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Transformative changes are needed to support socio-bioeconomies for people and ecosystems in the Amazon

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Current social-technical and political conditions threaten the integrity of the Amazon biome. Overcoming these lock-ins requires structural transformations away from conventional economies towards 'socio-bioeconomies' (SBEs). SBEs are economies based on the sustainable use and restoration of Amazonian ecosystems, as well as Indigenous and rural livelihood systems in the region. They include sustainable eco-tourism as well as diversified production and innovative processing of fruits, nuts, oils, medicines, fish and other products deriving from socio-biodiversity. Using a sustainability transitions perspective, we argue for multi-scalar policy changes to sustain, enhance and scale-out and scale-up SBE initiatives. To nurture niche SBE acitivities, we advocate for improvements in infrastructure, value chains and social organizations. To dismantle structural barriers, we call for an end to harmful subsidies, greater representation of marginalized communities in territorial planning, enhanced rural–urban and intersectoral linkages, international collaboration, shifts in demand, and changes in conservation and production narratives. Policies for SBEs must also use clear definitions, participatory processes and a multi-biome approach to avoid perverse outcomes.

Half a century of deforestation, 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 areas as well as global climate and water security[1]. Although the export of commodities linked to deforestation can lead to regional and national economic improvements though infrastructure jobs, interstate movement taxes and foreign exchange, the positive effects are fleeting and the value generated from forest clearing activities is largely captured by international actors and domestic elites[2–4]. This unequal context is characterized by underinvestment in education, innovation and sustainable infrastructure to add value to regional products[5]. Despite conversion of large amounts of natural capital into material exports, energy and food over the past 50 years, income, life expectancy and educational attainment in Amazonian municipalities remains below other regions within the same countries and substantially lower than the region's largest trading partners[6].

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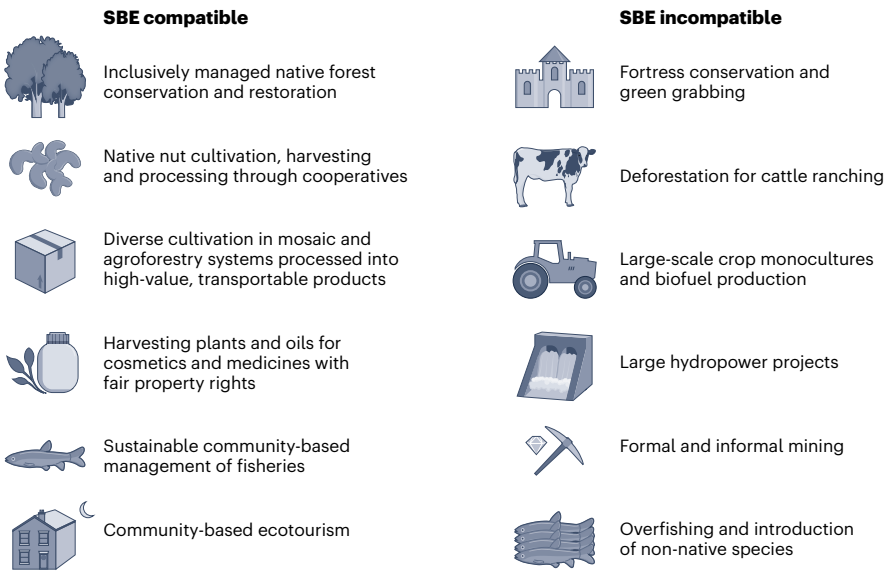

Fig. 1 | Examples of activities that are compatible with the SBE concept. These include not only specific land-use and aquatic activities, but also the governance and value chains these activities should be embedded in. Adapted with permission from ref. 94, Science Panel for the Amazon.

The development of existing and emerging socio-bioeconomies (SBEs) offers an alternative to conventional economies based on ecologically degrading processes and low-value commodity production. SBEs are defined here as systems of production, management, processing, distribution, recreation and consumption based on the sustainable use and restoration of healthy forests and rivers (see Fig. 1 for examples). The actual land uses these SBEs are based on are often referred to as 'nature-based solutions' (activities compatible with healthy ecosystems for climate mitigation, resilience, biodiversity protection and healthy livelihoods). The nature-based solutions we refer to are land uses that are often pursued by Indigenous or traditional communities and smallholders in the Amazon and take advantage of the unique genetic, chemical and physical resources of the region[7,8]. For instance, Ecuadorian Kichwa peoples have long used agroforestry systems (called Amazonian Chakra) with products such as cocoa (*Theobroma cacao* L.), guayusa (*Ilex guayusa* Loes.), vanilla (*Vanilla* spp.) and rubber (*Hevea brasiliensis*)[9].

As a modification of the conventional bioeconomy concept, the term SBE places justice as a core value. SBEs enact procedural justice by ensuring participation of women, youth and ethnic-territorial diversity. As such it pursues inclusive development and protection of knowledge, rights and territories of Indigenous people (IP) and local or traditional communities (LCs), inclusive of former-slave communities[10]. SBEs enact restorative justice by foregrounding Indigenous populations' ethical normative values 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[11,12]. Indeed, a longer terminology for SBEs should read as 'Indigenous, traditional and local economies based on socio-biodiversity' so as not to further invisibilize the presence of pre-existing models. These value-based approaches are recognized in the constitutions of Bolivia, Colombia, Ecuador, Brazil and Peru. Finally, SBEs aim for distributive justice by prioritizing (re)investment and budget increases in health, education and food distribution centres for both rural and urban people. As such, they include revitalized urban economies with manufacturing and service industries that add value to the products coming from nature-based solutions to better serve the vast majority of the Amazonian population.

How to strengthen SBEs

Bioeconomy concepts are gaining traction in Amazonian political agendas. Bioeconomy is prominent in Brazil's international climate announcements[13] and gained traction in the national agenda[14]. In June 2024, Brazil adopted the National Bioeconomy Strategy[15] and included a section on bioeconomy in its most recent deforestation control and prevention plan[16]. Discussions about SBEs were also present during the Belem meeting of Amazonian countries' presidents and included in the Belem Declaration for inter-Amazonian cooperation. Yet, it remains unclear how to achieve the ambitious goals of strengthened SBEs in Brazil, and policies to support SBEs have yet to be developed in other Amazonian countries.

Here we use a socio-technical transitions lens[17] to conceptualize the barriers and opportunities for more sustainable development in the Amazon. The socio-technical transitions framework views existing lock-ins through a multi-level perspective. The multi-level perspective describes the 'regime' as the dominant mode of production, sourcing, value accumulation and consumption in the system. It also includes the policy goals and narratives, and scientific and technological paradigms[18,19]. The 'landscape' is the set of external factors influencing the system. 'Niches' are the alternatives to the behaviours and practices embedded in the current regime[20].

