SCIENCE PANEL FOR THE AMAZON

POLICY BRIEF

THE AMAZON WE WANT
Science Panel for the Amazon

SUPPORTING SOCIO-BIOECONOMIES OF HEALTHY STANDING FORESTS AND FLOWING RIVERS IN THE AMAZON

Rachael Garrett • Joice Ferreira* • Ricardo Abramovay • Joyce Brandão • Eduardo Brondizio • Ana Euler • Daniel Pinedo • Roberto Porro • Emiliano Cabrera Rocha • Oscar Sampaio • Marianne Schmink • Bolier Torres • Mariana Varese*

***Co-lead authors**

KEY MESSAGES

(i) Amazon socio-bioeconomies are economies based around the sustainable use and restoration of healthy standing forests and flowing rivers to support the well-being, knowledge, rights, and territories of Indigenous peoples and local communities (IPLCs), as well as all Amazonian residents and the global community.

(ii) Socio-bioeconomies include a combination of activities that maintain productive and conserved multifunctional landscapes and cultural diversity, while promoting economic and social added value to the Amazon's biodiversity and agrobiodiversity, including: the provision of numerous ecosystem services through the conservation and restoration of forest and aquatic ecosystems and the diversified production and processing of native plants (i.e., fruits, nuts, medicines), fish, and others.

(iii) The numerous families and communities responsible for safeguarding ecosystem services and producing valuable biodiversity products are often those who benefit the least from the existing Amazonian economies. Strengthening and developing Amazonian socio-bioeconomies can provide a sustainable and just alternative to existing economic models and power structures.

(iv) A focus on developing Amazonian socio-bioeconomies involves actively changing narratives about how the most value and wellbeing can be generated within the region. Instead of focusing on forgone profits from not pursuing deforestation or developing unsustainable river infrastructure for resources, energy, and navigation, we encourage policy makers to consider the foregone inclusive development opportunities from not investing in socio-bieconomies.

(v) A coherent and collaborative mix of policy interventions is urgently needed to support socio-bioeconomies. These include stopping activities that degrade the region's forests and rivers,protecting IPLCs' rights, establishing a participatory socio-bioeconomy design process, developing mechanisms to stimulate financing and demand for bioeconomy solutions and developing the enabling conditions and logistics to increase the supply of bioeconomy products.

RECOMMENDATIONS

(i) Stop activities that threaten IPLCs, as well as socio-bioeconomies, and establish safeguards against the misuse of the bioeconomy concept.

(ii) Establish an inclusive and participatory socio-bioeconomy planning and collaborative implementation processes that builds on IPLC knowledge and institutions.

(iii) Increase demand, finance, and marketing pathways for ecosystem services and high value, low impact products.

(iv) Enhance connections between actors at many regions and scales to support knowledge sharing and value creation.

(v) Put enabling conditions into place: logistics, land and resource rights, co-production of knowledge, governance, and enforcement capacities, following the Nagoya Protocol and Convention on Biological Diversity principles and respecting the rights of IPLCs.

FIGURE 1: Sociobioeconomies based on sustainable use, cultural diversity, and economic and social value added to biodiversity in the Amazon region. Illustration: Dedê Paiva | www.dedepaiva.com.br

WHAT ARE SOCIO-BIOECONOMIES OF HEALTHY STANDING FORESTS AND FLOWING RIVERS?

Socio-bioeconomies are economies based around the sustainable use and restoration of healthy standing forests and flowing rivers to support the well-being, knowledge, rights, and territories of Indigenous people and local communities (IPLCs), Amazonian residents, and the global community[1] (See Figure 2). It places *justice*, especially for Indigenous women and youth, and *diversity* (including socio- cultural diversity), as core values. It combats poverty and inequality, and aims to reduce structural inequities in value capture, power, and representation.

Among Indigenous populations, ethical- normative values underlying the socio- bioeconomy are captured in the concept of *Buen Vivir* (good living) that highlights the intrinsic relationships between nature and people in local ecosystems, and the need to safeguard biological, cultural and social diversity[2,3]. These value-based approaches are recognized in the constitutions of Bolivia, Colombia, Ecuador, Peru.

Community- and family-based livelihoods based on use of diverse forest products and fisheries, as well as an array of traditional agroforestry systems (TAFS) are the oldest production systems in the Amazon and embody many dimensions of the socio-bieoconomy definition. These systems generate high value with low or even beneficial environmental impact, take advantage of the unique genetic resources of the region, and are pursued by some of the most marginalized communities in the Amazon[4,5]. They have shown strong growth and resilience over recent decades, despite receiving relatively little policy support, credit financing, and technical assistance[6–8]. For instance, Ecuadorian Kichwa peoples have included market-oriented products in their TAFS (called "Amazonian Chakra"[a]) over the past 40 years, e.g., cocoa (*Theobroma cacao* L.), guayusa (*Ilex guayusa Loes.*), vanilla (*Vanilla spp.*), and rubber (*Hevea brasiliensis*)[9]. These bioeconomies are already linked with Amazonian cities, and peri-urban areas and show great promise for further expansion, adaptation, and added-value. Yet, to avoid the conflation of sustainability with specific products, a socio-bioeconomy view emphasizes that equitable value generation from highly diverse agro-ecosystems or native ecosystems is needed[10].

