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Amazonia in motion: Changing politics, development strategies, peoples, landscapes and livelihoods

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ABSTRACT

We review the often-invisible powerful processes that drive social and ecological change in Amazonia, and the diverse peoples who inhabit its landscapes. It explores large-scale development ideologies of modernization, and the policy tools that were deployed to carry them out. Outlining general periods of macro policy shifts, we show the evolution of the framework for today's complex interactions between large-scale agroindustry, mining, and hydrocarbons, and diverse small-scale livelihoods, as well as the clandestine and illicit economies of land grabbing, gold, coca and timber, and their operation in globalized and regional economies. While Pan-Amazonian governments have oscillated between authoritarian and democratic forms of governance since the mid-20th century, more democratic transformations and trade openings have led to interactions among a wide array of new civil society actors and international sources of funding. Integration into numerous globalized markets and finance have had enormous effects on Amazonian politics and economies at all scales. These dynamics have generated new kinds of policies, political framings, institutions, and economies, and restructured old ones, reshaped forms of urbanization, settlements, and land regimes, and stimulated extensive and controversial infrastructure development. On the ground, diverse Amazonian peoples who often suffer the impacts of these processes have continued to adapt to changing circumstances while fighting to advance their own proposals for alternative forms of Amazon conservation and development.

KEYWORDS: globalization; urbanization; clandestine economy; deforestation; dams; social movements

Amazônia em movimento: Mudanças políticas, estratégias de desenvolvimento, povos, paisagens e meios de vida

RESUMO

Revisamos os frequentemente invisíveis, mas poderosos processos que impulsionam as mudanças sociais e ecológicas na Amazônia, e os diversos povos que habitam suas paisagens. Exploramos as ideologias desenvolvimentistas de modernização e as ferramentas políticas empregadas em sua implementação na região. Delineamos os períodos de transição macropolítica e a evolução do marco para as complexas interações atuais entre o agronegócio, a mineração e a indústria do petróleo e os diversos modos de vida em pequena escala, assim como as economias clandestinas da grilagem, garimpo, coca e madeira, e sua operação a nivel das economias global e regional. Desde meados do século XX, governos panamazônicos oscilaram entre formas autoritárias e democráticas de governança, dentre as quais transformações mais democráticas e abertura econômica levaram a interações entre uma ampla gama de novos atores civis e fontes internacionais de financiamento. A integração em mercados globais e de finanças teve enormes efeitos sobre a política e a economia na Amazônia em todos os níveis. Essa dinâmica gerou novas diretrizes, marcos políticos, institucionais e econômicos, e reestruturou marcos antigos, remodelou formas de urbanização, assentamentos e regimes fundiários, e estimulou um extenso e controverso desenvolvimento de infraestrutura. Sobre o terreno, diversos povos amazônicos que frequentemente sofrem os impactos desses processos procuram se adaptar às circunstâncias cambiantes, ao mesmo tempo em que lutam para avançar suas próprias propostas alternativas para o desenvolvimento e conservação da Amazônia.

PALAVRAS-CHAVE: globalização; urbanização; economia clandestina; desmatamento; barragens; movimentos sociais

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INTRODUCTION

Far from being a homogenously forested river basin, the Amazon is full of diverse peoples and landscapes. These are often hidden from external communities that tend to see the region as a vast forest devoid of human inhabitants (Denevan 1992). People on the ground make a living from the forests, rivers and lakes, wildlife and trees, crops they grow and animals they raise after clearing the forest, and minerals and oil they dig from under the ground. They live in ranches, farms, mining camps, Indigenous territories, and villages – but mostly in the region's cities and towns, invisible in the wider public's imagination of the Amazon as an untouched forest or ravaged empty disaster zone. Meanwhile, politicians, businesses, environmentalists, researchers, and financiers exert their influence over the region, both local elites and those hidden from sight in cities and countries far removed from the forest itself (Baletti 2012; Pacheco and Benatti 2015; Gustafsson 2017; Bebbington et al. 2018b; Schmink et al. 2019; Klingler and Mack 2020; Brombacher and Santos 2023). Largely unnoticed, in recent decades Amazonian people's ways of living, the places they live in, and their quality of life have been transformed, swept up in nation-building projects, regional development initiatives and global development and absorbed into migratory flows to cities, towns and frontiers.

Powerful outside forces and their impacts interact in complicated ways with the complex circumstances in each different corner of the Amazon, where particular histories have evolved over millennia and continue to change, reflecting new opportunities and new migrations. To see Amazonian people, how and where they live, and how that is changing under the impact of large-scale deforestation, massive fires, land degradation, climate change, urbanization, and rapidly changing regional politics, and to clarify what forces and actors turned Amazonia into a region in crisis in terms of climate, species extinctions, and development inequalities and contradictions, this review sheds light on the major ideas, actors, and practices that have shaped its current dynamics. The review is derived from a chapter of the report produced by the Science Panel for the Amazon (https://www.theamazonwewant.org/). The aim of the report was to perform a scientific assessment of the current state of the Amazon and explore opportunities for policy relevant actions. Broad accessibility to this information is at the core of understanding the complexity of the Amazon basin and the urgency for conservation actions.

We begin with a section on development ideas, ideologies and modernization paradigms, discussing the macro ideas of development in the post war period and the politics that actively shaped the theoretical and political approaches to Amazonian transformation from the 1940s to the 1980s. We outline their emergent properties and large processes, as well as problems which remain largely invisible, not widely studied but major features of Amazonia's socio-economic and socio-environmental dynamics today.

We then focus on large-scale development policies that have changed Amazonian regional economies since the 1960s up to the present via large-scale infrastructure programs, settlement projects and national regional policies. These policies establish the framework for the economic, ecological and social dynamics that shape current processes of land use, settlement, urbanization, infrastructure, state expansion, globalization, new forms of investment and finance, as well as rising social movements in the region.

In the next section, we focus on what is usually called the neoliberal period that emerged after the 1990s as a more general global development approach. Enhanced structural changes in Amazonian economies accelerated the integration of Amazonia into regional, national and global economies as part of post-authoritarian neoliberal reforms. These included privatization of public lands and expropriation of commons; widespread deforestation including clearing of protected areas and territories of Indigenous peoples and local communities (IP and LCs); and significant expansion of infrastructure development and global markets for natural resources and agricultural commodities. While average human development indices have improved in

many areas (e.g., schooling, access to water and health care) through national programs such as the Brazilian basic income program (*Bolsa Família*), inequality has also increased (Richards and VanWey 2015; Costa 2023; Zapata 2023; Costa et al. 2024), especially during the COVID-19 pandemic that ravaged the Amazonian countries (Nacher et al. 2021).

To understand the differing national contexts and politics that reflect the wider role of Amazonia and its commodities in planetary politics and national economies, we then focus on emergent and often less-visible drivers, such as new forms of globalization, financing for projects and commodities, export dependency and clandestine economies. We also discuss emergent processes of urbanization, settlement patterns, and infrastructure development as new drivers and outcomes of socioeconomic change as well as increasing climatic and ecological vulnerabilities.

In the last section, we focus on Amazonian peoples and the complex livelihood systems they have developed over millenia in urban and rural settlements historically shaped by evolving livelihood systems in each part of the region and the complex migratory flows that have accompanied these changes. We highlight the often-overlooked growing importance of urban settlements and their linkages with rural economies and with multifaceted livelihood systems, as well as the emergent social movements that push back against current conservation and development policies to propose promising alternative paradigms for Amazon governance and sustainability.

MODERNIZATION AND ITS DISCONTENTS

Development and modernization paradigms

Amazonia, like much of the tropical world in the 1950s, was the object of "meta" thinking about development as processes amenable to and reflecting the reconstruction of Europe, Third World decolonization and the rise of development studies as a discipline and as practices (Rostow 1971; Furtado 1976; Cardoso and Faletto 1977; Cardoso and Müller 2008; Boianovsky 2010; Hirschman 2012; Unger 2018). The post-World War II (WWII) tropics seemed transformable from its existing systems of wealth and poverty into the modern world through transforming traditional social relations. The idea of development (or improvement, a more colonial term), implied the change from under-developed or traditional societies into a uniform kind of modernity, essentially urban, industrial, largely secular, and organized by laws, institutions and markets (Arndt 1987; Engerman and Unger 2009; Rist 2014; Unger 2018), a mirror of the North Atlantic world. This paradigm reflected bureaucratic states framed by nationalist identities and put into place to disrupt colonial administrations or societies largely structured by bonds of kinship, identity, patronage or tradition (Scott 1998).

The modernization paradigm involved a shift from relatively non-capitalist or traditional forms of society and institutions into modern economic social and political structures. Non-waged labor was substituted by waged and monetized forms, with emphasis on private property regimes and institutions over collective property. Structures, policies and economic mechanisms also were meant to shift from rural to urban, implying cultural changes in terms of individualization, secularization and new values and forms of consumption, leading to monetization and privatization of what had been collective resources, as well as industrialization (de Janvry 1981; Arndt 1987; Baer 2018). This modernization process depended on strong state intervention in the economy, spatial planning, technology development and many other social processes (Holston 1989; Scott 1998; Hall 2000; Holston 2009). Modernization was also seen as a mechanism to counter the unevenness of regional---especially agrarian--- economies within nations, as the sleek modernism of Latin America's urban capitals was regularly contrasted with imagery of abject poverty in its rural societies (Albuquerque 1999; Buckley 2017).

At least until the early 1990s this modernization paradigm was seen as the dominant way to resolve so-called "Third World poverty", understood as the expression of underdevelopment, through the powers of technocratic science and planning (Fearnside 1986a,b; Jasanoff 2004; Buckley 2017; Hecht and Rajão 2020). It was thought that regional inequalities and poverty could be overcome by accelerating economic growth and structural change. This, in theory, was argued to support developing state capacity and development institutions and moving beyond natural resource dependency as the central economic driver (Darwent 1969; Rist 2014; Baer 2018).

Development planning, programs and processes

The modernization vision involved instruments that had worked in rebuilding Europe via the Marshall Plan, and for poverty alleviation in the United States (The Tennessee Valley Authority (TVA) and the New Deal), focusing on zoning of natural resources, modernization of rural production, and infrastructures and hydropower development (Miller and Reidinger 1998; Ekbladh 2002; Ekbladh 2011; Buckley 2017) This technocratic approach fit well with both authoritarian and civil governments in the Amazon region in contrast to the more personalistic trajectories that characterized the first half of the 20th century (Burns et al. 1979; Skidmore 1986). The large-scale plans promulgated throughout the Andean and Brazilian Amazon mimicked the more general five-year planning models of Europe and the communist bloc. Scientific assessment of natural resources and land suitability served as guiding mechanisms in the development of resource and land capability zoning inspired by the large-scale river basin level resource planning model of the TVA. The bureaucratic states would expand their territorial presence within Amazonia as

a coordinated capitalist development planning "laboratory," and a bulwark against communism, a key concern in the Cold War period (Silva 1957; Manwaring 1968; Reis 1972, 1975; Becker 1982; Alves 1985; Martins and Zirker 2000; Klein and Luna 2017).

A second important strategy was that of "growth poles", inspired by the ideas of French economist Henri Perroux, defining sites of specialized investment and supporting infrastructure for Amazonia, accompanied by development corridors between specific poles and regions (Figure 1) (Perroux 1955; Mønsted 1974). Targeted social investment (agro-industrial and mining development, and later agrarian reform or its kindred programs) would be used to stimulate particular sectors which would then promote other economic linkages thus driving new types of regional development, as well as supporting and legitimating social programs such as agrarian reform efforts by the state (Richardson 1975; Furtado 1976; Kohlhepp 2001; Hite 2004; Rego and Meneguetti 2010; Buckley 2017).

In Amazonia, regional planners focused on the idea of national integration as the first step of what would become a larger concern with integrated planning and coordinating institutions. Brazilian military and US planners dreamed of similar transformations of Amazonia by means of a kind of tropical TVA (Hecht and Rajão 2020; Garfield 2013; Buckley 2017). The integration of the TVA approach with basin-wide scale and organization, and centralized management agencies for the regional growth poles such as SUDAM (Superintendency for Amazon Development) became the model for much of the planning in Amazonia, best exemplified by Ciudad Guyana and the huge Macagua dam in Venezuela (Angotti 2001; Irazábal 2004; Izaguirre 2015) and more broadly agricultural development through the Cordecruz agency in Bolivia, and the Corporación Araraquara in Colombia, as well as in Ecuador and Peru (Martine 1980; Smith 1982; Almeida 1992; Maki et al. 2001; Hite 2004; Pacheco 2009; Rego 2017; Fonseca 2022).

In these earlier modernization approaches, ecosystems were simply classed as natural resources, and the forest itself was often seen as an obstacle to development, a position that has continued to be repeated today. Ecological simplicity was created through land transformation, as diverse ecological and livelihood systems on which many Amazonians ---rural and urban--- depended, were cleared and burned. Much of Amazonia was mapped into large-scale grids and planning spaces to be occupied by ranching and colonist monocultures. This kind of modification depended on what anthropologist James Scott has called the "drive for legibility" by authoritarian modernist states (Scott 1998) and served the technical demands of agro-industrial monocrops and ranching landscapes (Oliveira and Hecht 2018; da Silva and de Majo 2021).