Within this context, we can consider most sustainable development initiatives (including SBEs) as niches that struggle to scale amid formidable structural constraints and pressures (Fig. 2a). The current Amazonian regime is characterized by economies based on timber, mineral and oil extraction, low-value agriculture and over-fishing. It was derived from neoliberal, modernist and colonial political narratives inherited and sustained by governments, international development banks and consuming countries[11,21]. Increasingly it is also influenced by growing energy demand and electrification, leading to widespread damming of Amazonian riverways[22,23]. The socio-technical landscape includes: (1) an acceptance of increasing global consumption of tropical commodities; (2) insufficient pricing of these commodities given their social and environmental costs to society; (3) a failure to sufficiently value climate stability, biodiversity, and the rights and livelihoods of people living in the tropics[24]; and (4) a lack of fair-trade conditions or equitable international cooperation. Recent changes in the landscape are creating new markets and finance for carbon and biodiversity, or increased pressure for zero deforestation through global commitments and international trade due diligence policies. Yet, their impacts are highly limited within the existing regime.

A recent study[25] proposes several policy intervention points to achieve socio-technical transitions, simplified and adjusted here as:

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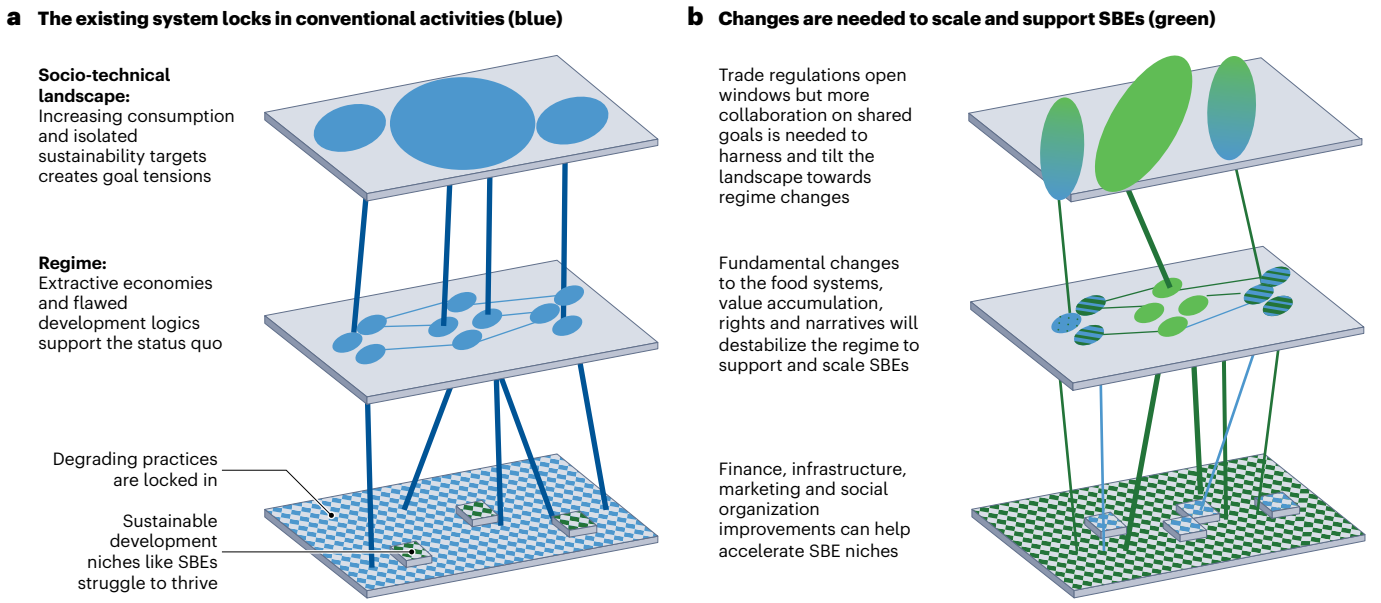

Fig. 2 | Proposed policy interventions to support SBEs. a, This panel uses the multi-level (landscape, regime and niches) perspective to show how existing regime and landscape lock in conventional degrading activities and block SBEs. **b**, This panel summarizes what policy changes are needed at the niche, regime and landscape scales to support SBEs. Small blue diamonds represent conventional practices locked into place by the existing regime and landscape. Green diamonds represent the development of SBEs. Blue ellipses are conditions (for example, networks of reinforcing actors, institutions and so on) in the landscape and regime that support conventional activities. Green ellipses are conditions in the landscape and regime that could help to scale-up SBE initiatives. Adapted with permission from ref. 95, Elsevier.

(1) accelerate niches; (2) destabilize the regime; (3) tilt the landscape; and (4) provide safeguards (Fig. 2b). Niche stimulation and acceleration refers to providing the financial and other policy resources to encourage and scale technologies to address sustainability crises. In the multi-level perspective framework, the niches are expected to remain trapped without regime destabilization, which involves disrupting the system of incentives arising from the incumbent economic systems, narratives and power dynamics to allow niches to emerge and scale. Tilting the landscape refers to changes in demand, trade, and international agreements and targets that can help to shift the regime by influencing the politics of national governments and changing financial flows. It is also critical to establish safeguards around the SBE concept and processes to avoid misuse and co-option (each policy step and specific actions are summarized in Table 1).

Niche acceleration

Transformation cannot happen merely by supporting niche activities of SBEs, but nevertheless niche acceleration is an important part of the picture that can occur immediately. The growth of niches can also help to shift narratives by providing evidence of their feasibility as alternatives. For all the below recommendations it is essential to ensure that the cultural values of IP and LCs, developed over millennia, are respected and protected.

End harmful subsidies. Finance must be redirected from activities that harm existing SBEs to activities compatible with SBEs[26]. Low-interest loans and tax advantages for agribusinesses[27] that skew heavily towards larger producers or producers with existing credit histories have helped to prop up activities such as cattle ranching and soy production[28–30]. It is necessary to immediately phase out credit programmes for conventional agriculture in areas with high forest cover and more gradually scale-down any subsidized credit to conventional agriculture that is not accompanied by sustainability criteria.

Redirect finance and research. International and national (or blended) finance should instead be directed to conservation for ecosystem services (for example, via carbon and biodiversity markets) and to research, innovations and scaling of production and processing of SBE-compatible activities. The development of state or Amazon-level portfolios for investable SBE activities would be useful for connecting small-scale projects to distant climate and development fund investors. Funding must prioritize IP and LCs with sustainable management plans, and other vulnerable land-use actors.

Existing financing mechanisms should be improved by: (1) allowing smallholder land users and community-based enterprises to obtain loans without formalized tenure arrangements; (2) reducing interest rates to zero for the more vulnerable families; (3) providing capacity for business model development; and (4) establishing longer time horizons for repayment to accommodate the long-term nature of socio-bioeconomy investments.

Funding for research on agricultural commodities typically dwarfs investments in diversified agricultural systems, non-timber forest products and sustainable fisheries in Amazonian countries. Funding for conventional systems (for example, direct planting or pasture recuperation) is also 500 times greater than organic production and agroforestry in the Brazilian 'Low Carbon Agriculture' credit disbursements[31]. Considering that Indigenous and traditional epistemologies are often excluded from science and decision-making, producing knowledge to support SBEs necessarily includes Indigenous and traditional frameworks from the initial phase of defining the aims and methods of research. Redirected funding could support activities that bring together Indigenous experts, ethnobotanists, agronomists and other scholars to co-create a sustainability science agenda driven by and responsive to local needs. Part of this agenda could include collaboration to better understand current and potential uses of forest products. One study estimates that Brazil alone could generate US$8.2 billion per year by 2050 relative to existing economic activities by investing in SBEs[32], but many more studies on the potential scale, scope and inclusivity are needed.