[a] As recognized in the FAO list of Globally Important Agricultural Heritage Systems (GIAHS), the Amazonian chakra can be defined as "a sustainable land-use model in which productive spaces located within the farm are managed by families under an organic and biodiverse approach, valuing ancestral knowledge".

LOCAL PERSPECTIVES, GLOBAL RESPECT

The bioeconomy concept is far from simple or unanimous. In fact, some people and local organizations even have reservations about using the term at all. It is common to use additional qualifications to make sure principles like equity and diversity are encompassed, such as socio-bioeconomy, socio- biodiversity bioeconomy, inclusive bioeconomy, restorative bioeconomy, bioecological bioeconomy, or simply new bioeconomy. There are already plenty of successful local initiatives that only need more support to scale up and to produce broader impacts in the region. These local voices must be heard and respected and should be pivotal in any plan for the development of the bioeconomy in the Amazon region.

WHAT IS INCLUDED?

Activities that...

- > Lead to ecosystem conservation and restoration
- > Improve river connectivity
- > Promote diverse, integrated (agro)ecosystems and agroecological practices
- > Result in biodiverse and multifunctional landscapes
- > Foster socioecological system recovery and resilience
- > Protect territorial and human rights
- > Increase cooperation and social participation
- > Add value locally to Amazonian products
- > Benefit local communities and a wide range of stakeholders
- > Promote long-term social benefits
- > Increase autonomy of local communities
- > Maintain the reproduction of local culture
- > Integrate science with Indigenous and local knowledge

EXAMPLES

- Native forest conservation and restoration for carbon and biodiversity payments
- Native nut cultivation, harvesting, and processing
- Fruit cultivation in agroforestry systems and processing into high-value, transportable products
- Harvesting plants and oils for cosmetics and medicines
- Sustainable community-based management of fisheries
- Community-based ecotourism

WHAT IS NOT INCLUDED?

Activities that...

- > Lead to deforestation and environmental degradation
- > Reduce river connectivity
- > Promote monocultures, simplification and unsustainable intensification
- > Result in homogenization
- > Reduce biodiversity and impair ecosystem services
- > Undermine ecosystem recovery
- > Infringe on territorial rights, promote conflict, or harm local people
- > Extract and export products without adding value
- > Benefit only elites or privileged groups or increase social inequality
- > Promote only short-term social benefits
- > Lead to dependency and poverty traps
- > Foster imposition of outside values over local culture
- > Do not value Indigenous and local knowledge

EXAMPLES

- Deforestation for cattle ranching
- Crop monocultures and large-scale biofuel production
- Large hydropower projects
- Formal and informal mining
- Overfishing and introduction of non-native species

FIGURE 2: Examples of activities that fit well with the bioeconomy concept.

WHY ARE NEW BIOECONOMY VISIONS NEEDED?

A half century of deforestation, degradation, commodification, and exploitation of ecosystem goods and services in the Amazon has not brought widespread development and now threatens the economic value of already deforested and degraded areas [11]. While crop production and exports associated with deforestation have contributed to macroeconomic improvements in Amazonian countries at times [12], value through forest clearing activities has been captured mainly by international actors and domestic elites [13]. Former and recent policies for the Amazon have not focused sufficiently on improving the well-being of communities living there, especially concerning how to achieve a structural economic transition away from low value extractive activities to high value production, manufacturing, and services.

Despite converting large amounts of natural capital into food, energy, and material exports over the last thirty years, Human Development Index (HDI) in Amazonian countries remains well below the HDI of the region's largest trading partners [14] and has come at the expense of degrading the regional natural wealth (Figure 3). There has been a lack of investment in education, innovation, and sustainable infrastructure to add value to goods produced from the region [15] or equitably reinvest profits into health and educational systems. It is time to recognize that Amazonian countries inherited a flawed external- and internal-colonial vision that development comes from converting socio-biodiversity wealth into deforestation-causing homogeneous commodities in a global market.

To generate inclusive development, a greater focus on distributed economic opportunities, improved connections with urban centers, and synergies between multiple sectors of the economy (environment, industry, health, and education) is needed. Socio-bioeconomies can bring benefits for rural and urban communities in public health and food security domains, including the availability of healthy and nutritious foods such as fish, fruits and nuts. Eliminating forest and river degradation