New technologies of large-scale assessment

The technocratic strategy involved *resource assessment* for new "rational" development planning. There were some cartographic endeavors in Amazonia during WWII by US

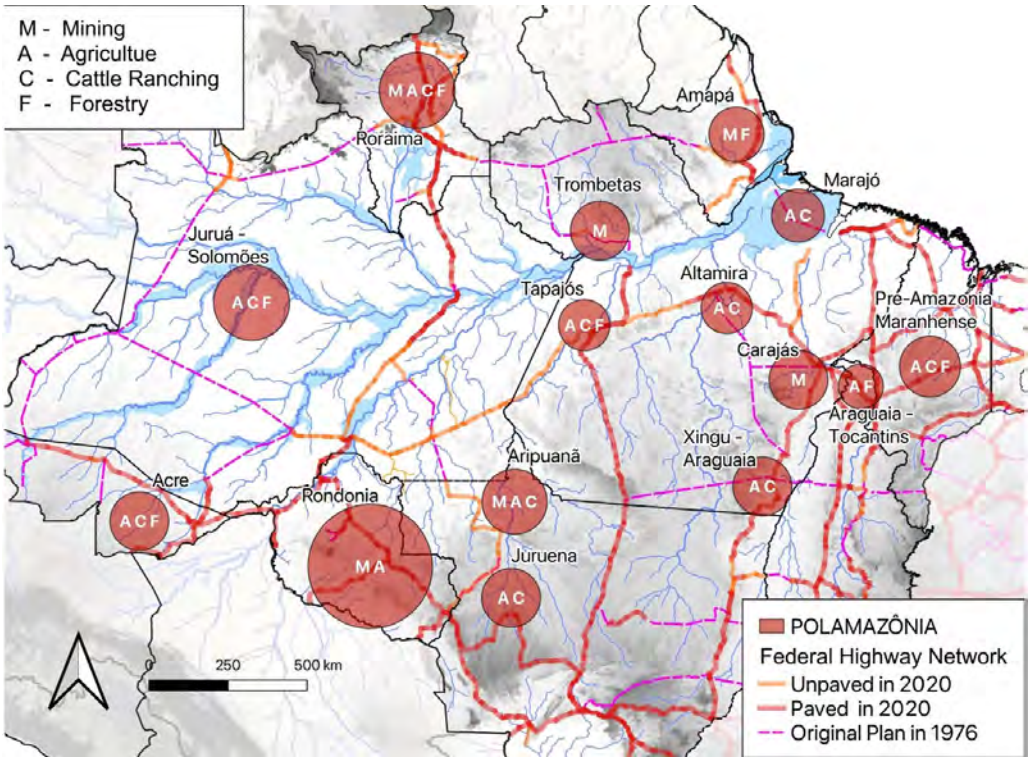

Figure 1. Growth poles in the Brazilian Amazon as part of the POLAMAZÔNIA program.

and Brazilian aircraft, but the scale and the frequent cloud cover required a new technology of remote sensing, beginning with the RADAM Project in Brazil in the 1970s. Initially, environmental questions were of limited relevance in the modernization discourse, except insofar as it related to the resource base, some issues of regional planning, and for designating a few remote national parks. Resource assessments such as RADAM Project were much more detailed, at much broader scale and largely focused on minerals, soils and forest types. RADAM examined the physical geography in order to upgrade the regional cartography of resources and boundaries to help guide growth poles, investment and agrarian reform settlement (Brazil 1973; Herrera Celemin 1975). Remote sensing was employed by the Brazilian military government as a strategy for Amazonian national integration projects and represented the largest peacetime use of this emerging technology at the time. The information gathered set the stage for the massive employment of remote sensing by all Amazonian countries, especially with the expansion of satellite remote sensing and computational capacities. In Brazil, world-class programs of remote sensing and monitoring of land-use change such as those of the National Institute for Space Research (INPE, *Instituto Nacional de Pesquisas Espaciais*) and the Amazon Large-scale Biosphere Atmosphere project (LBA) were instrumental in assessing and modeling the dynamics of Amazonian climate and impacts of large-scale land-use change (Soares-Filho et al. 2006; Batistella et al. 2009; Nobre et al. 2009; Betts and Dias 2010; de Goncalves et al. 2013; Miranda et al. 2019). The models developed from satellite data have become key in understanding the spatial dynamics of land-use change and its implications in the Amazon, forest fragmentation, and carbon dynamics for conservation and for development scenarios.

Remote sensing provided the data that ultimately fed into Amazonian development models and analytics. It also reflected the rise of the use of science in the Amazonian development ideologies and analytics, even if this did not always translate into practice. Satellite remote sensing became key in making land-use change and degradation visible and legible to policy makers and was increasingly important in making hidden processes more apparent. It also became an input into social mapping, and the ability to document large-scale changes became a key resource for social movements and Indigenous and traditional peoples' land demarcations.

Remote sensing projects like RADAM were unable to capture many aspects of human occupation, especially regarding traditional populations whose livelihoods based on extractivism, small-scale agriculture, bushmeat, and subsistence fishing largely transpired under forest canopies and at very granular scales. The remotely sensed images of a vast agglomeration of forest and land resources underscored the idea of a demographic void and, fundamentally, of an experimental space that fit into a centralized vision of regional development to be transformed as scientific, uniform, and ordered, underscoring a modernist vision of Brazilian and Amazonian development (Silva 1957; Silva 1967; Silva 2003; da Costa Freitas 2004; Jasanoff and Kim 2015). This dynamic resulted in a continuing contest for control of regional resources among local populations, the state, new investors and immigrants, and in new regional aspirations by local inhabitants for land, rights and citizenship, contesting the ambitions of more distant or wealthier coteries.

ISI and military modernization in Amazonia

Import Substitution Industrialization (ISI) was the main meta-policy framework for much of the mid-20th century period in the Pan-Amazon and throughout South America (Fishlow 1972; Weisskoff 1980; Tavares 2016; Baer 2018). The initial phase, exemplified by Brazilian president Juscelino Kubitschek's promise to modernize "50 years in five", included the first major Amazonian infrastructure project, the Belém-Brasilia highway, built in 1958-1960, becoming the prototype for the Trans-Amazon highway, which was part of the "highways of integration" of the strategic development plans by the military governments in Brazil (1964-1985) (Reis 1975; Fearnside 1980; Smith 1982; Cardoso and Müller 2008; Rupprecht 2011; Godar et al. 2012b). These infrastructure ambitions continued after the period of military rule in Brazil, shifting to the integration of pan-Amazonia into large-scale export corridors, as we discuss further on. At the same time, significant colonization projects were implemented in Brazil, Peru, Columbia, Ecuador and Bolivia, engaging state-run, private and spontaneous colonization, to stimulate territorial occupation, provide regional food supply and deflect demands for agrarian reform in already settled areas (Brazil 1976; Barbira-Freedman 1980; Becker 1982; Kohlhepp 2001; Intrator 2011; Godar et al. 2012b).

The colonist agricultural systems, initially based on rice production, were plagued by production and marketing problems, logistical difficulties, labor issues, agronomic failure, with problems of soil degradation and low yields, and the use of varieties and practices not adapted to local conditions. All these issues were exacerbated by titling insecurities, rural violence, and very high colonist attrition rates and turnover (Fearnside 1986c; Schmink and Wood 1992; Hall 2000; Fearnside 2001a; Murphy 2001; Caldas et al. 2007; Etter et al. 2008; Fearnside 2009a; Pacheco 2009; Perz et al. 2010; Godar et al. 2012a; Acker 2014; Carrero et al. 2020.

From the 1990s onward, these localized impacts as well as concerns about large-scale deforestation increasingly became international issues throughout Amazonia, as research expanded the understanding of the dynamics of standing forests, and the consequences of forest clearing at the local, regional, and planetary levels. The link of social issues of development with broader environmental concerns internationalized the controversies associated with Brazil's

Polonoroeste program, the paving of the Cuiaba-Porto Velho highway (BR-364), and the continuing problems concerning the Transamazon highway, as well as with active colonization zones elsewhere in the Amazons in Ecuador, Peru and Bolivia (Nicholaides et al. 1985; Diegues and Millikan 1993; Fujisaka and White 1998; Kaimowitz et al. 1999; Mertens et al. 2004; Barbieri et al. 2005; de Barros Ferraz et al. 2005; Browder et al. 2008; Bax et al. 2016). These controversies mobilized international environmental groups, human and Indigenous rights organizations, who allied with national environmental and social movements that, along with urban industrial unrest, corruption within the military, distress over torture and political killings, and the clamor for democracy, eventually undermined authoritarian regimes as democratization spread more widely (Schmink and Wood 1992; Luciak 2001; Hagopian and Mainwaring 2005; Zimmerer 2006; Hochstetler and Keck 2007; Schmink et al. 2019). Military developmentalism in Pan-Amazonia was variable, but entailed similar approaches. In most cases, the environmental problems, human rights abuses, other forms of repression and serious corruption problems, declining economic performance, and debt of the authoritarian regimes stimulated national mobilizations and alliances among actors of the civil society, including labor unions, and were instrumental in the region's rise to democracy and writing of new constitutions (Hecht and Cockburn 1989; Schmink and Wood 1992; Kingstone and Power 2000; Hagopian and Mainwaring 2005; Hochstetler and Keck 2007).

Our review of political economies of the 20th century and political ecologies of different interventions in the Amazon helps us understand what we might call "Amazon Ascendency", i.e.; how a backwater region has become a crucial asset in national economies, and an increasing driver of national social, economic and environmental policy issues beyond gross domestic product (GDP). These new concerns about legitimacy, social inequalities, and uneven patterns of development in the Amazon could be attenuated by multi-scale alternative programs to support both large and small-scale producers (Supplementary Material, Appendix S1).

These changes also ushered in a much more active period of civil society mobilizations, but did so under the shift to macro policies of neoliberalism: free trade, fiscal austerity, deregulation, privatization of state enterprises, and contraction of government spending. This shift was also associated with the rise of China and the "China Shock" in global economies including Pan-Amazonia, as a market, investor, and disruptor of national manufacturing industries (Casanova et al. 2016; Wesz Jr et al. 2023).This dynamic produced a renewed emphasis on raw materials and agricultural goods, often called "neo-extractivism" and increased economic dependence on export commodities (McKay 2017; Svampa 2019; Stallings 2024).

Transition, constitutionalism and early neoliberalism

The last decades of the 20th century are often used as a marker for the shift from authoritarian to nominally democratic politics and regimes in Latin America, although modernization ideas did not actually recede. Instead, new approaches were advanced with new scientific framings of environment, history, ethnography, and social movements that challenged the forms of technocratic orientation and planning models that had dominated Amazonian interventions for a generation. This meant the end of the ISI model of development, which had been highly centralized, focused on internal markets, urbanization and industrial expansion, and tariff and currency controls. Cronyism, human-rights violations and the marginalization of an emerging entrepreneurial class undermined the legitimacy of these kinds of rules and rulers (Guidry et al. 2000; Hochstetler and Keck 2007). This shift produced constitutional conventions, and an emphasis on more market-oriented, decentralized, privatized state sectors and economic austerity were demands required for international finance and early neoliberalism throughout the Amazon countries. The transitions to democracy also represented much broader openings to civil society in the construction of national constitutions. These would have far-reaching implications even if they became increasingly contested over the decades and changing contexts of Amazonian governance.

During the 1988 Brazilian Constitutional Convention, the articulation of inhabited landscapes as conservation spaces, and the idea of forest peoples as forest guardians and defenders gained salience, and was incorporated into land laws and the creation of legislative frameworks and institutional development for agro-extractivist reserves, sustainable development settlements, historical communities ---like *quilombos* (afrodescendent communities of former slaves) and their territorial claims, as well as better recognition of Indigenous land rights. Indigenous peoples and local communities successfully pushed for conservation approaches, laws, and institutions that recognized the important role of historical Amazonian populations in both creating the Amazon's ecological complexity and protecting forested landscapes (Balée and Erickson 2006; Nepstad et al. 2006; Vogt et al. 2015; Levis et al. 2018; Maezumi et al. 2018; Montoya et al. 2020; Brondizio et al. 2021a; Levis et al. 2024).