These must be coupled with ecological studies to better understand thresholds and practices for sustainable harvesting, water and residue management, and feedback with soil health and biodiversity

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Table 1 | Key recommendations by level

Level	Actions	Examples	Audiences
Niche			
End harmful subsidies	• Phase out credit programmes for conventional agriculture in areas with high forest cover • Scale-down subsidized credit to unsustainable agriculture	• Measure 22 in the Declaration of the 'Povos da terra pela Amazônia'[75] • Brazil's credit moratorium and blacklisting programmes in high-deforestation properties and areas • Elements of Brazil's Low Carbon Agriculture scheme (although the scheme as a whole still skews towards traditional practices)	DGOV, DEV, IF, NGO, PS
Shift finance and research	• Improve and adapt existing financing mechanisms to be more smallholder and common property friendly. • Fund research on: (1) thresholds and practices for sustainable harvesting and feedbacks with soil health, water and biodiversity; (2) climate resilience of SBEs; (3) market bottlenecks and logistical constraints and solutions; (4) governance arrangements that support SBEs; and (5) science and policy-making centred in IP and LC knowledge	• Guyana's Low Carbon Development Strategy • Green Climate Fund's Amazon Bioeconomy Fund • Cross-scale and thematic research fund for science and innovation, such as Amazonia +10 Initiative[76] • Private Social Investment (ISP) platform for the Amazon	DGOV, DEV, IF, NGO, PS
Build the infrastructure	• Build low-impact transportation, storage, cold-storage and food processing facilities • Improve digital connectivity, electrification and small-scale renewable energy • Develop better sanitation and nutrient reuse capacities • Control sprawl and improve access to public transport	• Brazil and Amazon nut phytosanitary investments in Bolivia and Peru • Cooperacre—a cooperative of cooperatives that has built processing and marketing infrastructure for SBEs (www.cooperacre.com) • Multipurpose forest biorefineries (fruit and nut biocompounds) • Small-scale renewable energy in reserves in Brazil[77]	DGOV, DEV, NGO, PS, AC, IP, LCs
Support associations and small enterprises	• Invest in technological development and marketing efforts of small enterprises • Support women's organizations • Provide funding for youth organizations and conferences	• Origens Brasil network to support enterprises of IP and LCs in Brazil (www.origensbrasil.org.br/) • 'Agroemprende cacao' investment to support cocoa agroforestry cooperatives in Colombia[78] • Corporation of Amazonian Chakra Associations (fosters small associative enterprises and inclusion of young people and women)[79] • Restaura Amazonia—Fundo JBS and Solidaridad LatinoAmerica[80] • Arapaima fisheries in Amazonas Brazil[81] • Babassu palm value chains in Maranhão, Brazil[82,83] • Latex and brazil nuts (Cooperacre) in Acre, Brazil[84] • Brazil's National Bioeconomy Strategy[15]	DGOV, DEV, NGO, PS, AC, IP, LCs
Enhance marketing pathways	• Develop SBE product brands and labels • Coordinate national and international tax incentives and trading policies • Media campaigns to show the benefits of SBEs • Public purchase programmes and price guarantee policies	• Food security programmes in Brazil (Programa de Aquisição de Alimentos and Programa Nacional de Alimentação Escolar) • Pre-natal food subsidy in Bolivia • Veja advertising fair-trade Amazonian native rubber as a sustainable leather substitute[85,86] • World Economic Forum and Mongabay videos on nuts like Sacha and Amazon nut (https://www.weforum.org/videos/25545-this-star-shaped-nut-could-help-save-the-amazon/, https://www.youtube.com/watch?v=qhb19Ozuo38) • Minimum Price Guarantee Policy for Sociobiodiversity Products in Brazil	DGOV, NGO, PS, IP-LC
Regime			
Stop activities that threaten IP, LCs and SBEs	• Expand protected and sustainable use areas, and conservation and water pollution regulations • Scale-up ecosystem restoration • Improve company and community deforestation monitoring systems • Cancel and block efforts to register public and private lands illegally or in Indigenous areas • Assess, avoid and remediate impacts of new infrastructure • Create a central intelligence hub for all deforestation and degradation control activities • Improve regulation of illegal economies and organized crime	• Brazil's Action Plan for the Prevention and Control of Deforestation in the Legal Amazon • Peru's National Forest Conservation Program • Bolivia's constitution (Articles 1, 211, 289, 403) and Authority of the Rights of Mother Earth • Ecuador's constitution (Articles 71–74 Rights of Nature) • Soy moratorium and G4 agreement	DGOV, IF, PS

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Table 1 (continued) | Key recommendations by level

Level	Actions	Examples	Audiences
Reduce demand	• Promote diet diversification away from cattle meat, especially in wealthy communities outside the Amazon • Recycle gold and other minerals to reduce overall demand	• The Good Food Institute—Brazil's collaborations for plant-based innovations • Gold recycling programmes for electronic waste	DGOV, IGOV, NGO, PS, AC
Develop synergistic urban–rural and intra-sectoral linkages	• Develop tax breaks and targeted finance for various value-added and service activities in Amazonian urban areas • Develop urban green belts for IP and LCs	• Zona Franca de Manaus (free trade zone to develop manufacturing) • Brazil's National Bioeconomy Strategy[15]—Article 3 and Article 4, prov. II aiming to link with food sector	DGOV, IGOV, NGO, PS, AC
Strengthen IP and LC rights and representation	• Increase finance and capacity building for electing Indigenous leaders • Create national and state IP and LC ministries • Secure IP and LC rights within territorial conservation and development governance processes	• Brazil's Ministry of Indigenous People • Bolivia's Authority of the Rights of Mother Earth • Ecuador's Jurisdictional Guarantee of Rights in the government organization of the Amazonian Special Territorial District	DGOV, NGO, IP-LC
Shift narratives	• Stop using language that frames not clearing land as an opportunity cost • Put greater emphasis on the missed development opportunities of not investing in conservation and the SBEs • Stop framing the SBEs as new • Highlight ancient and existing SBE initiatives	• Statements by Fernando Haddad, Minister of the Economy, around the Ecological Transformation Plan[13] • Working papers/reports: refs. 43,87 • Refs. 88,89 • Bolivia's National Assembly of Agroecological Production	DGOV, NGO, AC
Landscape			
Seize policy windows	• Reference supportive changes in international policies when lobbying for additional national and regional policies • Leverage global finance to support national and regional initiatives	• Bonn Challenge; Glasgow Declaration; NY Declaration on Forests goals 1 and 5; Kunming-Montreal Global Biodiversity Framework targets 2 and 3; UN Strategic Plan for Forests; UN Sustainable Development Goals 15.1–15.3 • EU, UK and US deforestation regulations • EU and France due diligence laws • Accelerator programmes for agroforestry and restoration in the Amazon as part of companies' net-zero pledges[90,91]	DGOV, NGO
Align international goals	• Listen to, support and amplify Amazonian visions and targets, rather than encouraging replication of external visions	• Belem Declaration—'cross-cutting principles and objectives' • Brazilian Ecological Transformation Plan	IGOV, NGO, UN
Build and strengthen institutions for cross-scale and regional learning and cooperation	• Improve pan-Amazonian institutions • Improve cross-scalar and inter-community networks • Improve distribution of educational and innovation research institutes to Amazonian regions	• 2019 Leticia Pact • Amazon Cooperation Treaty Organization Amazon Presidents' Summit • Belem Declaration of 2023—'Amazon Indigenous People Mechanism and Observatory of Rural Women for the Amazon Region'	DGOV, IGOV, NGO, IP-LC
Safeguards			
Clear definitions	• Establish clear definitions around what SBEs entail, including what values they represent • Do not include monocultures and single aquaculture species • Do not allow investments and control of SBEs to go to a narrow set of multinational companies or domestic elites that participate in SBEs[72]	• Refs. 43,92 • Brazil's National Bioeconomy Strategy[15], Article 2	DGOV, NGO, AC, IP-LC
Participatory and transparent processes	• Define research in collaboration with Amazonian peoples and regional research institutions • Ensure public engagement in science and open access to research results • Plan infrastructure and marketing arrangements with active participation of the local populations	• Brazil's National Bioeconomy Strategy[15], Article 8 • Pará State Bioeconomy Plan[93]	DGOV, NGO, IP-LC
A multi-biome approach	• Develop plans and policies for SBEs in all biomes, not just the Amazon	• Brazil's National Bioeconomy Strategy[15], Article 5	DGOV, IGOV, NGO, IP-LC