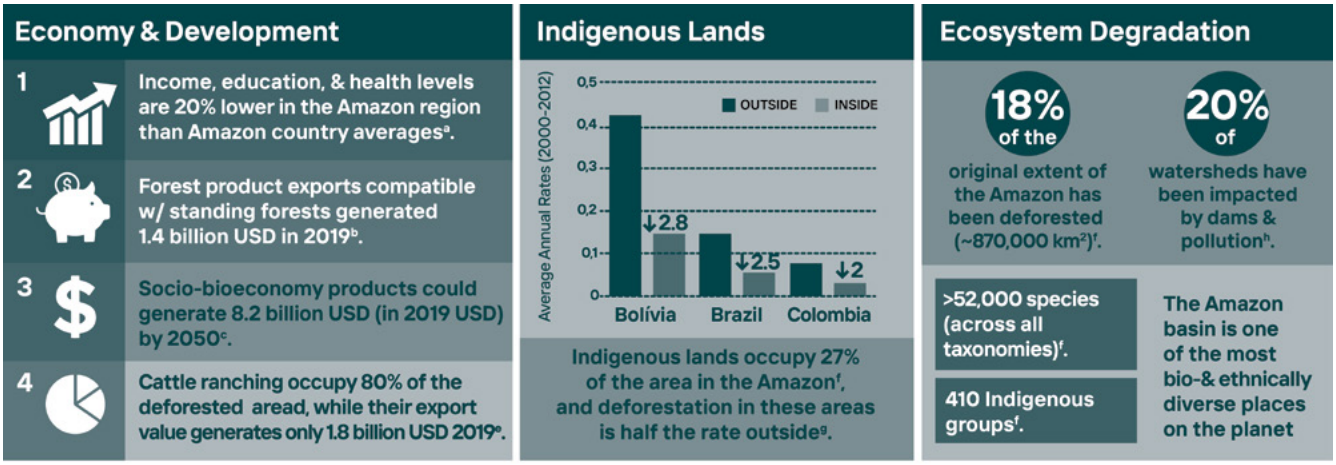

FIGURE 3: **Facts and figures about socio-bioeconomy threats and opportunities in the Amazon.** Sources: a Smits, J, and I. Permanyer. 'The Subnational Human Development Database'. Scientific Data 6, no. 190038 (2019). b. Costa, F. 'A Economia Dos Sistemas Agroflorestais Na Amazônia: Uma Trajetória Crítica Para o Desenvolvimento Sustentável'. Made/ USP., 2022. c. Nobre, C.A. New Economy for the Brazilian Amazon. São Paulo: WRI Brasil; 2023. Available from: www.wribrasil. d. MAPBIOMAS. 'MapBiomas Amazon Collection 4.0', 2023. e. Coslovsky, S. 'Oportunidades Para Exportação de Produtos Compatíveis Com a Floresta Na Amazônia Brasileira'. Amazônia 2030, 2021. f Nobre, C. et al. 'Amazon Assessment Report 2021'. New York: United Nations Sustainable Development Solutions Network, 2021. g . Ding, H. et al. 'Climate Benefits, Tenure Costs: The Economic Case for Securing Indigenous Land Rights in the Amazon'. WRI, 2016. h Leal, C.G. Amazon Water Impact Index (AWII). Ambiental Media, 2021.

activities can reduce harmful mercury contamination and the transmission of vector-borne diseases like malaria, chikungunya and zika, while supporting bioeconomy products like quinine (as an antimalarial) and latex (for condoms) to alleviate public health problems. Likewise, eliminating deforestation and degradation can help maintain a local climate envelope and other ecosystems services that supports agricultural yields on existing areas.

To envision a new economic paradigm overcoming existing narratives around flawed economic accounting or conservation planning approaches that characterize avoided deforestation, resource extraction and commodification at a cost is needed. There is a harmful focus on the foregone profits from cropland or pastures as a down-side of conservation activities. Problematically, there has been little attention to quantifying the opportunity costs of a lack of investment in activities that could generate high value from the healthy standing forests and flowing rivers.

As an example, the value chains of 30 bioeconomy products were found to generate USD 1.4 billion in income and employ 224,600 workers in the Amazon in 2019 [16]. It is estimated that Brazil alone could generate 8.2 billion (USD) per year by 2050 relative to existing economic activities by investing in socio- bioeconomies [17]. This contrasts with the relatively low returns of existing food and mineral commodities [18]. Like most economic growth accounting, the estimates of value generated by these commodities do not account for the social costs associated with their production, including a loss of water and air quality, food and health security, and other ecosystem services that cost society >8K per hectare (in 2023 USD), including lost revenue in existing agricultural areas [11,19].

HOW TO ACHIEVE SOCIO-BIOECONOMIES OF HEALTHY STANDING FORESTS AND FLOWING RIVERS?

1. Stop activities that threaten IPLCs and socio-bioeconomies and establish safeguards against the misuse of the bioeconomy concept.

It is necessary to avoid further threats to IPLCs and socio-bioeconomies by strengthening forest and river degradation control efforts. Such improvements should include, among others [b]: turning undesignated forest lands[c] and other areas into protected and sustainable use areas; stricter protections (and associated enforcement) against forest degradation, water pollution, and waterway alterations; expanding, improving, and integrating systems to monitor deforestation-risk supply chains; strengthening community-level ecosystem monitoring systems; canceling and blocking efforts to register private lands in Indigenous or protected areas; taking into account the impacts of infrastructure on deforestation, forest degradation, and river connectivity; the creation of a central intelligence hub for all deforestation and degradation control activities; and experimenting with various market-based policy tools like a forest reserve trading program and payments for environmental services.

It is essential that dialogues about socio-bioeconomies are treated with scrutiny (Figure S1). Socio- bioeconomies have the potential for both over-exploitation and misinterpretation. Monocultures and single aquaculture species should not be substituted for diversity under the guise of “bio” production [20] and investments and control of socio-bioeconomies must not go to a narrow set of multinational companies or domestic elites. Focus should be placed on

[b] Many of these suggestions are present in the fifth phase of Brazil’s Plan for the Control and Prevention of Deforestation.
[c] Public forestlands not allocated by the federal or state governments to a specific tenure status.

addressing power asymmetries and maximizing the diversity of social organization forms (e.g., cooperatives, family agriculture, Indigenous associations) that participate in socio-bioeconomies [21].