New ways of thinking about the role of Amazonian forests emerged in global and regional climate dynamics, environmental services, expanded ecological economics, recognition of the rights of nature, and concerns over environmental and ecological justice (Conklin and Graham 1995; Nogueira et al. 2018a; Marengo et al. 2018; Marengo et al. 2022). This was matched by new forms of activism throughout Pan-Amazonia and constitutions that reflected enhanced questions about forms of development, such as

advancing the ideas of Buen Viver ---"living well" with dignity and justice rather than simply economic ideas of economic growth. In addition, questions of Indigenous and local knowledge as well as participatory research practices involving local populations opened up alternative ways of engaging with existing and new processes (Heckenberger, 2013a; Schmink et al. 2019; Hill et al. 2020). In addition to new constitutions, this period saw the creation of new national environmental agencies, the emergence and institutionalization of the idea of socio-environmentalism, and radically reconfigured Amazonian conservation strategies (Nunes et al. 2016; Davenport et al. 2017; Rajão et al. 2017; Sparovek et al. 2019); Berenguer et al. 2024). Socio-environmental politics that recognized the rights of consultation and historical territorial rights of traditional and Indigenous people are now part of the constitution of every Amazonian country, as well as concepts like the rights of nature, the idea of environmental crimes and a substantive recognition of the conservation value of inhabited landscapes.

The hidden processes of Amazonian transformation

One central problem in understanding Amazonia is that of invisibilities. Partly this reflects the historical and political description of the region as *terra nullius* –empty lands--- and the invisibility of forest dwellers of many kinds. Producers of goods that did not necessarily circulate widely outside of Amazonia, or, like *quilombos* who had traditionally used secrecy as a means to avoid re-enslavement or who were part of obscure supply chains such as for gold, reinforced the invisibility of many Amazonian inhabitants (Nugent 1993; Harris and Nugent 2004; Brondizio 2009). Many invisibilities are associated with socio-economic systems, i.e., illicit economies (timber, gold and coca) and land grabbing, which generate high economic value, and significant social and environmental costs. Invisibilities are also associated with informal economies and precarity i.e., exchanges in kind, in informal market, the use and subsistence value of forests and rivers to local populations, and the large-scale flows of populations as they travel in daily, periodic and seasonal movements in the shaping of their livelihoods, especially given the high degree of insecurity that prevails in Amazonian livelihoods. There also are the invisible costs of many population displacements associated with enclosures, land seizures, infrastructure development and violence (Bratman 2014; Fearnside 2014; Atkins 2017; Ioris 2017; Randell 2017; Calvi et al. 2020).

Other invisibilities are related to environmental impacts, including the environmental consequences of Amazonian land -use transformations such as hydro-bio-climatic changes at the continental scale through the shift in atmospheric rivers, and the role of Amazonia in the global climate and its impact on South American climates and carbon dynamics (Steffen et al. 2018). The extensive forest degradation, which is difficult to assess from remote images, now rivals deforestation in area and underpins the extensive fires under drought conditions and produces other regional, national and global impacts such as changing rainfall patterns, increased ecological fragmentation and enhanced vulnerabilities to fires that may have pushed Amazonia past tipping points (Aragão et al. 2008, 2018; Longo et al. 2020; de Faria et al. 2021; Flores et al. 2024). Finally, there are the invisible and ultimately incalculable. ecological and social costs of corruption, resource theft and speculation, and the costs of the loss of cultural diversity, knowledge and value systems that have been central to maintaining ecosystem integrity and historical livelihoods in the Amazon.

Informal institutions, tradition, and tenurial regimes also operate in ways that are often invisible to outsiders but obvious and trenchant in the operation of daily lives in much of Amazonia. "New" social mapping elaborated by local communities is now being used to reveal forms of rural and urban ecological resources and territories (Sauer and Almeida 2011; Mere-Roncal et al. 2021; Tebbutt et al. 2021; Carrión and Pérez Albert 2022). Among the most dramatic of these has been the discovery of the extent of *quilombolas* (Gomes 2005; Bargas and Cardoso 2015; Rosero-Peña 2021). Other ubiquitous, but largely invisible populations are the "*caboclo*" river dwellers, lake-side dwellers and fisherman, forest collectors and swidden cultivators, omnipresent since the first descriptions of Amazonia (Harris and Nugent 2004; Brondizio 2009; Silva 2009), as well as multi-sited households who migrate between rural holdings and work opportunities and urban areas (Sears et al. 2007; Padoch et al. 2008; Brondizio et al. 2011; Eloy et al. 2015; Vogt et al. 2015; Futemma et al. 2020). In spite of the overarching image of Indigenous people as rural, about 25% of Indigenous populations are at least part-time urban residents (Alexiades 2009; Eloy and Lasmar 2011; Sobreiro 2014; Campbell 2015a,b; Nasuti et al. 2015) relying on urban access for markets, communication, education, health access and political organization.

Subsidy from nature

A significant factor in life and livelihoods in Amazonia is the importance of the "subsidy from nature". These subsidies include support for small scale livelihood activities that can be for subsistence or small scale commerce such as fisheries and forest products like babaçu and açaí palms that are freely collected. In many cases this "no cost" subsidy for smallholders involves landscape and habitat resource management, and can reflect the use of "legacy" landscapes elaborated from earlier engagements in the structuring of forests, as in the case of Brazil nuts (Pärssinen et al. 2021). This involves deploying knowledge and labor inputs to support semi-domesticated and wild species that are often taken to be "wild resources". The subsidy provided by collected goods amounts to about a third of people's income, a result that for small-scale forest collectors is remarkably widespread. This means that typical ways of looking at rural and urban livelihoods often overlook the importance of collected goods in the economic

portfolio (Brondizio et al. 2021; Coomes et al. 2010; Brondizio et al. 2011; Eloy et al. 2015; Padoch et al. 2008; Vogt, 2015).

The idea of the "subsidy from nature" has other meaning as well. It can reflect externalities, through the simple extraction of value from nature with no attention to replacement costs, mediation or remediation of environmental and social effects, or of impacts on ecosystem trajectories at local, regional and planetary scales. In these cases the "subsidy" is a kind of plunder in which the real costs of the extraction---including ecological costs--- are not included in the price. For example, simple destructive commercial logging with no remediation or replanting involves capturing and monetizing a resource embedded in ecological processes, incarnated in wood, without incurring any costs of the reproduction of the resource. In complex systems like Amazonia, while there are costs of logging (roads, trucks, labor), the timber resource itself - the main source of value - is often collected at no or little cost to loggers, or through corrupt capture of concessions, in contrast to other kinds of formal forestry and land-use systems (Duchelle et al. 2011).

A more general subsidy from nature is the value of ecosystem services, which remains variable and controversial. Robert Costanza pioneered this field (see for example Costanza et al. 2014), and more recently there have been attempts to place at least a value on carbon in developing REDD+ (Reduced Emissions from Deforestation and forest Degradation) as part of climate offsets and more general climate and conservation policies and politics (Correa et al. 2019; Brouwer et al. 2022). Valuation exercises are almost a genre in Amazonian studies, with results highly dependent on forest type and resources (Strand et al. 2018). Meta-analyses of published estimates of the value of ecosystem services placed them in a range from about 400 USD/ha to more than 3,175/ha with very high variance between different sites. The total value of carbon currently being used in climate negotiations places the value at between 5 and 15 UD dollars per ton.

Path dependency

Socio-economicpath dependence is a concept in the social sciences that refers to processes in which past events or decisions constrain later events or decisions and conditions of possibility in the present and future. In the case of Amazonia, dynamics of destructive land uses and economies can have enduring, historically mediated outcomes on landscape structures, biodiversity patterns, livelihood and other economic potentialities, hydrologies and biophysical/climate dynamics, and a range of unknown outcomes. The enduring influence of path dependency involves embedded institutional, political, and economic commitments to a particular socio-technological regime, or, in the case of Pan-Amazonia, particular agroindustrial, mining or ranching technological landscapes, with considerable barriers and high costs of replacements.

For ecological and environmental reasons, such landscapes may involve not just political/technical regimes, but may produce what might be called "quasi-irreversibility" because ecological changes can undermine ecosystem functionality and resilience. These changes are reflected in effects such as the deflection of successional pathways, soil toxins that limit re-establishment of local species, soil compaction, and the impacts of ecosystem fragmentation, local extinctions, and barriers to recuperation, to mention just a few. These can produce degraded lands that are usually very expensive to recover, and provide the background of scrubby brush visible next to every roadway in Amazonia (Laurance 2002; Laurance et al. 2002; Laurance et al. 2018).

These ecological changes can align with political blockages or institutional barriers that can limit the capacity to support more resilient and/or complex social or ecological states. Land- use decisions and practices can preclude other options and development paths because they are so transformative of the natural base of production and/or the institutionalities that support them, or the people involved with them who, due to land/resource constraints, as well as power dynamics such as violence, may migrate away to towns or other rural areas. If the underlying ecological and biophysical structures are destroyed and resources are depleted, there may be no possibility of return to previous states, and the system itself passes a tipping point and enters into a different state. Given the dynamics and structural rigidities of current development trajectories, the questions of tipping points becomes a real concern (Marengo et al. 2011; Lovejoy and Nobre 2018).

OLD PATHWAYS, NEW DRIVERS (2000-2020)

Politics during the 2000-2020 period reflected the integration of many emergent factors that stimulated new social, institutional and political structuring. The response to these complex pressures and changes was not uniform in Pan-Amazonia, but it produced new ideologies and strategies that moved beyond both the traditional conservation modes and standard development frameworks. The importance of new forms of land rights for Indigenous peoples and local communities, especially afro-descendants, forest product extractors, river and lake communities, and others legitimized by long historical occupation, created both cultural and political spaces, a kind of forest citizenship (Supplementary Material, Appendix S2). In Bolivia and Ecuador, ideas of the Rights of Nature (the Pachamama) and ways of living (Buen Viver) focused rather on well-being than on accumulation were incorporated into their national constitutions and political language. Yet, while socio-environmentalism increasingly influenced Amazonian policy, macro-development economic policies associated with neoliberalism worked against these approaches through their deregulatory stances, limitations on state actions, privatization, extensive national opening to

international investment, political decentralization, and tariff-free trade, and often enhanced the usually unequal power and economic relations (Simmons et al. 2007; Aldrich et al. 2012; Guedes et al. 2012; Carrero et al. 2022).

The neoliberal period in Amazonia coincided roughly with growing Chinese and European engagement and investments in the economy, including a "China/Asia shock", as inexpensive high-quality Chinese and other Asian-manufactured imports undermined many national industries, and China and the EU became more involved in the economies of the Amazonian countries. This was also reflected in accelerated demand for raw materials, especially minerals, soy and beef (de Waroux et al. 2019). Instability in the manufacturing sectors triggered a more erratic policy context, and shifted the ideas of the economy away from what had been import-substitution thinking, to export-led development based on raw or minimally processes materials, later called the "commodity consensus" (Svampa 2019), or "neo-extractivism" (Burchardt and Dietz 2014; Guerisoli and Mandirola 2022). This expansion coincided with a commodity boom largely led by demand from Asia, and also a dynamic of increased national and global environmental concern, as environmental justice issues animated local politics (IP and LC, including afro-descendent communities, whose lands and livelihoods were increasingly threatened). These dynamics were reflected in greater activism in both rural and urban domains, and pressure for social investments and new institutions for socio-environmental support at national as well as local levels. This produced a shift into a development regime of "neo-extractivism" which involved continuing export expansion while engaging fiscal transfers to be used as a means of poverty alleviation, such as the *Bolsa Familia* program in Brazil, and other conditional cash transfers found throughout Latin America, a social transfer that provides a guaranteed income to mothers conditioned on children's schooling and child vaccination. These transfers as well as funded retirements, increased minimum wages and expanded social services were largely associated with the President Lula regime in Brazil, which originated the "*Bolsa família*".

In this context, "socio-environmentalism" represented a rethinking of the nature of conservation, which could include inhabited environments of many kinds oriented to sustainable and resilient forms of development (Allegretti and Schmink 2009). Because of its environmental and social justice components, as well as the increased international concerns over climate change and deforestation, international conservation and environmental activists began large-scale investments oriented to addressing the idea of maintaining standing forests, as social as well as biotic places. This represented novel forms of rural investment that went well beyond the production credits previously provided for small farmers. These macro-changes in the development models had significant policy impacts throughout Amazonia, but perhaps the most closely studied has been the Brazilian case, where important policy changes led to dramatic declines in deforestation after a peak in 2004, and a subsequent new increase after policy reversals since 2016 (Figure 2).

Annual deforestation rates in the Brazilian Amazon dropped by 80% from 2005 to 2012, due to commodity price decreases and unfavorable currency exchange rates, policy interventions, significant institution development at local and national levels, wide participation of civil society in sustainable development initiatives, voluntary market agreements, expansion of protected areas, international support for forest-based initiatives such as the Pilot Project for the Amazon, much better monitoring of deforestation, and significant "leakage" (displacement of major deforestation processes) to zones of cerrado savanna in Brazil, and to Bolivia and the chaco of Argentina), which all aligned to reduce Amazonian clearing in Brazil (Fearnside 2007; Hecht 2012; Hecht 2014a; de Waroux et al. 2016; Davenport et al. 2017; Duchelle et al. 2017; Lambin et al. 2018; Nogueira et al. 2018a; de Waroux et al. 2019; Silva et al. 2020). Nevertheless, by 2014, with the impeachment of President Dilma Rousseff in Brazil and the emergence of a powerful agribusiness coterie (the *bancada ruralista*), deforestation began to climb. By 2019 the annual deforestation rate in the Brazilian Amazon had increased by 122% since the low point in 2012 (Carrero et al. 2020), and the numbers continued to increase throughout 2020, 2021, and 2022.