DGOV, domestic state and national governments; IGOV, international governments; DEV, international and national development banks; IF, international financial actors; NGO, non-governmental organizations; PS, private sector; AC, academics; UN, United Nations General Assembly and other institutions; IP-LC, Indigenous people, Quilombolas and traditional or other vulnerable local communities. These recommendations stem from a consultative process by the UN Science Panel for the Amazon to develop a policy brief on the topic of SBEs in advance of the Amazon Presidents' Summit, Climate Week NYC and the UN General Assembly meeting in 2023. The analysis was developed and written by experts from Amazonian countries and the Global North after an initial meeting with review and comment from 25 additional experts.

in different management approaches. A renewed focus is needed on IP and LC knowledge with respect to sustainable practices, ecological feedbacks and governance. Research on climate resilience is a priority given the combined climate impacts of global greenhouse gas emissions and regional deforestation and degradation on the regional climate, which threaten IP and LC livelihoods. On the socioeconomic side, there is a need to better understand market bottlenecks and logistical constraints, identify mechanisms and policies that can overcome these constraints, and document and test governance arrangements that support just use and marketing of SBE products.

Build the infrastructure. Sustainable infrastructures are needed to improve the welfare of Amazonian populations and enhance Amazonians' access to information, energy, sanitation and markets[33]. Infrastructure needs specifically related to the SBEs include low-impact transportation, 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 SBEs[34]. Many of these forest-product processing technologies are crucial to exporting with sufficient value.

Electrification and development of distributed (and/or small-scale) renewable energy are crucial to help Amazonians to reduce their dependence on diesel oil and support multipurpose small-scale industrialization. They may also support and should go hand-in-hand with investments that consider the changing climate and the additional risks it brings to ecosystems through changes in water stress and fire severity[35]. In urban areas, there needs to be realistic planning to control sprawl and improve access to public transport and markets for rural products with sufficient infrastructure to reduce spoilage. Appropriate waste infrastructure needs to be established to reduce water pollution to protect Indigenous communities and aquatic biodiversity. This could include capturing human refuse for nutrient extraction to be used for fertilization for agroforestry systems.

Moreover, it is necessary to foster new lines of technological education in innovative systems with a high practical curricular content that focus on these SBE topics, as well as small financial incentives for access to appropriate equipment, such as extraction of essential and vegetable oils, tinctures, resins, fibres and so on, and processing of value-added products.

Support community organizations and small-scale enterprises. Cooperatives and community enterprises have a decisive role in supporting SBEs. The lessons learned from positive examples should be analysed 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 finance or training in management and business. In parallel to research innovations, investment must forecast mechanisms by which small enterprises and cooperative businesses can be incubated for technological improvement and stable market access[36]. As women have a disproportionate role in the collection and sale of SBE products it is particularly crucial to support women's collective organization and social movements. These can help to improve their material outcomes, as well as their visibility, environmental and political awareness[37]. As youth are also on the forefront of SBEs, particularly within social media and other digital spaces, efforts should be made to support these communities through seed funding for physical gatherings, including youth conferences.

Enhance marketing pathways. To reach new markets it is necessary to further develop SBE 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 large-scale and long-term benefits of strengthened SBEs and related products in the Amazon basin. Public purchase programmes and price guarantee policies could create a stable and circular market for forest products. A pan-Amazonian trade organization could be created with the objective of encouraging cooperation around international trade in products and services from SBEs, including developing quality standards, sharing market information and statistics, participating in joint marketing campaigns, and regularly discussing priorities, problems and concerns.

Regime destabilization

Existing regimes only allow for incremental changes that place conservation at odds with development[25]. More transformative regime change can reconcile these tensions through new pathways that change structures and paradigms enabling synergies between ecosystem conservation, climate stability and improved wellbeing[38].

Stop deforestation and degradation. Ongoing ecosystem loss and degradation threaten IP and LCs, and (low-income) urban residents. Ongoing degradation also hinders the potential diversity of the socio-bioeconomy opportunities and bolsters the beneficiaries of the existing regime. For these reasons, improvements in efforts to reduce forest and river degradation are critical to regime destabilization. Such improvements include, among others: turning undesignated forest lands and other areas into protected and sustainable use areas; expanding conservation and water pollution regulations; scaling-up ecosystem restoration; expanding and improving systems to monitor deforestation-risk supply chains; strengthening community-level ecosystem monitoring systems; cancelling and blocking efforts to register public or private lands illegally or in Indigenous areas; assessing, avoiding and remediating the impacts of any new infrastructure on deforestation, forest degradation and river connectivity; and the creation of a central intelligence hub for all deforestation and degradation control activities. It is also essential to improve regulation of illegal economies and organized crime (for example, land invasions, illegal gold mining and fisheries, drug and wildlife trafficking) via improved enforcement, reduced corruption and protection of 'environmental defenders' (for example, IP and LC leaders or journalists).

Rethink the prevailing food systems and mining. Existing food systems in the Amazon are dominated by production strategies oriented towards long supply chains benefiting distant consumers. They are underpinned by high and growing global demand for the products that contribute disproportionally to the destruction in the Amazon. Meanwhile, many people in Amazonian countries struggle with either hunger or obesity and other food-related health challenges[39–41]. Programmes to stimulate and support the consumption of a diverse and nutritious diet will directly benefit SBEs as they favour a more diverse production landscape. Policies should also aim to reduce beef consumption outside the Amazon, because pasture for cattle drives the largest share of deforestation in the biome. This can be done with sensitivity, acknowledging that meat is critical to poorer households. A greater focus on recycling and recovery of minerals as part of developing more circular supply chains for technologies such as batteries and smartphones could help to reduce demand for damaging land-use activities such as gold mining.