Another risk of efforts to enhance socio-bioeconomies is that they may inadvertently draw attention away from non-forest biomes (including the Cerrado savanna, the Chaco region, and the Chiquitano dry forests). For these reasons, efforts to launch socio-bioeconomies of healthy ecosystems should be launched simultaneously across the world, but in particular in potential spillover zones across the Amazon biome [22].

2. Establish inclusive and collaborative socio-bioeconomy planning processes

Participatory processes are needed to gather input, understand values and weigh trade-offs in the creation of land and water use, community, and economic development plans. The creation of cross- scalar and inter-community networks to help identify and magnify bottom-up experiences with socio- bioeconomies will require a sustained effort, resulting in a cross-country political effort. Amazonian IPLCs must be active participants in this effort, especially given their historical marginalization. Statements made by IPLC representatives who gathered in Pará, Brazil in 2021 in a counter-event to the World Bioeconomy Forum already indicated that the standing forest bioeconomy better aligns with theirwishes than current economic approaches [d].

Building on the Amazon Cooperation Treaty Organization and the more recent 2019 Leticia Pact, the creation and improvement of Pan-Amazonian institutions could greatly enhance the effectiveness of developing the bioeconomy. A Pan-Amazonian [economic] Union could enhance marketing opportunities. Amazon-wide policy initiatives could enable policy coherence and reduce negative spillovers across countries. Greater emphasis must be channeled to cross-learning from research and development, sharing data intelligence, monitoring, and policy that support socio-bioeconomies [23]. Within countries, allocations of national research budgets should improve the geographic distribution of educational and innovation research institutes to enhance the capacity of Amazon-based organizations (rather than historical centers of wealth and power)[24]. These could build on the structures of the Inter- American Network of Academies of Sciences (IANAS) and the InterAcademy Partnership (IAP).

Efforts should also be made to include and harness the tremendous potential of younger generations. Given their engagement with social and visual media, youth could be important leaders and amplifiers of media campaigns. Bioeconomy planning processes should thus engage with IPLCS, with Indigenous youth networks, as well as non-indigenous movements [e].

[d] Their official statement noted (as translated) "We propose our best: the experience of our historical societies and cultures, built on our traditional and ancestral knowledge, in addition to our deep knowledge of nature. The socio-bioeconomy that we defend is based on science and technology to improve the production of forestry and fishery products, enabling us to process, store, and market socio-biodiverse products while respecting our ways of life".

[e] Examples include Red de Jóvenes Indígenas for all of Latin America and the Caribbean and the various Amazonian-specific networks within it, including the Rede de Juventude Indígena (the Indigenous Youth Network in Brazil, which focuses on social media campaigns), Movimento Mebengokre Nyre (Kayapó youth movement) in Brazil, and the La Red Ñuqanchik Maronijei Noshaninka in Peru.

3. Increase finance for socio-bioeconomy to push and pull innovations

3.a) Redirect harmful subsidies

Redirecting finance from activities that actively harm the existing socio-bioeconomy through deforestation and degradation to sustainable agroforestry, sustainable management of timber and non- timber forest products, sustainable aquaculture and community-led nature tourism is important. The potential for community-based ecotourism, for example, is immense in the region and can be integrated within the category of sustainable-use reserves and spread knowledge, concern, and financing to conserve socio-biodiversity [1] .

3.b) Research and development finance and financial terms

International and domestic finance is needed to support socio-bioeconomies (e.g., the Green Climate Fund's new Amazon Bioeconomy Fund, Brazil's Amazon Fund). This funding can be directed to conservation for ecosystem services (e.g., via carbon and biodiversity markets) or to research and innovations for socio-bioeconomy production and processing. The foci of this research must be defined in collaboration with Amazonian populations and regional research institutions ensuring that they benefit from research. The development of state or Amazon-level portfolios for investable bioeconomy activities would be useful for connecting small-scale projects to distant climate and development fund investors. There is a need to improve and adapt existing financing mechanisms by allowing: i) small or community-based enterprises to obtain loans without formalized tenure arrangements and ii) a longer-time horizon for repayment than traditional agricultural finance to accommodate the long-term nature of socio-bioeconomy investments.

Future research funding and themes include: i) improving the quality and shelf-life of bioeconomy products; ii) identifying thresholds and practices for sustainable harvesting, including logging/ timber and numerous non-timber forest products; iii) documenting and testing governance arrangements supporting just use and marketing of socio-bioeconomy products; iv) understanding market bottlenecksand logistical constraints; v) understanding socio-ecological feedbacks, including changes in under- researched ecosystem services like soil health and pollination, as well as impacts of climate change; and vi) identifying financial mechanisms and policies that can successfully support innovations.

3.c) Sustainable Infrastructure, marketing and value chain finance

The development of socio-bioeconomies requires sustainable infrastructures that can improve the welfare of Amazonian populations and enhance Amazonians' access to information, energy, and capacities to market and add value locally to Amazonian products. Infrastructure needs include transportation, electricity, storage and cold-storage facilities, food processing, digital connectivity and information technology to address challenges of perishability, seasonality, and low species abundance without losing the decentralized and equitable nature of bioeconomy collection [25]. Electrification is crucial to help Amazonians reduce their dependence on diesel oil, as well as for micro-industrialization of products to add value and improve shelf-life, cold transport chains, and lighting.