The current development model of neo-extractivism in Amazonia with minimal diversification of the main export sectors has been usefully summarized by McKay (2017): (1) large volumes of materials extracted, destined for export with little or no processing; (2) value-chain concentration and sectoral disarticulation; (3) high intensity of environmental degradation; and (4) the deterioration of labor opportunities and/or conditions. Agrarian extractivism is a politically and analytically useful concept for understanding new landed dynamics and trajectories of agrarian change, which lacks the value-added processing, sectoral linkages, and employment generation that rural investments and subsidies were supposed to provide.

New circuits of globalization

Since the 2000s, global markets, rather than the earlier internal development strategies, have increasingly driven land-use processes in the Amazon. In particular, global markets for timber, pulp and paper, meat, drugs, oil, gold and oilseeds have accelerated transformations of the Amazon basin. More industrialized countries have off-shored their environmental footprints toward the Amazonian region, with the expansion of oil palm for biofuels in the Netherlands, soy for China and the EU, and beef for Asia and the US (Rudel 2007; Austin 2010; Klinger 2018).

While certain forms of agro-industrial production can generate development where they involve value-added processes (Richards et al. 2015; Richards and VanWey

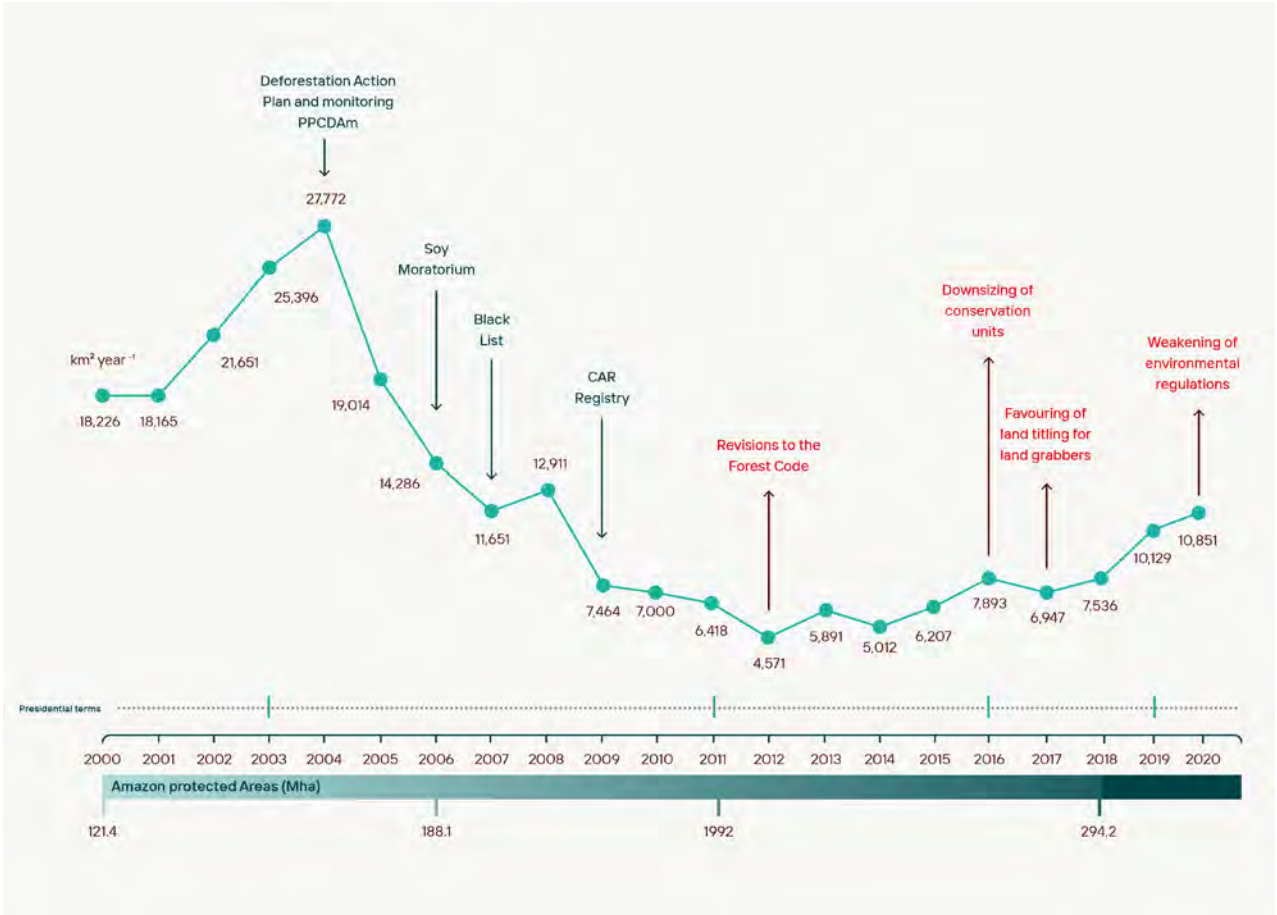

Figure 2. Deforestation in the Brazilian Amazon in response to policy changes from 2000 to 2018. Adapted from: PRODES 2020, Soares-Filho and Rajão 2018.

2015; Garrett and Rausch 2016), they generally perform poorly in terms of generating increased employment and improved access to services, and tend to exacerbate inequality (Weinhold et al. 2013; Sauer 2018). In this same way, model municipalities emerged as nodes in the evolution of a governance frontier in the Amazon, advancing a neoliberal paradigm that replaced more direct democratic measures (such as participatory budgeting) with municipal governance that regulated and stabilized 'green' agro-industrial development (Schmink et al. 2019).

Amazonian financialization

An important new aspect of Pan-Amazonian dynamics at the end of the 20th and beginning of the 21st century was the transformation of the financial sector in the Amazon. The role of South American development banks and state-owned commercial banks decreased in providing loans and investment capital for agriculture, agroforestry, timber and other forest product extraction, mineral extraction, and even infrastructure construction. New private financial actors started to play an increasingly larger role in production, consumption, and conservation practices. This included not only greater participation of private commercial bank lending in the region, but also, and even more important is the role of new financial actors such as hedge funds, sovereign wealth funds and pension funds, and new domains of direct foreign investment from China as well as new financial instruments, in shaping the development trajectories and historical geography of the Amazon (Bebbington and Bebbington 2011; de Castro and Castro 2022). By 2021, illegal Amazonian land was being sold on Facebook and digital technologies of geolocation for land registry (CAR, *Cadastro Ambiental Rural*, a self reported GIS protocol) had come to play an important role in facilitating illegal land. The grabbing and market transactions (Bebbington and Bebbington 2011; de Castro and Castro 2022; Davis et al. 2014; Grajales 2015; Ferrante et al. 2021; Kruid et al. 2021; Carrero et al. 2022).

In agricultural production and ranching, state-owned commercial banks (such as *Banco do Brasil*) were the most important financiers of agriculture and ranching in the Amazon until the 1980s (Torres 1996). But as soy monocultures expanded in the southern Brazilian Amazon during the 1990s, particularly over the degraded pastures cleared from the Amazon forest in the states of Mato Grosso, Rondônia, and Pará, farmers

started to rely increasingly upon seed and agrochemical trading companies such as Monsanto, Bunge and others for credit, often pre-negotiating a third or more of their future harvests at the moment of purchasing their inputs for the year (Wesz Jr. 2016). In turn, this financialization of agribusiness trading companies provided them with more dynamism in generating profits, and even in making speculative gains from commodity trading and farmland investment (Salerno 2017). This process unfolded alongside the deregulation of the banking sector in South American economies since the 1990s (Studart 2000) and the rise of private equity funds, hedge funds, local investment circles and investment banking worldwide (Wójcik et al. 2018), which began to see natural resources and agribusiness in developing countries (particularly those with potential for growth, such as Brazil) as ideal targets for investment (Visser et al. 2015). Consequently, when soy displaced ranching in the southern fringes of the Amazon (especially in Mato Grosso state), private equity funds, pension funds, and other new financial actors became the leading providers of capital (both from South America and beyond the region) to large-scale land development and farm management companies (Oliveira and Hecht 2016).

Similar transformations have taken place with regard to finance for infrastructure construction, including not only roads and ports, but also, very significantly, hydroelectric dams in the western Amazon (Ecuador, Peru, and Bolivia) and in the eastern Amazon (Brazil's Tapajós and Xingu basins). Many of these infrastructure projects involving Brazilian construction companies, especially the transnational giant Odebrecht, were recently swept up in corruption scandals that reached into other Amazonian countries, toppling governments in Peru, Bolivia, Ecuador and Brazil (Branford 2016; Zysman-Quirós 2019; Campos et al. 2021; Jacopo 2022). Historically, large-scale infrastructure projects have been financed by state-owned or multilateral development banks, among which Brazil's National Economic and Social Development Bank (BNDES) has played an outsized role in the region, including in neighboring Pan-Amazonian countries such as Peru, Ecuador, Colombia, and Venezuela (Hochstetler 2014; Rivasplata Cabrera et al. 2015).

There has been a notable shift in international development finance away from the Inter-American Development Bank (BID) and the World Bank (WB) towards the China Development Bank and the China Export-Import Bank (Ray et al. 2019), in part because of the limited environmental or social conditionality on their loans. The latter are newcomers not only to the Amazon, but also to the realm of international development finance, and so there has been concern that the entrance of Chinese development banks may destabilize perceived gains in the best practices for environmental protection and social responsibility adopted by the BNDES, IDB, and WB (BankTrack and Friends of the Earth 2012; Dussel Peters et al. 2018).[1]

Chinese finance is more responsive to government-to-government articulations and national-level policies than to bottom-up social movement and non-governmental organization (NGO) interventions (Ray et al. 2019). Consequently, this shift in an important origin of development finance for large-scale infrastructure construction transformed the power balance among Amazonian actors, empowering national elites, state agencies in charge of contracting, and other actors outside the Amazonian region who might benefit from those infrastructure construction projects, while avoiding the direct negative effect of these projects, and seemingly weakening the relative strength of Amazonian Indigenous peoples, social movements, and NGOs in the face of such mega-projects.

In this way, China is becoming a major force in Amazonian deforestation and environmental degradation (Fearnside et al. 2013; Fearnside and Figueiredo 2016) and is now the main trading and lending partner in Amazonian Latin America. However, in the face of serious environmental governance problems, recent years have seen the emergence of much stronger environmental and resistance movements, especially by Indigenous groups. In Brazil this was reflected in the creation of a new Indigenous agency under the Lula government (Ministry of Indigenous affairs), in the success of the Yasuni referendum in Ecuador (spearheaded by Indigenous populations) on keeping the oil in the ground, and the continuing activism against road building by Bolivia's TIPNIS (Rival 2010; Sovacool and Scarpaci 2016; Hirsch 2019; Hope 2021).

In terms of conservation funding, the Amazon Fund has become the world's largest deforestation control financial instrument, and a lynchpin of the strategy of mobilizing finance and trade mechanisms for reducing emissions from deforestation and forest degradation (i.e., REDD or REDD+) and various sustainable development pilot projects and land-use monitoring. Nonetheless, the implementation of REDD+, and the activities of the Amazon Fund more broadly (including mechanisms for monitoring and calculating deforestation and emissions), and the economic quantification of these processes, have fallen under intense scrutiny and heated debate (van der Hoff et al. 2018; Correa et al. 2019; Pinsky et al. 2019) with significant accusations

1 This is somewhat ironic given the troubled history of BNDES sustainable development lending in the Amazon (Gallagher and Yuan 2017), even as recently as the 2000s, with the high-profile disputes about the Belo Monte dam on the Xingu River (Diamond and Poirier 2010; Bratman 2014). The rise of Chinese development finance has been accused of provoking a "race to the bottom" in international standards and perceived best practices (Gerlak et al. 2020). The lack of concern for impacts is illustrated by the 2014 Chinese purchase of a 33% interest in the notorious São Manoel Dam in Mato Grosso, located only 700 m from the Kayabí Indigenous Land, where the Indigenous people were not consulted (in violation of Brazilian law and International Labour Organization (ILO) Convention 169). The São Manoel reservoir was filled in 2017, despite multiple licensing irregularities, and it is the scene of continuing tensions with the Indigenous people it impacts (Fearnside 2020).

of corruption in one of the major carbon brokers (Greenfield 2023). Beyond technical questions about how to monitor and measure deforestation, degradation, and carbon emissions/sequestration, and how to calculate these phenomena in economic terms (Fearnside 2012a,b), the most important debates pertain to the political struggle over who sets the terms for and benefits from development in the Amazon (Corbera 2012; Mahanty et al. 2013; Klinger 2018). These political tensions became especially clear in 2020 as European donors withheld funds for the Amazon Fund due to the rising deforestation under Brazil's Bolsonaro government, which publicly rejected the idea of other nations imposing conditions on Brazilian Amazon policy, and the increased tensions over Mercosul agreements as a function of rising deforestation (Garrett et al. 2021; Risso et al. 2022).