Develop synergistic cross-sectoral rural–urban linkages. A shift to inclusive development requires a greater focus on distributed economic opportunities, improved connections with urban centres and synergies between multiple sectors of the economy (environment, industry, health and education). Strengthened SBEs 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. Urban–rural linkages provide key investment opportunities for both urban and rural agroecological and production activities[42]. Existing SBEs are already linked with Amazonian cities, and

peri-urban areas show great promise for further expansion, adaptation and added value. Developing various value-added and service activities in Amazonian urban areas through tax breaks and targeted finance can help to diversify and increase the number of jobs in SBEs[43].

Strengthen IP and LC rights and representation in state and federal government. There are 2.2 million IP in the Amazon accounting for 4.6% of the population on 27% of the area[44,45]. These communities' livelihoods and cultural survival depend on healthy standing forests and flowing rivers for access to clean water, food, good health and spiritual values[40,46–48]. Protected areas, including those under Indigenous management, have fared significantly better than other governance approaches to reducing deforestation in the Amazon[49]. 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[50]. Strengthening Indigenous land rights means enacting laws, or enforcing existing ones, that provide official recognition to the rights IP have over their territories and improve communities' abilities to monitor and deter deforestation and forest and aquatic degradation.

One of the best ways to strengthen these rules is by establishing or strengthening the ministries of Indigenous affairs and improving representation of IP and LCs in congresses via improved campaign financing and training of those groups. This is especially needed to counteract the growing share of agrobusiness interests in national congresses[51]. IP and LC representation groups should be established and heard within every major rural development and conservation-related planning process, with due attention to enforce the Indigenous and Tribal Peoples Convention of the International Labour Organization (ILO Convention 169).

Change the narratives around conservation and development. We suggest two shifts are needed, as outlined in this section.

Stop framing conservation and development as necessary trade-offs. Conservation policy discussions in the Amazon (and elsewhere) often focus on estimating the foregone profits from cropland or pastures as a cost of deforestation control[52]. Many studies aim to identify the most cost-effective activities considering these forgone profits[53–57]. Yet, there is little quantification of the societal and tributary costs and inequalities associated with existing activities or emphasis on the low returns of existing food and mineral commodities[58]. A focus on opportunity costs also feeds into narratives about the 'sacrificeability' of certain regions to deforestation due to their higher perceived agricultural profits (for example, the Cerrado and dryland forests)[59,60]. Greater emphasis is needed on the missed development opportunities of not investing in ecosystem conservation and existing SBEs.

Stop framing the bioeconomy as something new and advanced and start focusing on how to support existing initiatives through structural changes. Proponents often frame SBEs as a radically new idea that is yet to be realized and dependent on advanced technologies[61]. These framings implicitly position richer countries as having the best capacity to lead the transition to SBEs and ignore the intellectual contributions of bottom-up movements on which SBE thinking builds[62]. Such 'promissory' and future-oriented approaches tend to ignore or unintentionally cast existing initiatives as 'backwards' despite their potential for technologies to be more equitable, feasible and effective than technologies developed outside the Amazon. A more inclusive and productive approach would diversify ideas about SBE technology to include new and traditional technologies[63].

Harnessing new global opportunities and further tilting the landscape

Changes in the global landscape, including the growth of biodiversity and carbon markets and a move towards due diligence in global sourcing, can provide new windows for strengthened SBEs, yet further efforts are needed to tilt the landscape towards SBEs, including improvements in the scope of global sustainability targets and international cooperation efforts to highlight justice, transparency and accountability.

Seize policy windows from due diligence regulations and international commitments. The global climate and biodiversity crises are leading to the creation of new markets and sources of finance that can support SBE scaling under the caveats included above[64]. Similarly, international commitments such as the New York Declaration of Forests and United Nations (UN) Sustainable Development Goals include the various targets with respect to protecting and restoring forest ecosystems, which can be leveraged to attract new development aid and finance. The new UK and European Union (EU) deforestation regulations[65,66] require companies that sell into the UK and EU to map their supply chains and understand their deforestation risks, and accordingly to undertake due diligence to ensure that no deforestation-linked products are sourced and sold.

These policies offer new leverage to support the deforestation control activities that underpin regime destabilization. Policymakers should reference these changes in international policies when lobbying for additional national and regional policies. Actors at all scales should seek finance from actors engaged in global conservation and development commitments to support national and regional SBE initiatives.

Advocate for alignment of international goals with internal visions rather than vice versa. Existing global targets represent a scattershot of ambitious, yet disjointed, sustainability ambitions (for example, achieving zero deforestation, conserving 30% of the planet or planting 1 trillion trees) and do not provide much of a blueprint for building a sustainable economy. Therefore, we encourage international actors to listen to, support and amplify Amazonian visions and targets, rather than encouraging replication of external visions. The content of the Kunming-Montreal Global Biodiversity Framework of the UN Convention on Biological Diversity is promising in this sense as it contains text on transformative actions relevant to SBEs, but it should not fall back on over-simplified targets[67]. The Global Biodiversity Framework Fund of the Global Environmental Facility is also mobilizing significant funding targeted to IP and LCs for inclusive conservation[68].

Strengthen institutions for cross-scale and regional learning and cooperation. The time is ripe to strengthen international institutions to support cooperation and learning across different visions and experiences of SBEs across countries. Building on the Amazon Cooperation Treaty Organization, the 2019 Leticia Pact and the 2023 Amazon Cooperation Treaty Organization Amazon Presidents' Summit, the creation and improvement of pan-Amazonian institutions could help to enhance market opportunities, enable policy coherence and reduce negative spillovers across countries. The creation and support of existing cross-scalar and inter-community networks to help to identify and magnify bottom-up experiences within SBEs will require a sustained effort.

Greater emphasis must be channelled to cross-learning from research and development, sharing data intelligence, monitoring and policies that support SBEs[69]. IP and LCs must be active participants in this effort, as should women, given their historical marginalization and prominent leadership of regional initiatives and organizations. Given their engagement with social and visual media, youth could be important leaders and amplifiers of media campaigns. 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 centres of wealth and power)[70].

Establishing safeguards

Clear definitions and guiding processes for SBEs. The SBE concept is far from simple or unanimous. In fact, some people and local organizations even have reservations about using the term at all. The 'bio' label gives the bioeconomy a 'green' aura that is not necessarily reflected in practice. This can be used for 'greenwashing', that is, using only the rhetoric of sustainability without substantial commitment. SBEs also have the potential for both over-exploitation and misinterpretation. Monocultures and single aquaculture species should not substitute diversity under the guise of 'bio' production[71], and investments and control of SBEs must not go to a narrow set of multinational companies or domestic elites. Clear definitions are needed around what SBEs entail. It is also important to emphasize the processes inherent in SBEs as a guiding value system. This includes addressing power and policy asymmetries and maximizing the diversity of social organizational forms (for example, cooperatives, family agriculture and Indigenous associations) that participate in SBE initiatives[72].

It would be problematic to frame SBE initiatives around visions and promises of economic growth based on per hectare profits and gross domestic product. Such narrow efficiency metrics do not account for the multiple contributions and societal benefits, including economic, generated by strengthened SBEs; nor do they account for the costs and erosion of the resource base. The development of truly sustainable pan-Amazonian SBEs requires narratives emphasizing the goals of economic justice and democratic economies, as well as growth-agnostic metrics centred on the wellbeing of people and their environments. A longer-term, more inclusive wealth perspective should focus on the need to safeguard the environmental and social support systems underpinning societal wellbeing, and securing IP and LC rights to food security, clean water and good health.