The gaps in food processing infrastructure are illustrated by the example of the Brazil nut (*Bertholletia excelsa*). The Brazil nut is a high value global commodity, that is mostly harvested from healthy natural (rather than planted)

forests. Bolivia, Brazil and Peru are the largest exporters. Yet, in many regions of Brazil, the product is exported with almost no processing due to, among other reasons, challenges with meeting international sanitary standards [26]. In contrast, Bolivia and Peru made advances towards solving these bottlenecks. Greater exchange and technology sharing would benefit Brazil substantially, and cooperation could increase the global availability of Brazil nuts.

Additional investment is needed in marketing bioeconomy products. To reach new markets it is necessary to further develop bioeconomy product brands and labels and coordinate national and international tax incentives and trading policies. Access to the internet and literacy about fair prices and direct marketing opportunities will allow greater buying and selling power. Media campaigns are also needed to show the benefits of the bioeconomy and related products in the Amazon basin.

Infrastructure and marketing arrangements must be planned and implemented with the active participation of the local populations that will benefit from it, not just external consumers. The private sector and international development banks could be used as a source of financing, but only with strong safeguards for co-creation and rights protections for Amazonian communities.

4. Enhance connections between actors and sectors at many scales

Urban-rural linkages provide key investment opportunities for both urban and rural agroecological and production activities [27]. Developing various value-added and service activities around the bioeconomy in Amazonian urban areas through tax breaks and targeted finance can help diversify and increase the number of jobs in socio-bioeconomies [10].

Public purchase programs and price guarantee policies could create a stable and circular market for forest products. The school lunch program in Brazil (*Programa de Aquisição de Alimentos*) purchases agroforestry and small-scale aquaculture products from family producers to support food provision in schools. The pre-natal subsidy in Bolivia (*Subsidio Universal Prenatal por la Vida*) for pregnant women has increased the national market and consumption of Brazil nut and other products derived from agroforestry systems in the Amazon (e.g., cocoa). Another example is the latex scheme in Acre, Brazil, which helped create a stable market for rubber tappers and reduce sexually-transmitted disease through condom manufacturing.

5. Put enabling conditions into place

5.a) Strengthen IPLCs' land rights

There are 2.2 million Indigenous peoples in the Amazon accounting for 4.6% of the population on 27% of the area [28,29]. There are also numerous local communities, including Afro-descendent communities and forest and river dependent communities of mixed descent. These communities' livelihoods and cultural survival depend on healthy standing forests and flowing rivers. Protected areas, including those under Indigenous management, have fared significantly better than other governance approaches to reducing deforestation in the Amazon [30]. Yet >50% of Indigenous lands are facing threats from cropland and pasture expansion, incursions for large-scale fisheries and infrastructure, land invasions, fossil fuels and mining prospecting and extraction [31]. Strengthening Indigenous land rights means enacting laws, or enforcing existing ones, that provide official recognition to the

rights they have over their territories and improve communities' abilities to monitor and deter deforestation and forest and aquatic degradation[f].

5.b) Support cooperatives and small enterprises, especially for women and youths

Cooperatives and community enterprises play a decisive role in promoting socio-bioeconomy products (e.g., cocoa agroforestry cooperatives in Colombia and CAMTA in Pará, Brazil). The lessons learned from positive examples, should be analyzed and discussed with other Amazonian communities to identify potential models for successful cooperative production, processing and management. A challenge faced by community enterprises is their low access to training in management and business. In parallel to research innovations, investment must forecast mechanisms by which small enterprise and cooperative businesses can be incubated for technological improvement and stable market access[32].

Women play a disproportionate role in the collection and sale of socio-bioeconomy products. Engaging them in collective organization and social movements can improve their material outcomes, as well as their visibility, environmental and political awareness[33]. Examples include women's participation in arapaima fishery management in Amazonas, Brazil[34] and in babassu-palm in Maranhão, Brazil for cosmetics value chains[35,36], as well as indigenous communities in Bolivia. Greater financial support and capacity-building is needed to support cooperatives and community enterprises, especially women's collective micro-enterprises.

CONCLUSION

Policy interventions coherent across instruments (in tackling multiple needs) and collaborative across the Amazon is needed to support socio-bioeconomies. Policy interventions should include developing incentives to stop activities that degrade forests and rivers in the Amazon and increase activities that protect them for the benefit of IPLCs and Amazonian communities. These policy processes and investments should be participatory and inclusive, developing mechanisms to stimulate financing and demand for socio-bioeconomy solutions as well as conditions and logistics to increase the supply of socio-bioeconomy products and services. Doing so, policymakers in the Amazon and beyond can take meaningful and urgently needed steps to promote the conservation and recovery of biodiversity, reduce the risk of tipping points, and enhance the provisioning of ecosystem services that are vital for a flourishing socio-bioeconomy in the Amazon.

ACKNOWLEDGMENTS

The authors are grateful to the following people for comments and suggestions on this policy brief: Alfredo Homma, Christopher Jarrett, Daniel Larrea-Alcázar, Erika Berenguer, Federico Ernesto Viscarra, Fernanda Sánchez, Frederico Brandão, Guilherme Oliveira, Jacques Marcovitch, Javier Ortiz, Judson Valentin, Maria R. Murmis, Mauricio Verkooijen, Philip Fearnside, Rafael Feltran-Barbieri, Sergio Margulis, Sven Wunder, Sebastian Heilpern. SPA Steering Committee: Carlos Nobre, Marielos Peña-Claros, Adalberto Val, Fernando Roca, Susan Trumbore, Luciana Villanova, and Jonas Nelson. Copyediting: Eliran Oz. Translation: Federico Ernesto Viscarra and Isabella Leite Lucas.