Clandestine economies

Clandestine economies emerge alongside, and converge with, regulated, lawful and formalized economies. Working in the economies of gold, timber, and coca is often part of a livelihood strategy for many people in Amazonia, both urban and rural. These economies form part of a portfolio that works in tandem with larger household livelihood approaches in agriculture, urban or rural waged labor, petty commerce and forest products, coupled with family cash income from formal sources like conditional cash transfers, retirements, and remittances. As we will discuss below, both rural and urban incomes exhibit a high degree of precarity, and this is also reflected in the relatively high number of workers in these illegal activities, at least periodically. All these types of income subsidize the relatively low wages and returns paid in all the livelihood sectors for relatively unskilled labor. The expansion of clandestine economies reflects new technologies, expanded transport infrastructure, new geolocation technologies, new or expanding markets, as well as failed national development policies that produce few other income opportunities (de Jesus et al. 2001; Hoogbergen and Kruijt 2004; Gootenberg 2017; Gootenberg and Dávalos 2018; Kolen et al. 2018; Cortes-McPherson 2019; Mestanza-Ramón et al. 2022). In addition, these economies are increasingly under the management of organized crime especially for coca, timber and gold (Phillips and Watts 2023).

Legal and illegal systems often operate side by side, melding into each other in both space and products, as in the timber industry. Illegal land acquisition can be laundered through livestock, fake titles, and land clearing amnesties or even sold on the internet. Traditional land tenure and access regimes held by communities often had limited legal standing if not demarcated under new laws and are currently still threatened by time of occupation legislation in Brazil, the "Marco Temporal". Community lands frequently are legally appropriated in spite of their new constitutional legal status, especially quilombola lands where only 4% have obtained legal recognition (Hatzikidi 2019; Shore 2022; Rios and Miranda 2024). The long history of fraudulent land grabbing in Amazonia often depended on simple forged documents, or failing that, setting fire to land registry offices, or simply using violence to intimidate or kill occupants (Schmink and Wood 1992; Grajales 2015; Sosa Varrotti and Gras 2021; Carrero et al. 2022; Costa 2023).

The revenue generated from clandestine economies is substantial -- for example, the U.N. estimates the coca economy at about USD half a billion globally (UNODC 2024) but returns often carry severe environmental damages and social costs and may or may not produce much by way of local development linkages over time. A recent study by the policy institute Escolhas comparing municipalities with and without gold-mining, showed that the economic impacts and well-being were highly ephemeral, since for many of these goods, the processing, other forms of elaboration (smelting, jewelry), and the main lucrative markets and processing occurred elsewhere. The commodity value increases with the distance from the site of production, as is so typical of Amazonian commodities (Escolhas 2020). The combination of rural and urban precarity has made engagement in clandestine economies increasingly attractive and necessary given the limited alternatives. In this context, the emergence of organized crime in Amazonian is not surprising, and indeed, in countries like Ecuador, Mexican cartels, and Albanian mafias have transformed the country into a narco state.

Gold

Peru is the largest gold producer in Latin America and the seventh largest in the world. Yet, over half of Peruvian gold is extracted by unregulated artisanal and small-scale gold mining (ASGM) operations (Caballero et al. 2018; Rodrigues 2019), and significant proportions of the gold extracted in Amazonian countries are extracted illegally (Table 1). Virtually all the gold mining in the Madre de Dios region of Peruvian Amazonia is informal, in violation of state environmental and labor regulations, which essentially criminalizes all small-scale mining despite its importance for livelihoods in the region (Bird and Kauer 2017).

Mining is responsible for about 10% of deforestation in the Brazilian Amazon (Soares-Filho and Rajão 2018). Mineral soils that underlie tropical forests of the Amazon basin contain

Table 1. Proportion of national gold production considered as 'extracted illegally' in different Amazonian countries.

Country	Gold production (%)
Brazil	36
Peru	28
Bolivia	30
Ecuador	77
Colombia	80
Venezuela	80-90

diffusely distributed gold deposits. Extracting this gold, which requires a combination of forest removal, soil pit mining, and the use of liquid mercury, poses a major threat to Amazonian biodiversity, water quality, forest carbon stocks, and human health (Diringer et al. 2019).

Relatively limited and controlled exits points, such as gold through Lima, have now been reconfigured to move almost entirely though Amazonia. This regionalization of the Peruvian ASGM trade reveals the flexibility of the gold production system, and particularly ASGM, in reacting to pressures emanating from the Peruvian state to eradicate illegal mining. This leakage mimics in many ways the shift of soy to less-regulated venues. The Global Initiative Against Transnational Organized Crime (2016) notes that illegal gold mining is rapidly spreading across the Pan-Amazon, a position borne out by the monitoring of Mapbiomas (2023).

These mining systems are organized in multiple ways, including cooperatives or semi-cooperatives in the "*Garimpeiro* Reserve" in Pará and Mato Grosso, Brazil, and legal mining reserves in part of Peru, mines managed by Maroons in Surinam or elsewhere by Indigenous groups, and through debt peonage and other forms of forced labor as well as waged labor or product payment (Asner et al. 2013; Caballero et al. 2018; Cortés-McPherson 2019). Gold mining provides an important complement to people's livelihood systems and has also provided a form of economic upward mobility for some (Cleary 1990; Escolhas 2020). Miners often become politically active in defense of the practices, and have in some cases made arguments in favor of informality and its redistributive and access features, compared with large-scale formal mining that often involves large international mining companies and state subsidies (Schmink and Wood 1992; Bebbington and Bury 2013; Bebbington and Bebbington 2018).

In the realm of precarious states and illegal extraction, Venezuela deserves special mention. The Orinoco Mining Arc (*Arco Minero*) is the product of a national policy established in 2012 that initiated operations in 2016 (Rendon et al. 2020). El Callao, a historical gold mine (begun in 1853), was exploited by the formal mining company Minerven since the 1970s. With the economic crisis, the mine stopped working and was taken over by informal armed groups as well as the Venezuelan military. Armed forces controlled the *Arco Minero*; they extorted illegal miners and controlled commercial routes. Planes took minerals to international markets (Caribbean via Curaçao, taking advantage of the free trade zone). Indigenous communities were forced into labor (mining or prostitution), but the mine itself was also the attractor for a desperate diaspora from other parts of Venezuela. While the Yanomami were periodically given respite and Brazilian miners expelled from their land, the Venezuelan situation remained complicated, especially in light of the precarity of the state itself. Illegal mining can affect Indigenous groups through direct land invasion, but also through the contamination of fish and aquatic birds, a major source of protein in many Amazonian communities and through the impacts of mercury vapor on the forest itself (Alho 2008; Nevado et al. 2010; Siegel 2013; Gerson et al. 2022; Pestana et al. 2022; Keane et al. 2023).

Land grabbing

In Brazil, land grabbing is known as *grilagem*, involving land claiming through showing effective use (Supplementary Material, Appendix S3). For centuries it has been a major part of Brazil's land-tenure practice by large actors, as well as invasion and later legalization by small homesteaders (*posseiros*) through various systems of traditional land recognition (Schmink and Wood 1992; Moreno 1999; Benatti et al. 2006). The 54 to 65 million hectares of undesignated lands (*terras devolutas*) in Brazil are the major targets, but substantial unclassified lands also exist in Loreto in Peru, and in the former FARC territories in Colombia (Reydon et al. 2020; Azevedo-Ramos and Moutinho 2018). Indigenous lands and other forms of land claiming, such as afro-descendent communities, as well as other traditionally recognized, but not yet demarcated, lands also are increasingly under threat, apparently encouraged by the 2019-2022 Jair Bolsonaro administration's discourse (HRW 2019).

In Colombia, various dynamics associated with the interactions of paramilitaries and shifts in FARC (Revolutionary Armed Forces of Colombia) governance have also stimulated land grabs in the absence of mediating authorities. Maroon lands in the Chaco have become the target of expropriation as well (Grajales 2011; Armenteras et al. 2013; Ballve 2013; Gomez et al. 2015; Grajales 2015).

While the legal dynamics in all the countries in Amazonia vary, the dynamics of land claiming can be quite similar. Land grabbing involves deforestation because clearing land for cattle pasture is the best way to demonstrate "productive use" in justifying a land title and possibly acquiring amnesty for clearing from local and national administrations. Clearing also discourages other potential claimants from invading the area and eliminates forest resources for those who might depend on them (Fearnside 2008). This kind of "conjuring property" (Campbell 2015a) is critical for understanding the expansion of livestock, as well as the continuing private expansion of roads which facilitate forest conversion (Sosa Varrotti and Gras 2021; Carrero et al. 2022; Kröger 2024).

Logging

In the highly biodiverse forests of Amazonia, logging is always selective, taking only the species that are commercially valuable, in contrast to the practice in temperate and boreal forests where logging often involves clearcutting. Illegal logging has been and still is rampant in Brazilian Amazonia and supplies more timber to the market than legal logging

(Greenpeace 2003; Butler 2013; Brindis 2014; IMAZON 2017). Much of the timber that appears in official statistics as coming from areas being deforested legally or from legal forest management projects is actually being "laundered" from illegal logging. Brancalion et al. (2018) showed that the volume of high-value species declared in supposedly legal timber sales far exceeds the volume of these species originally present in the forest areas from which the timber supposedly came. An estimated 47% of wood sold in Colombia is illegal (EIA 2019). In the Peruvian Amazon, illegal wood is extracted in Loreto, Ucayali, Madre de Dios, the Marañon River, Yurimaguas, Ucayali River, and Ucayali/Contamana, and is legalized in Colombia and sold in Tabatinga, Brazil.

Licensed forest management systems can be unsustainable due to various loopholes that have been created, as well as frequent violation of regulations both by government licensers and by those who receive the licenses. More fundamentally, economic contradictions make unsustainable behavior financially rational due to the widespread availability of wood from predatory and unsustainable sources. Moreover, because forest trees grow at rates up to around 3% per year, while other investments can produce returns on the order of 10% per year (in real terms, independent of inflation), it makes financial sense to cut and sell the potentially sustainable forest resource as fast as possible and invest the proceeds elsewhere. This fundamental contradiction has been shown to lead to unsustainable harvesting of potentially renewable biological resources throughout the world (Clark 1973), and it applies strongly to Amazonian forest management (Fearnside 1989a, 1995; de Jong et al. 2014; Santos de Lima et al. 2018).

Coca

Coca leaf chewing can alleviate hunger, cold and fatigue, and coca is also a psychotropic with a vast international market. It is a crop that can be flexibly produced; it is processed to paste locally, and the production can shift very easily from one area to the other in the current coca producing zones, as political pressure or state repression increase, as has occurred with frequency (Gootenberg 2017; Gootenberg and Dávalos 2018).[2]

Over four million Peruvians continue to practice traditional use of the coca leaf (Rospigliosi et al. 2004) as they have done for perhaps as long as 5,000 years (Piperno and Pearsall 1998). Coca has been an object of international harassment since US President Richard Nixon's War on Drugs, and Bill Clinton's Plan Colombia, which invested billions of USD in coca eradication, to limited success (Bradley and Millington 2008). The justifications for coca eradication programs have also included political discourses on anti-insurgency, anti-communism, and the War on Terror, and it has been a source of persistent corruption in coca growing states, as exemplified by the extradition of Bolivia's drug crime Czar on drug charges (Olivares 2024).

A highly valuable traditional crop, coca is an ideal product for small farmers, since it generates considerable employment as well as revenue, is locally processed, and integrates well into agroforestry systems. United Nations data from coca cultivation on the Ucayali River indicated that one hectare could conservatively produce approximately 860 kg of sun-dried coca leaf at a variable farm gate price but one much higher than other legal crops without the farmer even having to leave his farm. These dwarf the income potential of alternative crops farmed close to the regional market city and are as little as 2% of the US street value for the same amount of leaf in cocaine form (Salisbury and Fagan 2011; UNODC 2024).

The indirect impact of coca production on deforestation is considered to be much larger than the actual area used for cultivation, since abandoned plots tend to convert to sites used for small-scale agriculture, cattle ranching and further land clearing in the surrounding area. As a means of money laundering, investment, and land speculation, coca often works in tandem with livestock, land claiming, and speculation in coca zones (Gootenberg 2017; Negret et al. 2019). While for a considerable time coca was eradicated manually, the expansion of the use of herbicides (glyphosate) has resulted in it drifting onto legal household and subsistence croplands, where it is quite toxic to small stock, has marginalized producers, and often exacerbated political tensions, threatening Indigenous areas (Arenas-Mendoza 2019). However, repressive measures have not succeeded in eliminating coca plantations in the region: the area from the southern Andean-Amazonian foothills to the Ecuadorian border is still one of the major coca-producing regions in Colombia (UNODC 2024). Current hotspots of cultivation include the Ucayali, the Putumayo, Caquetá, the border areas between Bolivia and Peru, and more generally in the fluid tri-border region (Cuesta Zapata and Trujillo Montalvo 2020).

