatizamos los importantes y múltiples servicios ambientales que la Amazonía brinda a sus países soberanos, así como al resto del mundo, incluyendo el papel fundamental que desempeña en los ciclos globales de agua, energía y carbono. Así, la cuenca amazónica contiene el 20% del agua dulce no congelada del planeta, y el bosque recicla el agua que llega a la atmósfera con gran eficiencia, está humedad ambiental es entonces transportada por los vientos a través de la lluvia alcanzando países fuera de la cuenca.

La Amazonía también es un amortiguador crítico contra el cambio climático, ya que absorbe entre el 13% y el 20% de los 2.400 millones de toneladas de carbono capturadas anualmente por los bosques en todo el mundo. En total, los bosques amazónicos almacenan más de 100 mil millones de toneladas de carbono, aproximadamente el equivalente a una década de emisiones globales. La

selva amazónica y sus ecosistemas asociados son vitales para todo el planeta y un patrimonio insustituible para toda la humanidad.

Advertimos que la Amazonía se está acercando a un punto de inflexión, debido a las tendencias devastadoras que amenazan la supervivencia tanto de los ecosistemas forestales y acuáticos que la sustentan, como de sus habitantes, especialmente los Pueblos Indígenas y las comunidades locales, cuyos derechos deben ser respetados más aún si aspiramos mantener su conocimiento y su importante papel en la conservación ambiental. Tales amenazas son el resultado de una expansión ineficiente de la ganadería; de una agricultura de baja productividad; del uso generalizado de productos químicos tóxicos, incluyendo contaminación por mercurio; de la construcción de grandes infraestructuras, como las represas hidroeléctricas; y de la tala y la minería ilegales; que provocan la deforestación y degradación de los ecosistemas forestales y acuáticos. Cerca del 70% de las áreas protegidas y territorios indígenas están amenazados por carreteras, minería, extracción de petróleo y gas, invasiones ilegales, represas hidroeléctricas y deforestación.

Actualmente, COVID-19 además ha agravado esta situación. La deforestación ilegal, la minería y otras actividades clandestinas han aumentado desde el comienzo de la pandemia, y ha revelado inequidades estructurales y económicas prevalentes en la región, incluyendo el acceso a servicios básicos como agua potable, saneamiento, atención médica, educación, transporte, electricidad y banda ancha. COVID-19 también está teniendo un impacto devastador en los pueblos indígenas de la Amazonía. A 23 de septiembre de 2020, se estima que 238 comunidades indígenas de la cuenca del Amazonas han sido afectadas por COVID-19, con más de 61.782 personas infectadas y 1.878 muertes, muchas de ellas, personas de edad avanzada. Cifras que, con toda probabilidad, subestiman en gran medida la verdadera propagación del virus y la devastación sobre docenas de culturas debido a la alta mortalidad de ancianos indígenas que son los que poseen el gran conocimiento tradicional. Igual de grave es la situación en las ciudades de la Amazonía. Ciudades como Iquitos, Leticia y Manaus han presentado tasas de infección extremadamente altas.

La bioeconomía[1] es una de las fronteras de la innovación científica y tecnológica más importantes. La Amazonía, que cuenta con la mayor biodiversidad del mundo, tiene sin lugar a duda, un gran potencial bioeconómico si se llega a aprovechar sus activos biológicos y biomiméticos, incluidos aquéllos codificados en los genomas de tanta biodiversidad.

[1] La Comisión Europea define la bioeconomía como "la producción de recursos biológicos renovables y la conversión de estos recursos y corrientes de residuos en productos de valor añadido, como alimentos, piensos, bioproductos y bioenergía. Sus sectores e industrias tienen un fuerte potencial de innovación debido al uso de una amplia gama de ciencias, tecnologías industriales y de capacitación, junto con el conocimiento local y tácito". Fuente: "Innovación para el crecimiento sostenible: una bioeconomía para Europa" (2012). En el contexto ecológico de la Amazonía, la comprensión de la bioeconomía se limita estrictamente al uso sostenible de los recursos biológicos forestales y acuáticos (incluidos los ríos de flujo libre) para garantizar la conservación de los bosques y los ecosistemas.