[f] Efforts like bill PL490 being put forth in the Brazilian Congress (known as the "Marco Temporal") to invalidate Indigenous land claims not established at the time of the 1988 Constitution are a huge step in the wrong direction.

REFERENCES

1. Abramovay R, Ferreira J, ***et al.*** 2021. Chapter 30: The New Bioeconomy in the Amazon: Opportunities and Challenges for a Healthy Standing Forest and Flowing Rivers. In: Nobre ***et al.*** C, editor. Amazon Assessment Report 2021. United Nations Sustainable Development Solutions.

2. Hecht S, Schmink M, ***et al.*** 2021. Chapter 14: The Amazon in Motion: Changing Politics, Development Strategies, Peoples, Landscapes, and Livelihoods. In: Nobre et al. C, editor. Amazon Assessment Report 2021. United Nations Sustainable Development Solutions.

3. Alcantara LCS and Sampaio CAC. 2017. Bem Viver como paradigma de desenvolvimento: utopia ou alternativa possível? Desenvolv Meio Ambiente [Internet] [cited 2023 Jun 20];40. Available from: http://revistas.ufpr.br/made/article/view/48566

4. Vera V RR, Cota-Sánchez JH, and Grijalva Olmedo JE. 2017. Biodiversity, dynamics, and impact of chakras on the Ecuadorian Amazon. ***Journal of Plant Ecology*** **12**(1):34–44.

5. Torres B, Maza OJ, Aguirre P, Hinojosa L, and Günter S. 2015. The Contribution of Traditional Agroforestry to Climate Change Adaptation in the Ecuadorian Amazon: The Chakra System. In: Leal Filho W, editor. Handbook of Climate Change Adaptation [Internet]. Berlin, Heidelberg: Springer; [cited 2023 Jun 26]. p. 1973–94. Available from: https://doi.org/10.1007/978-3-642-38670-1_102

6. Costa FA, Schmink M, Hecht, ***et al.*** 2021. Chapter 15: Complex, Diverse and Changing Agribusiness and Livelihood Systems in the Amazon. In: Nobre ***et al.*** C, editor. Amazon Assessment Report 2021. United Nations Sustainable Development Solutions.

7. Brondizio ES, Andersson K, Castro F, ***et al.*** 2021. Making place-based sustainability initiatives visible in the Brazilian Amazon. ***Current Opinion in Environmental Sustainability*** **49**, 66–78.

8. Londres M, Salk C, Andersson K, ***et al.*** 2023. Place-based solutions for global social-ecological dilemmas: An analysis of locally grounded, diversified, and cross-scalar initiatives in the Amazon. ***Global Environmental Change*** **82**, 102718.

9. Torres B, Andrade A, Enriquez F, ***et al.*** 2022. Estudios sobre medios de vida, sostenibilidad y captura de carbono en el sistema agroforestal chakra con cacao en comunidades de pueblos originarios de la provincia de napo: casos de las asociaciones kallari, wiñak y tsatsayaku, amazonía ecuatoriana. [Internet]. Quevedo: UTEQ 2022 [cited 2023 Jun 26]. Available from: https://repositorio.uteq.edu.ec/handle/43000/6766

10. de Assis Costa Jr. F. Bioeconomy for the Amazon: concepts, limits, and trends for a proper definition of the tropical forest [Internet]. WRI Brazil Working Paper; Available from: https://www.wribrasil.org.br/sites/default/files/2022-07/NEA-BR_Bioeconomy_EN.pdf

11. Flach R, Abrahao G, Bryant B, ***et al.*** 2021. Conserving the Cerrado and Amazon biomes of Brazil protects the soy economy from damaging warming. ***World Development*** **146**, 105582.

12. Celentano D, Sills E, Sales M, and Veríssimo A. 2012. Welfare Outcomes and the Advance of the Deforestation Frontier in the Brazilian Amazon. ***World Development*** **40**(4), 850–64.

13. Hecht SB. 2005. Soybeans, Development and Conservation on the Amazon Frontier. ***Development and Change*** **36**(2), 375–404.

14. Smits J and Permanyer I. 2019. The Subnational Human Development Database. ***Scientific Data*** [Internet] **6**(190038). Available from: https://doi.org/10.1038/sdata.2019.38

15. Science Panel for the Amazon. 2023. SPA Sustainable Infrastructure Policy Brief [Internet]. 2023. To be launched.

16. Costa F de A. 2022. A economia dos sistemas agroflorestais na Amazônia: Uma trajetória crítica para o desenvolvimento sustentável [Internet]. Made/ USP. Report No.: Working Paper n o 012. Available from: https://madeusp.com.br/publicacoes/artigos/a-economia-dos-sistemas-agroflorestais-na-amazonia-uma- trajetoria-critica-para-o-desenvolvimento-sustentavel/

17. Nobre CA. New Economy for the Brazilian Amazon [Internet]. São Paulo: WRI Brasil; 2023. Available from: www.wribrasil. org.br/nova-economia-da-amazonia

18. Garrett RD, Gardner T, Fonseca T, ***et al.*** 2017. Explaining the persistence of low income and environmentally degrading land uses in the Brazilian Amazon. ***Ecology and Society*** **22**(3):27.