Infrastructure

Rising global demand for commodities, particularly grains and beef but also minerals and fossil fuels, and the seemingly unquenchable imperative of regional and global integration, are driving large-scale land-use change and dramatically reshaping the physical and human environment of the Amazon region. Access and energy infrastructure projects dominate the investment portfolios of all Amazonian governments and are the projects whose spillovers generate most environmental

2 The sources of all cultivated coca are two closely related South American shrub species *Erythroxylum coca* and *Erythroxylum novogranatense* (Plowman 1984), adapted to environmentally distinct regions in Colombia, Bolivia, Peru and, more recently, Brazil (Duffy 2008). Each species has an additional variety, *E. coca* var. *ipadu* and *E. novogranatense* var. *truxillense*, with the former known for its traditional use by lowland Amazonian groups (Plowman 1981, 1984) and the latter a drought-resistant variety grown largely for commercial purposes in arid to semi-arid inter-Andean valleys. Although *E. coca* var. *ipadu* has been cultivated in lowland Amazonia for many centuries, historically its low alkaloid content has made it a poor choice for cocaine production; nevertheless, recent research on coca cultivated illegally in the Colombian Amazon indicates farmers are increasingly cultivating high producing hybrids of *E. coca* var. *ipadu* (Johnson et al. 2003), in part as a response to climate change. These hybrids would be well-adapted and easily diffused to other parts of the Amazon (Duffy 2008).

and social impacts. Land is cleared to build transoceanic multi-modal transport networks to support agro-industrial expansion, to construct hydroelectric dams and transmission networks, and to develop mega-mining projects and enable the extraction and transport of hydrocarbons. These investments interact and support each other enabling each project's financial viability. However, the significant environmental and social impacts unleashed by multiple projects are rarely if ever assessed for their potential cumulative and synergistic effects (Bebbington et. al. 2020).

Governments across Pan-Amazonia, and from across the political spectrum, pursue export-oriented economic policies that prioritize large-scale infrastructure projects in support of natural resource extraction and agroindustry expansion (Figure 3) and also because they are increasingly a form of employment program in light of the contraction of small-scale agriculture and stable urban employment. Such investments both attract large amounts of foreign investment, and fuel bursts in employment and economic activity in more remote geographies. They form part of a longstanding development paradigm that promotes urbanization, connectivity and economic growth increasingly focused on export flows over more local, resilient and participatory strategies. These investments are also important for the support of the mineral and fossil fuel extraction that finance social policy and other expenditures that give viability to their "neoextractivist" political projects and are meant for funding social programs (Bebbington et al. 2019).

One of the truisms of infrastructure could be the axiom: "have road, have deforestation" and current estimates place 95% of deforestation within 5 km of a road. There are numerous scientific articles that have documented this dynamic everywhere in Amazonia for decades (Armenteras et al. 2006; Arima et al. 2008; Baraloto et al. 2015; Vilela et

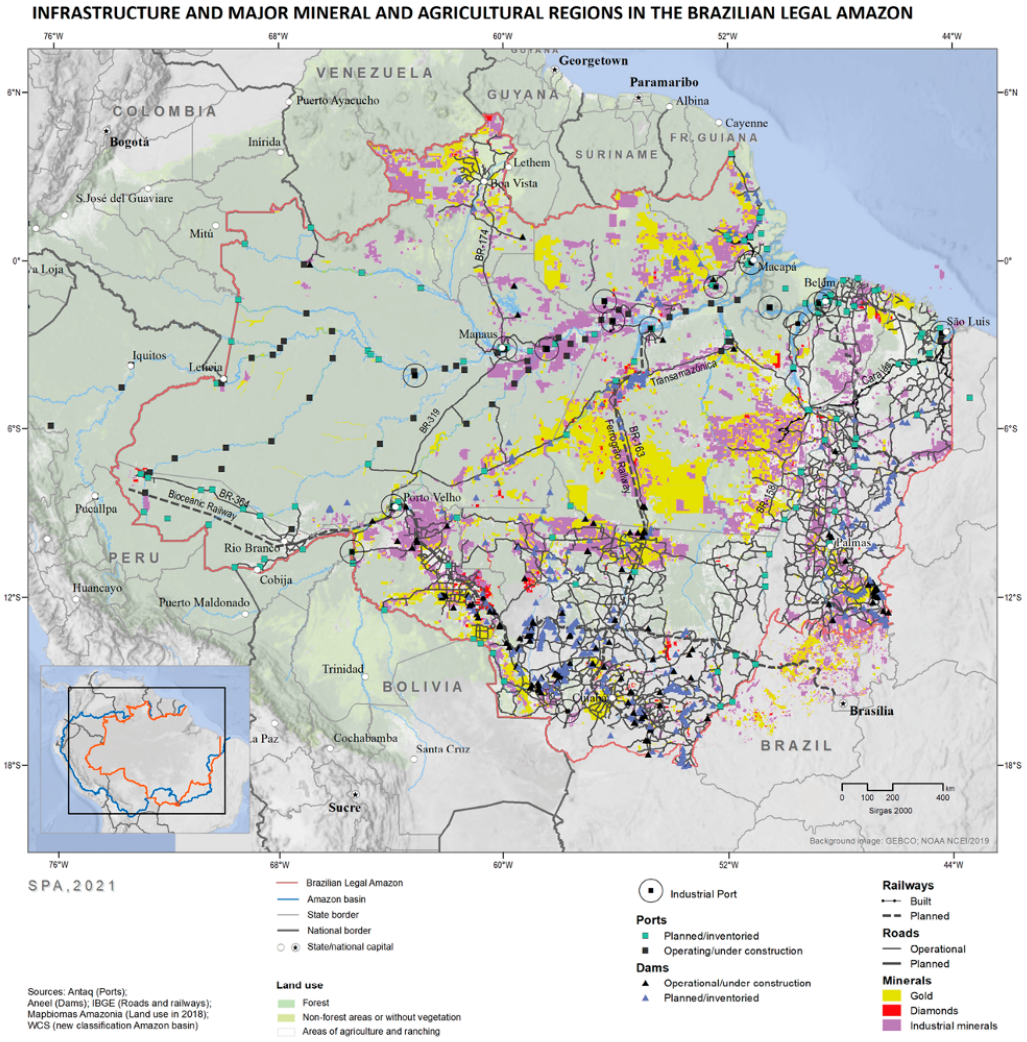

Figure 3. Map of infrastructure and major mineral and agricultural regions in Amazonia.

al. 2020; Ferrante et al. 2021; Botelho Jr et al. 2022), usually accompanied by the images of deforestation flanking the road. Clearing associated to the rapidly expanding Amazon road network permanently alters the world's largest tropical forest through forest fragmentation and sub-canopy processes (selective logging, hunting, and increased fire vulnerability) and sub-canopy cutting in preparation for more-extensive clearing for eventual land claiming (Vilela et al. 2020). Most proposed road projects lack rigorous impact assessments or even basic economic justification, reflecting the habits of bureaucratic practice. Vilela et al. (2020) analyzed the expected environmental, social and economic impacts of 75 road projects, totaling 12 thousand km of planned roads. All projects, although in different magnitudes, would negatively impact the environment, and involved deforestation of some 2.4 million ha, and 45% would also generate economic losses, even without accounting for social and environmental externalities. Canceling economically unjustified projects would avoid 1.1 million ha of deforestation and USD 7.6 billion in wasted funding for development projects (Vilela et al. 2020). The fragmentation, ecological loss of connectivity, degradation of landscapes used mainly for speculation, and the constant threat to protected areas of many types, undermining the integrity of significant areas and ecologically important landscapes, remain part of the massive externalities associated with roads (Berenguer et al. 2024).

Beginning in 2000, and led by Brazil, an ambitious, coordinated infrastructure initiative, IIRSA (Initiative for the Integration of the Regional Infrastructure of South America), now managed by COSIPLAN (South American Council on Infrastructure and Planning), has prioritized and promoted select sectors and geographies to receive infrastructure investment (Supplementary Material, Appendix S3). IIRSA/COSIPLAN's proposed hubs traversing the Amazon basin are especially contentious given their high costs in terms of human rights, threats to Indigenous peoples and local communities, land expropriation, and forest clearance degradation (Bebbington et al. 2018; Ferrante et al. 2020).

Roads

In recent decades, significant investment has been directed to building new and upgrading existing highways that form part of a series of strategic transport corridors promoted under IIRSA/COSIPLAN. These plans echo the large-scale road building projects of previous eras such as the Belem-Brasilia highway (1960) and the Carretera Marginal de la Selva (1963), which was intended to connect the Amazon regions of Bolivia, Peru, Ecuador, Colombia and the Venezuelan llanos. In subsequent decades the Trans-Amazon highway was started in Brazil in the early 1970s, followed by the Cuiaba-Porto Velho road, and a burgeoning set of formal and informal road building since the opening of the major trunk roads (Fearnside 2015a; Berenguer et al. 2024). One outcome of this dynamic has been continuing deforestation and forest degradation, except in periods of deep civil strife, as in Peru with Shining Path, and in Colombia with various occupying rebel groups (Negret et al. 2019; Clerici et al. 2020).

New roads attract actors of various types. Individual families can migrate to the area to occupy land (known in Brazil as *posseiros*) (e.g., Simmons et al. 2010; Schmink 1982). The initial occupants are soon replaced by other actors, usually by selling their holdings to wealthier newcomers (sometimes under threat of violent expulsion), who convert the area into large ranches, as occurred along the Belém-Brasília highway (Foweraker 1981). The initial settlers may also either be regularized in Brazil by the National Institute for Colonization and Agrarian Reform (INCRA) or be granted lots elsewhere in official settlement projects (Schmink and Wood 1992; Fearnside, 2001a), where a parallel process occurs, even if not legally permitted. The original settlers sell their lots to others who concentrate them into medium and large ranches (e.g., Carrero and Fearnside 2011; Yanai et al. 2020). Initial occupation can also occur as large areas are appropriated by landgrabbers (*grileiros*), who then subdivide the claims and sell the land in smaller parcels, or alternative land consolidators may use multiple names to acquire larger holdings. Brazil's *Terra Legal* (Legal Land) program, which was intended to curtail the advancement of the agricultural frontier into the Amazon, actually consolidated agribusiness and extractivism in the Amazon-Cerrado transition zones.

Road paving, or the mere announcement of plans for paving, causes an immediate increase in the price of land along a highway (Schmink and Wood 1992; Campbell 2015). Land is more valuable both because of the actual increase in the profitability of agriculture and ranching with better transportation possibilities, and because of the expectation of further increases in land prices, yielding speculative profits from reselling the land. This is one of the oldest stories about land and land use change in Amazonian development. Land speculation provides a significant motive for deforestation because clearing forest secures the claim to the land and counts as an improvement (*benfeitoria* in Brazil) in justifying a future land title (Fearnside 1979; Hecht 1985; Hecht et al. 1988; Schmink and Wood 1992; Fearnside 2008, 2015a).

Ports

Nearly 100 major industrial river ports have been built on the Brazilian Amazon's major rivers over the past two decades. Many of the projects have been internationally financed and built by commodity companies with little government oversight, such as former Minister of Agriculture Blairo Maggi's port in Porto Velho, Brazil. These ports have transformed the region, opening it to agribusiness and reducing transport costs for export commodities, especially soy and ores to China and the rest of the world. However, this boom in port infrastructure often came at the expense

of the environment and traditional riverine communities. Today, more than 40 additional major river ports are planned in the Brazilian Amazon biome on the Tapajós, Tocantins, and Madeira rivers, as well as proposed port development related to the Amazon waterway project in Peru and the Ichilo-Mamoré-Madeira-Amazonas waterway in Bolivia, also projects largely pursued without taking into account cumulative socio-environmental impacts (Silva et al. 2008; Leal et al. 2012; Alves et al. 2015; Barbosa and Moreira 2017).

Dams

The construction of dams and hydroelectric plants remains a major development strategy across the region and has been key to energy, urban and mining policy. Decisions on logistical infrastructure, such as roads, dams, railways, ports and waterways, are critical both because they represent major government investments and because their social and environmental consequences are enormous (Berenguer et al. 2024). How infrastructure decisions are made does not necessarily reflect the magnitude of these consequences, but in many cases reflects the political power of coteries, especially in the absence of more participatory forms of planning, and full-cost accounting. These pressure groups can include the military, economic interests, grassroots social movements, and other actors, as well as the influence of corruption, and personal interests and even vanity of political leaders --- the so called "pharaonic" projects. Decisions often reflect a great deal of political expediency and largely follow the autocratic practices of the military period.[3] In Brazil, the information on broader impacts is not even gathered before the critical decisions are made -- this comes later during the licensing process that serves to justify the decisions that have already been made for political reasons (Fearnside 2012c). Even when involving the Chinese government and state-owned companies, the latter often display distinct interests and priorities, and compete for capital and political support for divergent infrastructure projects, such as the north-south Ferrogrão railroad connecting Mato Grosso state to the Amazon basin ports on the Tapajós in Brazil, and the east-west Bi-Oceanic railroad crossing the Amazon and the Andes, or the recent Ferro-Pará, also in Brazil.