Participatory and transparent 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. Research initiatives must be defined in collaboration with Amazonian peoples and regional research institutions, ensuring that they benefit from it. It is also crucial to ensure public engagement in science and open access to research results for the public, following the principles of open and collaborative science[73]. 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.

A multi-biome approach. Economic incentives for Amazonian deforestation are linked to other national and international regions. SBE-based conservation focused exclusively on the Amazon risks overlooking both distant sources of deforestation incentives and how they could 'leak' elsewhere (for example, if efforts are exclusively focused on the Amazon, incentives for environmental degradation might migrate to other biomes of Amazonian countries[74]). A holistic approach seeks to support SBEs 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.

Time for action

To achieve Amazonian conservation, safeguard its people, and prevent climate and biodiversity catastrophes, scientists and policymakers must confront the flawed colonial economic models and development ideas that have led to Amazonian economies that convert the region's social and biological wealth into homogeneous commodities for global markets. Transformation involves disrupting existing economic, political, cultural and scientific patterns to allow new just and sustainable futures to emerge. SBEs hold significant promise as both an economic approach and a guiding value system for policies and planning in the Amazon. Support for strengthened SBEs through finance, infrastructure and marketing is a useful part of the picture to stimulate niche activities, yet it is insufficient to achieve structural change. A large shift in policies and development narratives across multiple levels is needed to destabilize the existing regime that supports ongoing activities that degrade forests and rivers in the Amazon. Doing so, decision-makers in the Amazon and beyond can take meaningful and urgently needed steps to promote people's wellbeing, the conservation and recovery of biodiversity, and provisioning of associated ecosystem services that are vital for flourishing SBEs in the Amazon.

References

1. Flach, R. et al. Conserving the Cerrado and Amazon biomes of Brazil protects the soy economy from damaging warming. *World Dev.* **146**, 105582 (2021).
2. Hecht, S. B. Soybeans, development and conservation on the Amazon frontier. *Dev. Change* **36**, 375–404 (2005).
3. Celentano, D., Sills, E., Sales, M. & Veríssimo, A. Welfare outcomes and the advance of the deforestation frontier in the Brazilian Amazon. *World Dev.* **40**, 850–864 (2012).
4. Rodrigues, T. Agricultural explosion in Brazil: exploring the impacts of the Brazilian agricultural development over the Amazon. *Int J. Sociol. Agric Food* **16**, 1–12 (2009).
5. *SPA Sustainable Infrastructure Policy Brief* (SPA, 2023).
6. Smits, J. & Permanyer, I. The Subnational Human Development Database. *Sci. Data* **6**, 190038 (2019).
7. Vera V, R. R., Cota-Sánchez, J. H. & Grijalva Olmedo, J. E. Biodiversity, dynamics, and impact of chakras on the Ecuadorian Amazon. *J. Plant Ecol.* **12**, 34–44 (2017).
8. Torres, B., Maza, O. J., Aguirre, P., Hinojosa, L. & Günter, S. in *Handbook of Climate Change Adaptation* (ed. Leal Filho, W.) 1973–1994 (Springer, 2015).
9. Torres, B. et al. *Estudios Sobre Medios de Vida, Sostenibilidad y Captura de Carbono en Chakra con Cacao: Casos de las Asociaciones Kallari, Wiñak y Tsatsayaku, Amazonía Ecuatoriana* (FAO–Ecuador, 2022).
10. Abramovay, R. et al. In *Amazon Assessment Report 2021* (eds Nobre, C. et al.) Ch. 30 (United Nations Sustainable Development Solutions, 2021).
11. Hecht, S. et al. In *Amazon Assessment Report 2021* (eds Nobre, C. et al.) Ch. 14 (United Nations Sustainable Development Solutions, 2021).
12. Schlemer Alcantara, L. C. & Cioce Sampaio, C. A. Bem viver como paradigma de desenvolvimento: utopia ou alternativa possível? *Desenvolv. Meio Ambiente* https://doi.org/10.5380/dma.v40i0.48566 (2017).
13. Leon, L. P. Brazil unveils ecological plan at COP28 as Global South proposal. *Agência Brasil* (12 January 2023).
14. Ministério do Desenvolvimento e Assistência Social, Família e Combate à Fome. MDS, MMA e MDA se unem para elaborar Plano Nacional da Sociobioeconomia. https://www.gov.br/mds/pt-br/noticias-e-conteudos/desenvolvimento-social/noticias-desenvolvimento-social/mds-mma-e-mda-se-unem-para-elaborar-plano-nacional-da-sociobioeconomia (1 November 2023).
15. Brasil, Decreto Nº 12.044 Institui a Estratégia Nacional de Bioeconomia. https://www.in.gov.br/en/web/dou/-/decreto-n-12.044-de-5-de-junho-de-2024-563746407 (5 June 2024).