19. Anderson-Teixeira KJ, Snyder PK, Twine TE, ***et al.*** 2012. Climate-regulation services of natural and agricultural ecoregions of the Americas. ***Nature Climate Change*** **2**(3),177–81.

20. Bergamo D, Zerbini O, Pinho P, and Moutinho P. 2022. The Amazon bioeconomy: Beyond the use of forest products. ***Ecological Economics*** **199**:107448.

21. Ramcilovic-Suominen S, Kröger M, and Dressler W. 2022. From pro-growth and planetary limits to degrowth and decoloniality: An emerging bioeconomy policy and research agenda. *Forest Policy and Economics* **144**:102819.

22. Villoria N, Garrett R, Gollnow F, and Carlson K. 2022. Leakage does not fully offset soy supply-chain efforts to reduce deforestation in Brazil. *Nat Commun* **13**(1):5476.

23. Sills J, Prist PR, Levin N, *et al.* 2019. Collaboration across boundaries in the Amazon. *Science* **366**(6466), 699–700.

24. Carvalho *et al.* Pervasive gaps in Amazonian ecological research. Current Biology. In press.

25. Abramovay R. 2022. Infraestrutura para o desenvolvimento sustentável da Amazônia [Internet]. Edição: Tadeu Breda Revisão: Laura Massunari&Daniela Uemura Capa&projeto gráfico: Bianca Oliveira Diagramação: Denise Matsumoto Lançamento: junho de 2022 Páginas: 108 Dimensões: 13 x 21 cm ISBN: 9786587235912. Sao Paulo: Editora Elefante [cited 2023 Jul 12]. Available from: https://elefanteeditora.com.br/produto/infraestrutura-para-o-desenvolvimento-sustentavel-da-amazonia/

26. Guariguata MR, Cronkleton P, Duchelle AE, and Zuidema PA. 2017. Revisiting the 'cornerstone of Amazonian conservation': a socioecological assessment of Brazil nut exploitation. *Biodivers Conserv.* **26**(9), 2007–27.

27. Brondizio ES, Siqueira AD, and Yogt N. 2014. Forest Resources, City Services: Globalization, Household Networks, and Urbanization in the Amazon Estuary. In: The Social Lives of Forests: Past, Present, and Future of Woodland Resurgence [Internet]. University of Chicago Press. Available from: https://doi.org/10.7208/chicago/9780226024134.003.0032

28. Nobre C, Encalada A, Anderson E, *et al.* 2021. Amazon Assessment Report 2021 [Internet]. New York: United Nations Sustainable Development Solutions Network; 2021 p. 48. Available from: https://www.theamazonwewant.org/amazon-assessment-report-2021/

29. Moutinho P, Leite I, Baniwa A, et al. 2022. Policy Brief: The role of Amazonian Indigenous Peoples in fighting the climate crisis [Internet]. Science Panel for the Amazon; 2022. Available from: https://www.theamazonwewant.org/spa_publication/policy-brief-the-role-of-amazonian-indigenous-peoples- in-fighting-the-climate-crisis/

30. Hänggli A, Levy SA, Armenteras D, et al. 2023. A systematic comparison of deforestation drivers and policy effectiveness across the Amazon biome. Environ Res Lett. **18**(7):073001.

31. Josse C, Futada S de M, von Hildebrand M, *et al.* 2021. The state of conservation policies, protected areas, and Indigenous territories, from the past to the present. In: Nobre et al. C, editor. Amazon Assessment Report 2021 [Internet]. United Nations Sustainable Development Solutions; Available from: https://www.theamazonwewant.org/amazon-assessment-report-2021/

32. Sampaio Neto OZ, Batista EAC, and Meirelles AJDA. 2020. Potencial de oleaginosas nativas no desenvolvimento de cadeias produtivas da biodiversidade brasileira. Desenvolv Meio Ambiente [Internet]. [cited 2023 Jul 13];54. Available from: https://revistas.ufpr.br/made/article/view/71934

33. Mello D and Schmink M. 2017. Amazon entrepreneurs: Women's economic empowerment and the potential for more sustainable land use practices. In Elsevier; p. 28–36.

34. Freitas CT, Espírito-Santo HMV, Campos-Silva JV, Peres CA, and Lopes PFM. 2020. Resource co-management as a step towards gender equity in fisheries. *Ecological Economics* **176**:106709.

35. Porro R and Sousa RC de. 2022. Anatomy of babassu-nut value chain for policy guidance in support of traditional agroextractive communities in the Mearim Valley, Maranhão, Brazil. *Rev Econ Sociol Rural.* **61**:e263743.

36. Vicari S. 2014. The cooperative as an institution for human development: the case study of COPPALI, a primary co-operative in Brazil. *Journal of International Development* **26**(5):683–700.