Availability of funds and expertise from outside sources can be important in determining which projects get priority. In the past this has included major projects financed by multinational development banks (Fearnside 1987), Korea, and, especially, financing from China, which is now critical for various planned railways, dams and waterways (Fearnside and Figueiredo 2016; Ascensão et al. 2018; Branford and Torres 2018; Serrano Moreno et al. 2020; Oliveira and Myers 2021; Oliveira 2022). State-owned companies, and their managerial agencies, can be significant influencers of decisions on major infrastructure projects. State-owned oil companies in Ecuador (PetroEcuador), Colombia and Brazil (Petrobrás) have significant pressure and financing over forms of regional development and extraction. Another example is the Tucuruí Dam, in Brazil, which blocked the Tocantins River in 1984. The dam was built by Eletronorte (the government electricity company for northern Brazil) to supply aluminum factories in Barcarena, Pará and São Luis, Maranhão (Fearnside 1999, 2001b, 2016). Construction companies have been famous for pressuring for access and energy infrastructure development. The soy transport corridor in Brazil, from the interior of Mato Grosso to the Cargill Terminal in Santarém, Pará was promoted by soy growers and infrastructure firms (Torres and Branford 2018). The effect of corruption on infrastructure decisions can also help explain why expensive projects can gain priority, as the Odebrecht story has so clearly indicated.

While the social impacts of dams vary from site to site, some of the major and well-documented social effects include displacement of population, loss of livelihoods from fisheries, downstream effects, impacts on Indigenous populations, as well as impacts on health and migration (Fearnside 2016; Andrade 2021; Supplementary Material, Appendix S4).

Export dependency and precarious states

As the previous sections have shown, the Pan-Amazonian states have become increasingly dependent on global exports of the enormously valuable natural resources from Amazonian forests, waters, lands and sub-soils, part of a wave of Latin American neoextractivism that combines a focus on commodity exports with the deployment of social welfare programs to address persistent poverty in the face of limited economic opportunity and virtually no structural change (Baletti 2014; McKay 2017; Svampa 2019). Some writers have labeled this current phase of development a new incarnation of dependent development (Svampa 2019).[4] At the same time, however, there are new innovative economies based on traditional Amazonian crops like açai, guarana, and other traditional Amazonian goods, animal products and medicines.

3 In Brazil, as in the other Amazonian countries, infrastructure projects are normally part of "pluriannual plans" (PPAs), which are sets of projects (including many investments in addition to infrastructure) that are proposed for implementation over a four- or five-year period. The president collects suggestions from the different ministries and is responsible for submitting a proposal for the PPA to the congress, where there is plenty of room for lobbying by interested parties, and "horse trading" among political groups. The 2020-2023 PPA was approved by the Senate with 326 amendments (Senado Notícias 2019). High-level plans such as IIRSA (see Killeen 2007; Zibechi 2015) have little influence, although they can be used as arguments for justifying projects wanted for other reasons. In Ecuador, for example, projects that had remained on the books were taken off the COSIPLAN system, mainly to assure more national autonomy. Once included in the PPA, further political struggles determine the priority a project receives for inclusion in the annual budget.

4 Dependency theory argued that over-reliance on natural resources made economies vulnerable to volatilities in global markets for reasons of price and politics, global competition and technical change in the sectors, as well as declining terms of trade of raw materials versus industrialized products. This actually led countries to underdevelopment rather than development, by structuring institutions and infrastructure around these sectors, which were often, (and still are) largely dominated by large international corporations that garner most of the benefits, as well as the national coteries allied to them. Environmental degradation is another element in the "development of underdevelopment" (Bunker 1985).

While GDP has increased in all of Pan-Amazonia, inequality and precarity remain central issues, and the COVID-19 pandemic ratcheted poverty inequality and vulnerability to new heights, as Peru, Colombia, Bolivia, Ecuador and Brazil had some of the highest per capita COVID-19-related infection, death rates and caseloads. The COVID-19 crisis diverted some attention away from forest destruction and protection, and made illegal incursions easier by paralyzing state actions to control clearing (Silva Junior et al. 2021).

All Amazonian governments have had serious corruption scandals, most recently associated with the Brazilian infrastructure company Odebrecht, which triggered impeachments in Brazil, Peru, Bolivia, and Ecuador, but this was just one among a continuing process of ruling through corruption (Durand, 2019; Fogel 2019; Campos et al. 2021). Six of the last Peruvian presidents have been indicted for corruption associated with cronyism, personal payoffs, etc., with Peru cycling through three presidents in the period of a month. Corruption concerns also emerge around the concession systems for hydrocarbons, minerals and timber. The lack of transparency and the existence of favoritism in many contracts and bidding processes have underpinned distrust of the national state, and supported a dynamic of illegality in land acquisition, infrastructure concessions, production certifications, clearing moratoriums and forms of bribery, as well as political patronage. All these add distorting elements to regional dynamics, and foster distrust of government as well as broader lower-level societal corruption (Bulte et al. 2007; Campos et al. 2021; Fogel 2019; Zysman-Quirós 2019).

The new innovative economies based on traditional Amazonian crops mentioned above remain largely niche crops, with modest value and value chains when compared to the large-scale commodity dynamics. Coca (of different varieties) and gold go through significant processing in Amazonian localities, and so might be considered as "industrialized exports" in contrast to most export commodities such as agroindustrial products (Gootenberg and Campos 2015; Gootenberg 2017; Hilson and Laing 2017; McKay 2017; Betancur-Corredor et al. 2018), even though the regional results are often ephemeral (Manso et al. 2021).

AMAZONIAN PEOPLES

In the midst of the powerful and often hidden forces and processes shaping Amazonian development and conservation, the diverse people who live there continue to respond as best they can to the increasingly precarious and contested options for making their living in the forests, rivers, lands, and cities of the Amazon. They draw on Indigenous cosmologies and practices dating back millennia, as well as the unique cultural identities and systems of management of natural resources that have evolved in each Amazonian country and locality, while adapting to the rapidly changing new drivers and processes that increasingly constrain their possibilities (Vadjunec and Schmink 2012; Athayde et al. 2017). They are also new migrants from mountain zones in western Amazonia, from the Brazilian Northeast, cerrado zones, and southern Brazil, as well fugitives from failed states and impossible economic conditions such as currently prevail in Venezuela. Far from passive and invisible, these Amazonians in motion have continued to mobilize to protect their homes, territories, livelihoods, and cultural identities by defending their own proposals for the future with new forms of governance, social innovation, land uses and goods. This is done through traditional local channels of governance, regional agencies, national political means, and new migrations as well as seeking cross basin partners and regional and international allies.

The settlement patterns of Amazonian populations historically are highly complex and dynamic, including diverse patterns of migration, both internal and external to the region, including international migration (Hecht 2014a) as well as between urban and rural areas. Contrary to the general understanding of the Amazon region as a large natural forest, the population of the region is highly concentrated in urban areas, including large numbers of Indigenous peoples (Eloy 2009; Sobreiro 2014; Eloy and Lasmar 2011; Campbell 2015b; Eloy et al. 2015) with complex links to the rural hinterlands, a pattern that dates to antiquity. We first examine urbanization as a settlement form of significant antiquity in Amazonia, and the historically rooted complex linkages between rural livelihoods and urban settlements. Finally, we examine broader settlement and migration patterns. Because of the surprisingly highly urbanized nature of Amazonia, we now turn to this topic.

Antiquity of Amazonian urbanization

Although Amazonia is perceived as a wild place with a biotic rather than human history, humans have occupied the region for at least 14,000 years with very large populations, in many places much greater than they are today. Extensive areas of ring ditch construction, numerous mounds and extensive engineering works, roads, widespread anthropogenic soils, humanized biogeographies, celestial observatories, and extensive mastery of long-distance water-based travel as well as artistic masterpieces, gold metallurgy, ceremonial burial sites and a complex suite of domesticated plants and the residue of a complex pharmacopeia are evidence of complex civilizations (Pärssinen et al. 2009; Schaan 2016; de Souza et al. 2018; Maezumi et al. 2018; Iriarte et al. 2020; Lombardo et al. 2020; Neves et al. 2021; Prümers et al. 2022). The populations declined by more than 90% due to epidemic diseases and slaving forays after contact with Europeans, obliterating knowledge systems and tropical ways of being that also included complex polities (Calisto 2019; Cabrera-Barona et al. 2020; David and Dean 2021; Buitron 2023) and forms of urban life (Whitehead

1994; Heckenberger et al. 2008; Heckenberger 2009; Rostain 2009; Prümers et al. 2022; Rostain et al. 2024). Amazonia in many ways went through a process of deurbanization due to the effects of disease and slavery.

During the colonial period, Amazonian urban settlements included a mix of Indigenous, religious, military and communities, reflecting geopolitical and economic strategies. Mission towns, typically built on top of Indigenous entrepots, stretched from the mouth of the La Plata River up through much of the Amazonian territories, especially the areas of the Bolivian Amazon, to the mouth of the Amazon and Orinoco rivers (Fritz and Edmundson 1922; Rey Fajardo 1977; Useche Losada 1987; Block 1994; Costigan et al. 2005). Trading centers established at river junctions became durable commercial entrepots, multiethnic urban sites and included substantial Indigenous and mixed populations (MacLaughlin 1972; Roller 2014; Maxwell 2001). Many Indigenous populations never left these enclaves, and native, traditional populations continued to move back and forth between towns and cities and into hinterlands and home villages.

Later, at the end of the 18th and beginning of the 19th century, the Amazonian trade in enslaved people through the ports of Belém were substantial even though this trade is less well known (Salles 1971; Hawthorne 2010). An important element of Amazonian settlement was the fugitive slave communities (*quilombos*, Maroons) deep in forests, spreading throughout the lower Amazon, and all the way up into the Guyanas (Agostini 2002; Cavalcante 2011; de la Torre 2012; Florentino and Amantino 2012a; Hecht 2013, dos Santos Gomes 2015; Rosero-Peña 2021). The mercantile system (and the military outposts that attended it), and ethnically complex towns and villages, made up an informal trading network, especially in the lower Amazon and its tributaries (La Torre López and Huertas 1999; de la Torre 2012), articulated to products of forests and rivers for subsistence and export---the "drogas do sertão".

The extractive cycles that sustained frontier economies in the Amazon during the 19th century contributed to a characteristic urbanism (Godfrey and Browder 1997), with multiple towns dispersed within a shifting economy focused largely on export and use value goods. The current focus on Amazonian globalization in its modern form obscures earlier urban and semi urbanized livelihood and economic systems that formed part of global systems. Many Amazonian cities have undergone periodic cycles of expansion and contraction, and of export versus local orientation, reflecting population movements into and from the countryside, following fluxes in the global demand for particular forest products and the emergence of new local types of demand for local construction wood, Amazonian foods, as well as new export products like açaí (Sears et al. 2007; Brondizio 2009; Uriarte et al. 2012) and other products of Amazonia's traditional bioeconomies.

After WWII, the dynamic relationships between urban and rural spaces became increasingly shaped by the influence of regional development programs and state-driven formalist planning in Amazonian territories, involving new "showcase cities" like Ciudad Guyana (in Venezuela) and, after 1989, the towns of Palmas and the redo of Goiania (in Brazil) as agro-industrial service towns like Lucas do Rio Verde. These corporate planned cities complemented the planned village settlements in Brazil, Bolivia, Colombia (Caquetá), and Peru (San Martin) as well as the extensive planned villages of agrarian reform and new settlement zones on highways (Jepson 2006; Rego 2014, 2017). A largely bifurcated Amazonian model of new settlements unfolded in which large-scale capital was encouraged by extensive subsidies, largely following the growth-pole spatial planning ideas, while spatially extensive agrarian reform using a different territorial settlement model was expanding, linking poles through settlement corridors with road infrastructure. A fantasy of planned urbanization and orderly settlement was met by massive spontaneous settlement and a striking fluidity in boom towns that were abandoned after resources were depleted or the speculative cycle in land ran its course (Jensen et al. 2018). Rural settlement has gone hand-in-hand with expansion of illegal side roads, and has contributed to the expansion of the "fishbone" patterns of clearing so widely seen in Amazonia was well as filagrees of access roads (Arima et al. 2013; Vilela et al. 2020; Ferrante et al. 2021; Nascimento et al. 2021; Botelho Jr et al. 2022). The increased importance and growth of medium-sized towns that permit interaction with rural resources, while providing access to banking, health and education systems, and periodic employments, are reflecting the changing rural economies.