Dado que la Amazonía está cerca de alcanzar un punto de inflexión irreversible, los planes de recuperación económica después de COVID-19 no pueden basarse en la extracción masiva de recursos. Más bien, deberían apoyar una transición hacia un desarrollo de la Amazonía más sostenible y socialmente inclusivo, tanto en entornos urbanos como rurales. El modelo de desarrollo industrial adoptado durante los últimos 50 años por la mayoría de los países amazónicos, está orientado en la exportación y uso intensivo de los recursos, lo que ha conducido a una destrucción masiva del bosque, así como a una gran desigualdad y pobreza. Es esencial que encontremos una transición a un modelo económico alternativo que ya no dependa de la deforestación y la extracción destructiva de productos básicos y materias primas, sino que agregue valor tecnológico a una cadena de producción que sea sostenible. Es necesaria una cooperación global que apoye planes locales de una recuperación de COVID-19 sostenible.

Recomendamos encarecidamente una recuperación económica para la región amazónica que haga énfasis en los empleos en sostenibilidad ecológica y que esté impulsada por una inversión en el reconocimiento de los derechos de los pueblos indígenas y las comunidades locales, en una infraestructura sostenible y baja en emisiones de carbono, y que incluya la salud, la educación y banda ancha. Se debe prestar especial atención a las necesidades de los jóvenes y los niños. También pedimos una restauración ecológica y uso justo de las áreas degradadas, así como una gestión sostenible de los recursos comenzando la transición a una bioeconomía vibrante y basada en los derechos humanos.

Reconocemos que la mayoría de la población amazónica vive en ciudades, tendencia hacia la urbanización que continúa. Hasta ahora, las vías de desarrollo en la Amazonía han ignorado en gran medida la importancia de lograr ciudades sostenibles en la cuenca. Eso debe cambiar. Las ciudades pueden crecer especialmente si sus huellas regionales se estabilizan

Creemos que un enfoque intersectorial integrado en el uso de la tierra, el agua, los bosques, la pesca y la infraestructura que asegura y aumenta la conservación de las tierras, restaura ecosistemas degradados, respeta a los pueblos indígenas e invierte en vías de desarrollo sostenible, puede salvar la Amazonía.

Reconocemos el conocimiento tradicional de los pueblos indígenas, que han gestionado de manera sostenible el bosque y sus ecosistemas durante más de 12.000 años. De hecho, cerca del 45% de las áreas mejor conservadas del Amazonas son tierras indígenas. Y además existe una creciente apreciación del conocimiento indígena y local al ser especialmente relevante en la restauración de áreas degradadas, así como en el avance hacia una economía sostenible.

Las economías avanzadas tienen una gran responsabilidad en proporcionar financiamiento y apoyo debido a su papel como consumidores principales de productos como la soja y la carne, los cuales contribuyen a la deforestación, y emisiones de gases de efecto invernadero históricas.

Se encuentran en surgimiento movimientos en las esferas política, empresarial, académica y de la sociedad civil para detener la deforestación y movilizar acciones a favor del desarrollo sostenible de la Amazonía.

Dada la urgencia de la crisis de COVID-19, y la continua destrucción de bosques y frecuentes incendios, instamos a la Cumbre de Biodiversidad a apoyar a las naciones soberanas de la cuenca del Amazonas a proteger lo que también es patrimonio de la humanidad. Insistimos especialmente en la protección y reconocimiento de los derechos de los Pueblos Indígenas, ya que son los primeros administradores legítimos de la Amazonía. Debemos movilizar una atención médica urgente, telemedicina, equipos de protección, programas de prevención de incendios y una mayor aplicación de la ley contra la minería y la tala ilegal.

Se necesita una acción urgente a nivel local, nacional y global, por ello, hacemos un llamamiento a los gobiernos, empresas, instituciones financieras, la sociedad civil, el mundo académico, los científicos, los medios de comunicación, las comunidades religiosas y las personas de buena voluntad de todo el mundo para que se unan en un mancomunado esfuerzo para salvar la Amazonía e invertir en su desarrollo sostenible a largo plazo.