AUTHORS AFFILIATIONS

Rachael Garrett: University of Cambridge, The Old Schools, Trinity Ln, Cambridge CB2 1TN, UK, rg711@cam.ac.uk

Joice Ferreira: EMBRAPA Amazônia Oriental, Trav. Dr. Enéas Pinheiro s/n°, Bairro Marco, 66095-903 Belém PA, Brazil, joice.ferreira@embrapa.br

Ricardo Abramovay: Instituto de Energia e Ambiente da Universidade de São Paulo, R. da Reitoria 374, Cidade Universitária, Butantã, São Paulo SP 05508-220, Brazil

Joyce Brandão: University of Cambridge, The Old Schools, Trinity Ln, Cambridge CB2 1TN, UK

Eduardo Brondizio: Indiana University Bloomington, 107 S Indiana Ave, Bloomington, IN 47405, USA

Ana Euler: Embrapa Amapá, Rodovia Juscelino Kubitscheck, Km 5, no 2600, Universidade, Macapá AP 68903-419, Brazil

Daniel Pinedo: Universidad Nacional Mayor de San Marcos, WWV8+G5Q, Lima 15081, Peru

Roberto Porro: EMBRAPA Amazônia Oriental, Trav. Dr. Enéas Pinheiro s/n°, Bairro Marco, 66095-903 Belém PA, Brazil

Emiliano Cabrera Rocha: University of Cambridge, The Old Schools, Trinity Ln, Cambridge CB2 1TN, UK

Oscar Sampaio: University of Cambridge, The Old Schools, Trinity Ln, Cambridge CB2 1TN, UK

Marianne Schmink: Center for Latin American Studies, University of Florida, Gainesville, Florida, USA

Bolier Torres: Universidad Estatal Amazónica, C. Teniente Hugo Ortíz E45, Puyo, Ecuador

Mariana Varese: Wildlife Conservation Society, Avenida Roosevelt 6360, Miraflores, Lima, Peru and Citizen Science for the Amazon Network, AV. Roosevelt 6360, Miraflores, Lima, Peru

CRITIQUES OF THE BIOECONOMY	BETTER APPROACHES
From assuming novelty to recognizing diverse traditions	
Proponents often frame the bioeconomy as a radically new idea, yet to be realized, ignoring the intellectual contributions of bottom-up movements on which bioeconomy thinking builds. Such 'promissory' and future-oriented approaches tend to ignore already-existing bioeconomies and the support they need.	Recognizing that place-based bioeconomies have historically being a key part of the Amazonian economy. Strengthening and developing the region's bioeconomy requires co-design with socio- environmentalists, Indigenous peoples and local communities in the leadership. Bioeconomy strategies and initiatives should prioritize supporting, learning from, multiplying, and innovating from existing socio-bioeconomies.
From greenwashing to strong sustainability approach	
The 'bio' label gives the bioeconomy a 'green' aura which is not necessarily reflected in practice. This can be used for 'greenwashing', i.e., using only the rhetoric of sustainability without substantial commitment.	Strong sustainability approaches to the bioeconomy—variously described as conservation- oriented bioeconomy or bioecology bioeconomy—consider the economic, environmental and societal effects of bioeconomy strategies and initiatives.
From growth-centered to wellbeing-centered	
Bioeconomy strategies at supranational and national levels commonly cast the spotlight on visions and promises of economic growth. Scholars have observed that growth-centered bioeconomy narratives rely on metrics such as GDP and net value, which do not serve the purpose of building sustainable (bio)economies and instead perpetuates existing inequalities and injustices.	The development of truly sustainable Pan- Amazonian bioeconomies requires narratives emphasizing the goals of economic justice and democratic economies, as well as growth-agnostic metrics centered on the wellbeing of people and their environments. Metrics might include Nature's Contributions to People, Human Development Index, and frameworks to evaluate sufficiency alongside the biophysical dimensions of the bioeconomy.
From high-tech visions to technologically plural bioeconomies	
Bioeconomies are frequently envisioned as dependent on advanced technologies. This approach positions richer countries as having the best capacity to lead the transition to bioeconomies. 'Low-tech' pathways are implicitly cast as 'backwards' despite their potential for technologies to be more equitable, feasible, and effective than novel technologies and/or technology developed outside of the Amazon.	A more inclusive and productive approach would be to diversify ideas about bioeconomy technology to include new and traditional technologies. Additional considerations, such as evaluating how capital or labor intensive different bioeconomic activities are, might be helpful to evaluate which of them meet context-relevant criteria, e.g., employment rate goals, technological capacity, capital availability, etc.
From exclusively Amazonian bioeconomies to holistic biome-economies	
Economic incentives for Amazonian deforestation are linked to other national and international regions. Bioeconomy-based conservation focused exclusively on the Amazon risks overlooking both distant sources of deforestation incentives and how they could 'leak' elsewhere. For example, if conservation-oriented bioeconomy efforts are exclusively focused on the Amazon, incentives for environmental degradation might migrate to other biomes of Amazonian countries.	A holistic approach seeks to construct bioeconomies in all biomes of Amazonian countries. This implies supporting the economies of all biomes to transition to increase their regional sufficiency, strengthening the 'domestic' economy of each biome, and thus protecting the livelihoods and population of each region from excessive exposure to the fluctuations of export-oriented economies.

FIGURE S1: Critiques of the bioeconomy concept and better approaches.

CONTACT
SPA Technical Secretariat New York
475 Riverside Drive | Suite 530
New York NY 10115 USA
+1 (212) 870-3920 | spa@unsdsn.org