16. Ministério do Meio Ambiente e Mudança do Clima. *Plano de Prevenção e Controle do Desmatamento na Amazônia Legal (PPCDAm): 5ª Fase* (2023 a 2027), https://www.gov.br/mma/pt-br/assuntos/prevencao-e-controle-do-desmatamento/amazonia-ppcdam-1/5a-fase-ppcdam.pdf (MMA Subcomissão Executiva do PPCDAm, 2023).
17. Geels, F. W. The multi-level perspective on sustainability transitions: responses to seven criticisms. *Environ. Innov. Soc. Transit.* **1**, 24–40 (2011).
18. McMichael, P. in *New Directions in the Sociology of Global Development* (eds Buttel, F. H. & McMichael, P.) 265–299 (Emerald Group, 2005).
19. Gaitán-Cremaschi, D. et al. Characterizing diversity of food systems in view of sustainability transitions. A review. *Agron. Sustain. Dev.* **39**, 1 (2019).
20. Tittonell, P. et al. in *Sustainable Agriculture Reviews* (ed. Lichtfouse, E.) 1–34 (Springer, 2016).
21. Garrett, R. D. et al. Forests and sustainable development in the Brazilian Amazon: history, trends, and future prospects. *Annu. Rev. Environ. Resour.* **46**, 625–652 (2021).
22. Almeida, R. M. et al. Climate change may impair electricity generation and economic viability of future Amazon hydropower. *Glob. Environ. Change* **71**, 102383 (2021).
23. Latrubesse, E. M. et al. Damming the rivers of the Amazon basin. *Nature* **546**, 363–369 (2017).
24. Barlow, J. et al. The future of hyperdiverse tropical ecosystems. *Nature* **559**, 517–526 (2018).
25. Kanger, L., Sovacool, B. K. & Noorkõiv, M. Six policy intervention points for sustainability transitions: a conceptual framework and a systematic literature review. *Res. Policy* **49**, 104072 (2020).
26. *A Multi-Billion-Dollar Opportunity – Repurposing Agricultural Support to Transform Food Systems: In Brief*, https://www.fao.org/documents/card/en/c/cb6683en (FAO, UNDP & UNEP, 2021).
27. Brasil. Emenda constitucional no. 132 Altera o sistema tributário nacional. (20 December 2023).
28. Helfand, S. M. The distribution of subsidized agricultural credit in Brazil: do interest groups matter? *Dev. Change* **32**, 465–490 (2001).
29. Hofmeister, N. Brazilian taxpayers subsidizing Amazon-clearing cattle ranches, study shows. *Mongabay Environmental News* https://news.mongabay.com/2020/05/brazilian-taxpayers-subsidizing-amazon-clearing-cattle-ranches-study-shows/ (26 May 2020).
30. Moreira-Dantas, I. R., Martínez-Zarzoso, I., Henning, C. & Souza dos Santos, M. A. Rural credit acquisition for family farming in Brazil: evidence from the Legal Amazon. *J. Rural Stud.* **101**, 103041 (2023).
31. Schmidt, N., Silva, C. & Santoyo, A. Análise do plano de agricultura de baixo carbono (ABC) no Brasil: resultados e perspectivas. *Univ. Soc.* **15**, 279–291 (2023).
32. Nobre, C. A. *New Economy for the Brazilian Amazon* www.wribrasil.org.br/nova-economia-da-amazonia (WRI Brasil; 2023).
33. Schaeffer, R. & Barrantes, R. *A New Infrastructure for the Amazon* https://www.theamazonwewant.org/wp-content/uploads/2023/09/SPA-Infrastructure-Policy-Brief_for-Public-Consultation.pdf (Science Panel for the Amazon, 2023).
34. Abramovay, R. *Infraestrutura para o Desenvolvimento Sustentável da Amazônia* (Editora Elefante, 2019).
35. Banerjee, O. et al. Can we avert an Amazon tipping point? The economic and environmental costs. *Environ. Res. Lett.* **17**, 125005 (2022).
36. Sampaio Neto, O. Z., Caldas Batista, E. A. & de Almeida Meirelles, A. J. Potencial de oleaginosas nativas no desenvolvimento de cadeias produtivas da biodiversidade brasileira. *Desenvolv. Meio Ambiente* https://doi.org/10.5380/dma.v54i0.71934 (2020).
37. Mello, D. & Schmink, M. Amazon entrepreneurs: women's economic empowerment and the potential for more sustainable land use practices. *Women's Stud. Internatl Forum* **65**, 28–36 (2017).
38. Pascual, U. et al. Governing for transformative change across the biodiversity–climate–society nexus. *BioScience* **72**, 684–704 (2022).
39. Cunha, M. P., Marques, R. C. & Dórea, J. G. Child nutritional status in the changing socioeconomic region of the northern Amazon, Brazil. *Int. J. Environ. Res. Public Health* **15**, 15 (2018).
40. Zavaleta, C. et al. Multiple non-climatic drivers of food insecurity reinforce climate change maladaptation trajectories among Peruvian Indigenous Shawi in the Amazon. *PLoS ONE* **13**, e0205714 (2018).
41. Piperata, B. A., Spence, J. E., Da-Gloria, P. & Hubbe, M. The nutrition transition in Amazonia: rapid economic change and its impact on growth and development in Ribeirinhos. *Am. J. Phys. Anthropol.* **146**, 1–13 (2011).
42. Brondizio, E. S., Siqueira, A. D. & Yogt, N. in *The Social Lives of Forests: Past, Present, and Future of Woodland Resurgence* (eds Hecht, S. B. et al.) Ch. 27 (Univ. Chicago Press, 2014).
43. de Assis Costa, F. Jr. *Bioeconomy for the Amazon: Concepts, Limits, and Trends for a Proper Definition of the Tropical Forest Biome* Working Paper https://www.wribrasil.org.br/sites/default/files/2022-07/NEA-BR_Bioeconomy_EN.pdf (WRI Brazil, 2022).
44. Nobre, C. et al. *Executive Summary of the Amazon Assessment Report 2021* (United Nations Sustainable Development Solutions Network, 2021).
45. Moutinho, P. et al. *Policy Brief: The Role of Amazonian Indigenous Peoples in Fighting the Climate Crisis* https://www.theamazonwewant.org/spa_publication/policy-brief-the-role-of-amazonian-indigenous-peoples-in-fighting-the-climate-crisis/ (Science Panel for the Amazon, 2022).
46. Bauch, S. C., Birkenbach, A. M., Pattanayak, S. K. & Sills, E. O. Public health impacts of ecosystem change in the Brazilian Amazon. *Proc. Natl Acad. Sci. USA* **112**, 7414–7419 (2015).
47. Conceição, K. V. et al. Government policies endanger the Indigenous peoples of the Brazilian Amazon. *Land Use Policy* **108**, 105663 (2021).
48. Walker, W. S. et al. The role of forest conversion, degradation, and disturbance in the carbon dynamics of Amazon Indigenous territories and protected areas. *Proc. Natl Acad. Sci. USA* **117**, 3015–3025 (2020).
49. Hänggli, A. et al. A systematic comparison of deforestation drivers and policy effectiveness across the Amazon biome. *Environ. Res. Lett.* **18**, 073001 (2023).
50. Josse, C. et al. in *Amazon Assessment Report 2021* (eds Nobre, C. et al.) Ch. 16 (United Nations Sustainable Development Solutions, 2021).
51. Pompeia, C. *Formação Política do Agronegócio* (Editora Elefante, 2021).
52. Busch, J. & Engelmann, J. Cost-effectiveness of reducing emissions from tropical deforestation, 2016–2050. *Environ. Res. Lett.* **13**, 015001 (2017).
53. Leal, C. G. et al. Integrated terrestrial-freshwater planning doubles conservation of tropical aquatic species. *Science* **370**, 117–121 (2020).
54. Strassburg, B. B. N. et al. Global priority areas for ecosystem restoration. *Nature* **586**, 724–729 (2020).
55. Balmford, A., Gaston, K. J., Blyth, S., James, A. & Kapos, V. Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. *Proc. Natl Acad. Sci. USA* **100**, 1046–1050 (2003).