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
[3] Marengo, J., and Espinoza, J.C. (2016) Extreme seasonal droughts and floods in Amazonia: causes, trends and impacts. International Journal of Climatology. doi:10.1002/joc.4420
[4] Silvério, D. V., Brando, P. M., Balch, J. K., Putz, F. E., Nepstad, D. C., Oliveira-Santos, C., & Bustamante, M. M. (2013). Testing the Amazon savannization hypothesis: fire effects on invasion of a neotropical forest by native cerrado and exotic pasture grasses. Philosophical Transactions of the Royal Society B: Biological Sciences, 368(1619), 20120427.
[5] Trondoli Matricardi E.A., Skole D.L., Cost.a O.B, Pedlowski M.A Samek J.H. and Miguel E.P. (2020) Long-term forest degradation surpasses deforestation in the Brazilian Amazon, Science 369, 1378-1382. doi: 10.1126/science.abb3021
[6] Flores, B.M., Staal, A., Jakovac, C.C. et al. (2020) Soil erosion as a resilience drain in disturbed tropical forests. Plant Soil 450, 11–25. https://doi.org/10.1007/s11104-019-04097-8Flores et al. 2020
[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

[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.
[12] Lovejoy, T.E. and Nobre, C. (2019) Amazon tipping point: Last chance for action. Science Advances Vol. 5, no. 12, doi: 10.1126/sciadv.aba2949
[13] Nobre, C. A.; Sampaio, G.; Borma, L. S.; Castilla-Rubio, J. C.; Silva, J. S.; Cardoso, M. F. (2016) Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm. PNAS, v. 113, n. 39, p. 10759 – 10768, 2016. doi: 10/1073/pnas.1605516113
[14] Espinoza, J.C. et al. (2020) Hydroclimate of the Andes Part I: Main Climatic Features. Frontiers in Earth Science. 8:64.
[15] Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GAB, Kent J (2000) Biodiversity hotspots for conservation priorities. Nature 403:853–858
[16] R.A. Mittermeier, W.R. Turner • F.W. Larsen T.M. Brooks C. Gascon (2011). Global Biodiversity Conservation: The Critical Role of Hotspots. In: F.E. Zachos and J.C. Habel (eds.), Biodiversity Hotspots, doi: 10.1007/978-3-642-20992-5_1
[17] Poveda, G., D.M. Álvarez, & O.A. Rueda (2010). Hydro-climatic variability over the Andes of Colombia associated with ENSO: A review of climatic processes and their impact on one of the Earth's most important biodiversity hotspots. Climate Dynamics, 36, 2233. doi:10.1007/s00382-010-0931-y.
[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

shrinkage of fragile *páramos* ecosystems, are also witnessing an increase in mosquito-borne 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

[21] Magrín G., J. Marengo, J.-P. Boulanger, M.S. Buckeridge, E. Castellanos, G. Poveda, F. R. Scarano, & S. Vicuña (2014). Central and South America, In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Volume II: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Edited by V. Barros, Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White, 10/2014: Chapter 27: 1499-1566; Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[22] Ruiz-López, F., González-Mazo, A., Vélez-Mira, A., Gómez, G. F., Zuleta, L., Uribe, S., & Vélez-Bernal, I. D. (2016). Presencia de Aedes (Stegomyia) aegypti (Linnaeus, 1762) y su infección natural con el virus del dengue en alturas no registradas para Colombia. Biomédica, 36(2), 303-308.
[23] Ryan SJ, Carlson CJ, Mordecai EA, Johnson LR. (2019). Global expansion and redistribution of Aedes-borne virus transmission risk with climate change. PLoS Negl Trop Dis.;13(3):e0007213.
[24] Watts AG, Miniota J, Joseph HA, Brady OJ, Kraemer MUG, Grills AW, et al. (2017) Elevation as a proxy for mosquito-borne Zika virus transmission in the Americas. PLoS ONE 12(5): e0178211. https://doi.org/10.1371/journal. pone.0178211.
[25] World Agriculture Towards 2030/2050, ESA Working Paper No. 12-03. June 2012, (FAO).
[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.

including large fish that are extremely important for the food supply in lowland Amazonian regions.

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

[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

activities; and poorly planned urbanization, cause ecosystem fragmentation, leading to more frequent human-pathogen contact, and facilitating the spillover of pathogens to humans.

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.

[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

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].
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

[38] Oldekop et al. Global Development (2020), *COVID-19 and the case for global development*
[39] https://f.hubspotusercontent20.net/hubfs/4783129/LPR/PDFs/ENGLISH-FULL.pdf

territories[40]. However, 68% of Protected Areas and Indigenous territories also overlap with planned infrastructure projects and investment plans[41].

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-

[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
[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

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 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.

[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
[45] IBGE 2018 Report

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.

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.

[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.

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 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

[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.
[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

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.
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].

[53] https://ec.europa.eu/knowledge4policy/publication/bioeconomy-policy-part-iii-update-report-national-strategies-around-world_en
[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

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.

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

[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
[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.

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:

- **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.

[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.

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

[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

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.

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.

[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
[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

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.