56. Lessmann, J., Fajardo, J., Bonaccorso, E. & Bruner, A. Cost-effective protection of biodiversity in the western Amazon. *Biol. Conserv.* **235**, 250–259 (2019).
57. da Silva, J. M. C., Barbosa, L. C. F., Topf, J., Vieira, I. C. G. & Scarano, F. R. Minimum costs to conserve 80% of the Brazilian Amazon. *Perspect. Ecol. Conserv.* **20**, 216–222 (2022).
58. Garrett, R. D. et al. Explaining the persistence of low income and environmentally degrading land uses in the Brazilian Amazon. *Ecol. Soc.* **22**, 27 (2017).
59. Oliveira, G. & Hecht, S. Sacred groves, sacrifice zones and soy production: globalization, intensification and neo-nature in South America. *J. Peasant Stud.* **43**, 251–285 (2016).
60. Levy, S. A., Garik, A. V. N. & Garrett, R. D. The challenge of commodity-centric governance in sacrifice frontiers: evidence from the Brazilian Cerrado's soy sector. *Geoforum* https://doi.org/10.1016/j.geoforum.2024.103972 (2024).
61. *Bioeconomia no Brasil e no Mundo: Panorama da Produção Científica* https://www.cgee.org.br/documents/10195/6917123/CGEE_OBio_bol-tem-bio.pdf (Centro de Gestão e Estudos Estratégicos, 2021).
62. Londres, M. et al. Place-based solutions for global social–ecological dilemmas: an analysis of locally grounded, diversified, and cross-scalar initiatives in the Amazon. *Glob. Environ. Change* **82**, 102718 (2023).
63. Emperaire, L. *Povos Tradicionais e Biodiversidade no Brasil [recurso eletrônico]: Contribuições dos Povos Indígenas, Quilombolas e Comunidades Tradicionais para a Biodiversidade, Políticas e Ameaças* (eds Carneiro da Cunha, M. et al.) Seção 7 (SBPC, 2021).
64. Löfqvist, S., Garrett, R. D. & Ghazoul, J. Incentives and barriers to private finance for forest and landscape restoration. *Nat. Ecol. Evol.* **7**, 707–715 (2023).
65. Sellare, J. et al. Six research priorities to support corporate due-diligence policies. *Nature* **606**, 861–863 (2022).
66. Schilling-Vacaflor, A. & Lenschow, A. Hardening foreign corporate accountability through mandatory due diligence in the European Union? New trends and persisting challenges. *Regul. Gov.* **17**, 677–693 (2023).
67. Obura, D. The Kunming-Montreal Global Biodiversity Framework: business as usual or a turning point? *One Earth* **6**, 77–80 (2023).
68. Aubert, G. & Dudley, N. *Progress on implementing the Kunming-Montreal Global Biodiversity Framework* https://www.europarl.europa.eu/RegData/etudes/IDAN/2024/754196/IPOL_IDA(2024)754196_EN.pdf (European Parliamentary Research Service, 2024).
69. Sills, J. et al. Collaboration across boundaries in the Amazon. *Science* **366**, 699–700 (2019).
70. Carvalho, R. L. et al. Pervasive gaps in Amazonian ecological research. *Curr. Biol.* **33**, 3495–3504 (2023).
71. Bergamo, D., Zerbini, O., Pinho, P. & Moutinho, P. The Amazon bioeconomy: beyond the use of forest products. *Ecol. Econ.* **199**, 107448 (2022).
72. Ramcilovic-Suominen, S., Kröger, M. & Dressler, W. From pro-growth and planetary limits to degrowth and decoloniality: an emerging bioeconomy policy and research agenda. *For. Policy Econ.* **144**, 102819 (2022).
73. Varese, M. et al. in *Amazon Assessment Report 2021* (eds Nobre, C. et al.) Ch. 33 (United Nations Sustainable Development Solutions, 2021).
74. Villoria, N., Garrett, R., Gollnow, F. & Carlson, K. Leakage does not fully offset soy supply-chain efforts to reduce deforestation in Brazil. *Nat. Commun.* **13**, 5476 (2022).
75. Povos da Terra pela Amazônia. Declaração dos Povos da Terra pela Amazônia. https://asambleamundialamazonia.org/2023/08/08/povos-da-terra-pela-amazonia/#content (2023).
76. *Amazônia +10* https://www.amazoniamaisdez.org.br/ (FAPESP, 2024).
77. Ianova, A. In the Brazilian Amazon, solar energy brings light — and new opportunities. *Mongabay Environmental News* https://news.mongabay.com/2022/01/in-the-brazilian-amazon-solar-energy-brings-light-and-new-opportunities/ (4 January 2022).
78. Mapping International Cooperative Development Programmes. Agroemprende Cacao. https://micdp.coops4dev.coop/project/agroemprende-cacao (2019).
79. *The Amazonian Chakra, A Traditional Agroforestry System Managed by Indigenous Communities in Napo Province - Ecuador* https://www.fao.org/3/cc5031en/cc5031en.pdf (GIAHS/FAO, 2023).
80. Productive restoration programme, Restauramozônica, chosen by the JBS Fund for the Amazon. *Solidaridad* https://www.solidaridadnetwork.org/news/solidaridads-productive-restoration-programme-restauramazonia-chosen-by-the-jbs-fund-for-the-amazon/ (24 August 2021).
81. Freitas, C. T., Espírito-Santo, H. M. V., Campos-Silva, J. V., Peres, C. A. & Lopes, P. F. M. Resource co-management as a step towards gender equity in fisheries. *Ecol. Econ.* **176**, 106709 (2020).
82. Porro, R. & de Sousa, R. C. Anatomy of babassu-nut value chain for policy guidance in support of traditional agroextractive communities in the Mearim Valley, Maranhão, Brazil. *Rev. Econ. Socio. Rural* **61**, e263743 (2022).
83. Vicari, S. The cooperative as an institution for human development: the case study of COPPALI, a primary co-operative in Brazil. *J. Int. Dev.* **26**, 683–700 (2014).
84. de Oliveira, R. *Relações Interorganizacionais da Cooperativa Central de Comercialização Extrativista do Acre–Cooperacre*. MSc thesis, Universidade Federal de Rondônia (2016).
85. Maciel, R. C. G. et al. The valuation of environmental services in the price formation of native rubber in Acre. *Res. Soc. Dev.* **10**, e218101016163 (2021).
86. Silvestre Zottin, L. *The Environmental Performance of Footwear in an Eco-Friendly Company and Recommendations to Increase Sustainable Value Creation*. MSc thesis, Utrecht Univ. (2019).
87. Cheston, T. et al. *Seeing the Forest for More than the Trees: A Policy Strategy to Curb Deforestation and Advance Shared Prosperity in the Colombian Amazon* (CID Faculty Working Paper Series, 2023).
88. Levis, C. et al. Persistent effects of pre-Columbian plant domestication on Amazonian forest composition. *Science* **355**, 925–931 (2017).
89. Brondizio, E. S. et al. Making place-based sustainability initiatives visible in the Brazilian Amazon. *Curr. Opin. Environ. Sustain.* **49**, 66–78 (2021).
90. Story, O. Amazon and the Nature Conservancy announce launch of agroforestry and restoration accelerator. *Climate Action* https://www.climateaction.org/news/amazon-and-the-nature-conservancy-announce-launch-of-agroforestry-and-resto (7 September 2021).
91. Sawaya, A., Ferreira, N., Fiorini, R., Fantoni, R. & Gurlit, W. *The Green Hidden Gem – Brazil's Opportunity to Become a Sustainability Powerhouse* https://www.mckinsey.com/br/en/our-insights/all-insights/the-green-hidden-gem-brazils-opportunity-to-become-a-sustainability-powerhouse (McKinsey & Company, 2022).
92. Ferreira, J. et al. A lack of clarity on the bioeconomy concept might be harmful for Amazonian ecosystems and its people. *Ecol. Econ.* **224**, 108299 (2024).
93. Bemerguy, C., Figueiredo, C. & Simões, J. *Plano Estadual de Bioeconomia do Pará* https://www.semas.pa.gov.br/wp-content/uploads/2023/01/Plano-Estadual-V9_pg-simple-2-1.pdf (Portaria SEMAS, 2022).

94. Garrett, R. et al. *Policy Brief: Supporting Socio-Bioeconomies of Healthy Standing Forests and Flowing Rivers in the Amazon* https://www.theamazonwewant.org/wp-content/uploads/2023/08/230811-PB-Bioeconomy-EN-approved2.pdf (Science Panel for the Amazon, 2023).
95. Geels, F. W. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Res. Policy* **31**, 1257–1274 (2002).

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