Current migration flows in the region are largely characterized by the rural-urban shift of population (Gori Maia and Buainain 2015). With nearly two thirds of the population living in urban areas, the Brazilian Amazon presents one of the highest rates of internal migration in the country: roughly 10% of the population migrated between 2005 and 2010.

The rural urban continuum

In spite of its image as a vast forest, Amazonia is highly urbanized. In the Brazilian Amazon, only about 36% of its roughly three million inhabitants in 1960 resided in urban areas, while by 2010, 74% resided in towns and cities. There has been a similar expansion of intermediate and small cities, many of which are the administrative centers for municipalities renowned for their role in agricultural supply chains [Itaitatuba (Amazonas state), Sorriso and Sinop (Mato Grosso), Tailândia (Pará), Ji-Paraná (Rondônia)], corporate mines [Marabá, Parauapebas, Oriximiná (Pará)], wildcat mining towns [Itaituba (Pará), Pontes and Lacerda (Mato Grosso)], or cattle landscapes renowned for high rates of deforestation [Altamira and São Félix do Xingu (Pará), Humaita (Amazonas)]. Most doubled their populations between 2000 and 2010 and have been growing at two to

three per cent annually over the last decade, a trend that has been replicated in the large and small town categories that are at the heart of the rural economy of the Brazilian Amazon (Killeen 2024). A similar pattern is found in Peru (Menton and Cronkleton 2019). Current urban transitions in the developing world have several features that differ from the Euro-American pattern: 1) they have occurred extremely quickly in a decade or two (as opposed to often centuries-long processes in the North), and may be underpinned by different kinds of urban, rural political or forest functionalities (Hecht 2010; Parry et al. 2010); 2) they reflect strong exogenous pressures, at least as much as endogenous dynamics (e.g., land wars, economic displacement, globalization, political violence, state territorial ambitions and, in some cases, climate change) (Simmons et al. 2007; Brondizio et al. 2011; Aldrich et al. 2012; Hecht 2014a; Hecht et al. 2014; Kanai 2014a; Mansur et al. 2018; Wilson and Bayon 2018; Wilson 2021); 3) rural areas, even when forested, often have high population densities, strong relations to historical and current forms of family or small scale agriculture and forest livelihoods, and deep regional histories (Sears et al. 2007; Brondizio 2008; Brondizio 2009; Pinedo-Vasquez and Padoch 2009; Brondizio et al. 2011; Hecht 2014a); 4) the current urbanization processes are generally more globalized in commodities, financial flows, and often, labor (or the lack thereof), and are shaped by new production ideologies, urban export corridors and mega-project sites. Marabá, Altamira and Carajás (in Brazil), are examples of the spontaneous expansion that accompanies planned cities with unplanned satellite cities or peri-urban expansion. These settlements become informal labor depots and service centers (Roberts 1995; Holston 1999; Kanai 2014b; Branford 2016; Cardoso et al. 2018).

Urbanization in Amazonia builds on older mobilities for livelihood support as well as increased dependency on state services for cash transfers, pensions, health and education services, as well as periodic work, local markets, and remittances in a context of an often wageless world with high degrees of precarity. About 40% of Amazonian residents now fall below the World Bank poverty line. This in turn has contributed to a need for enhanced levels of mobility and migration, a regular re-engagement with cities and markets, and to intensified rural–urban links and exchanges, often through the use of complex informal social networks of kinship, clientelism and patronage (Pinedo-Vasquez et al. 2001; Peluso and Alexiades 2009; Brondizio et al. 2011; Eloy et al. 2015, Tritsch and Le Tourneau 2016).

Living and livelihoods in the urban-rural matrix

Several insights help characterize the current dynamics we see in "embedded urbanization" (i.e., towns and cities historically rooted in their regional livelihood systems) versus "export cities" (i.e., those linked to construction sites, oil camps, and export enterprises). First, the increase in multi-sited households has blurred distinctions between rural-urban areas, creating new forms of livelihood in peri-urban areas and urban peripheral hinterlands. This includes forest, agricultural, urban and rural waged livelihoods and petty commerce, as well as state transfers. From the perspective of families, the Amazon region is indeed a rural-urban continuum. Family networks shape the urban and rural landscapes in the region, supporting intense patterns of circulation and exchange across short and long distances. However, interactions between people/families in rural and urban areas vary significantly in the region as a function of geography and transportation, as interaction density and frequency depend on proximity to cities and the type of transportation available (Padoch et al. 2008; Parry et al. 2010; Eloy et al. 2015; Nasuti et al. 2015). Independently, rural/resource economies are intrinsically connected to urban hubs, involving social networks between extended families, intermediaries and market brokers, and corporations (such as açaí or Brazil nut exporters in Brazil) (Figure 4; Gregory and Coomes 2019), which are behind large segments of the regional economy and social life, generating high-value regional economic chains in fishing, fruit production, and regional and international non-timber forest products. Rural-based extractive activities such as logging, gold mining and fisheries are now important sources of employment and income for urban residents (Cleary 1990, Pestana et al. 2022). Life in most rural communities has become a reflection of life in low-income urban neighborhoods and vice-versa (WinklerPrins 2002a,b). Seasonal economies are especially important to families (e.g., açai and fish commercialization along the floodplains, mining, harvesting, construction work). Seasonal mobile economies tend to be highly gendered, predominantly dominated by men. Almeida (2011) has documented the dependence of Brazilian urban populations on resource configurations for the cities of Belém (Pará state) and Manaus (Amazonas state), showing the extent of travel, seasonality, and gender division in these systems.

Several factors have affected rural-urban interactions and urbanization in different parts of the region: increasing availability of inter-municipality transportation and personal transportation (motorcycles, small boats, cars); developed kinship networks, access to market opportunities and market niches; access to cellphones and communication; availability of public services and education, as well as life-style. A continuing dynamic is the marginalization of small farm agriculture in Amazonia except in peri-urban areas, areas with traditional tenurial regimes, more traditional regional settlements and those close to historic urbanizations (Costa 2021). More recent colonist settlements have been characterized by very high levels of land ownership turnover, close to 72% (Yanai et al. 2012; Yanai et al. 2020), high deforestation, continuing rural violence, as well as infrastructure development, such as dams, producing expulsions from rural areas (Chiavenato

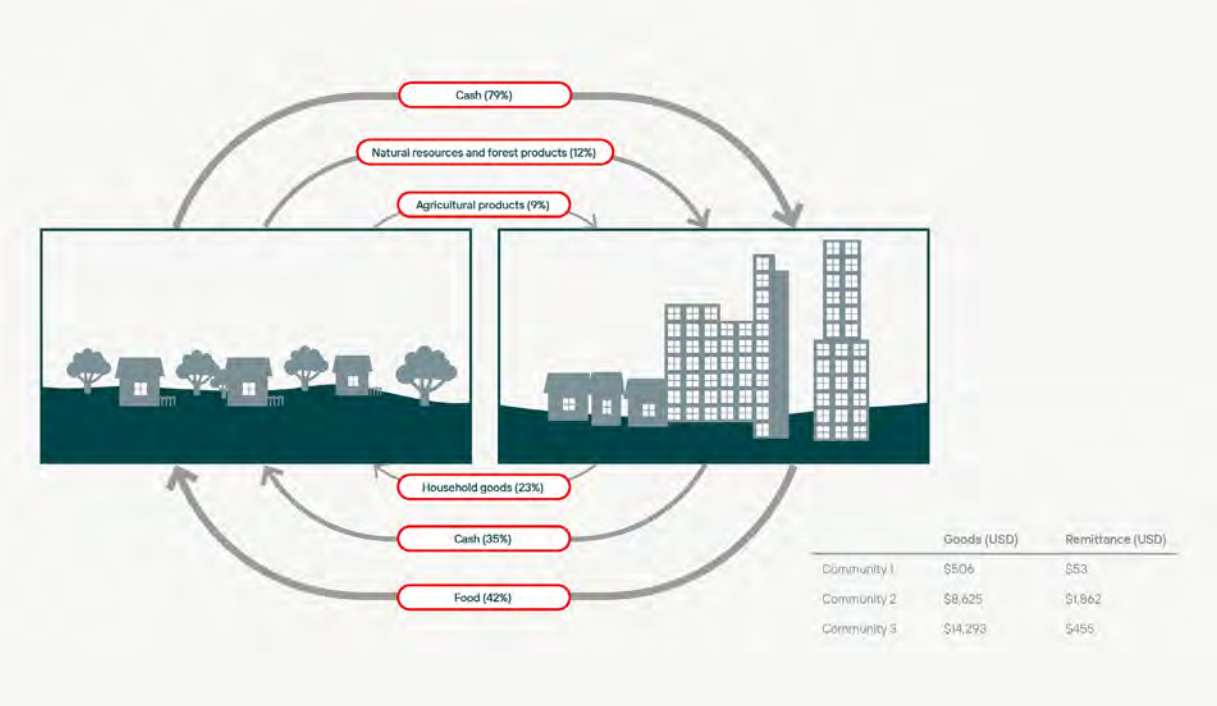

Figure 4. Remittances and gift flows between the city of Iquitos and rural communities in Peru. Adapted from Gregory and Coomes 2019 (p.298).

1993; Sousa Júnior and Reid 2010; Carrero and Fearnside 2011; Fearnside 2016; Atkins 2017; Ferrante et al. 2020).

The peri-urban areas and peripheries have become new, central forms of livelihood construction in Amazonia's low-income urban neighborhoods, as in Belém, Santarém, Tefé, Rio Branco, Manaus, Macapá and infrastructure development hubs like Marabá, in Brazil, Iquitos and Pucallpa, in Peru, boom towns along the oil axis of Ecuador (Lago Agrio) and Coca, the smuggling town of Leticia, and drug entrepots like San José del Guaviare, in Colombia (Cuesta Zapata and Trujillo Montalvo 1999; Armenteras et al. 2013). These peri-urban and household agroforests are increasingly important for food security and petty commerce under conditions of precarity (Madaleno 2000; Emperaire et al. 2012).

Another key finding is that local ecological knowledge and complex production systems support rural and peri-urban livelihoods and agro-diversity in the Amazon. Multifunctional agroforestry and forest and aquatic management systems form both rural and peri-urban production systems. These multi-strata and multi-species systems of natural resource exploitation can incorporate small stock, stagger harvest times, have labor flexibility, engage local fisheries and cycle materials (Coomes and Barham 1994; Pinedo-Vasquez et al. 2002; Padoch et al. 2008; Perrault-Archambault and Coomes 2008; Manzi and Coomes 2009; Coomes et al. 2010; Coomes et al. 2015; Pereira et al. 2015; Vogt et al. 2015; Vogt et al. 2016). The different, varied forms of rural and peri-urban and urban agriculture are important providers of agro-diversity conservation, as well as other forms of ecosystem services (Padoch and Pinedo-Vasquez 2010; Beyerlein and Pereira 2018). Under-recognized, but increasingly important, are the roles these agroforestry-urban ecosystems play in the larger issues of environmental services support, and in moderating the heat island effect, as well as wind and water infiltration (de Souza and Alvala 2014; Fernandez et al. 2015; Livesley et al. 2016).

Historically, Amazonians were given a one-dimensional occupational definition, e.g., as a farmer, fisher, rubber tapper, wage worker. Rural income has become more complex, reflecting changes in agricultural economies and encompassing employment in urban areas, commerce, and various forms of cash transfer/benefit programs. Amazonian incomes come from agriculture and resource markets, but the role of remittances also is increasingly important, including money sent to Amazonian kin from other cities or rural areas and even abroad. About one fifth of Ecuador's population resides overseas, as does a similar proportion of Venezuelans, and their remittances often exceed regional direct foreign investment funds (Hecht et al. 2015). Incomes come from different combinations of agricultural/resource-based activities, access to urban employment and market-niche opportunities, education, health services and other arrangements (Padoch et al. 2008; Eloy et al. 2015).

The complex interactions between urban waged work and natural resources livelihoods in subsistence, exchange and commerce, city services, state transfers and the dynamics of rural survival, are linked to multivalent forms of income and identities. These dynamics suggest that there are many ways

that Amazonian peoples' resources and environmental services can be simultaneously supported to improve welfare. Recent panel studies of welfare in Brazilian Amazonia in urbanizing and rapidly deforesting areas show that urbanization does not lead to positive changes in human welfare, and that state agricultural investments also often undermine welfare (Silva et al. 2017). This information coupled to recent studies on the socioeconomic impacts of gold mining (Manso et al. 2021) and large-scale agro-industrial development suggest a problematic set of paths of Amazonian transformation in terms of their development benefits, while their environmental and social costs are high. The poor infrastructure conditions of many towns, and the precarity of incomes, may make integration with rural life an economic necessity, indicative of a new kind of rurality (Rivera and Campos 2008; Hecht 2009).

Urban environmental issues

The intersection of economic and infrastructural precarity, high rates of violence and crime, and the effects of climate change are particularly impacting low-income populations in rural areas and urban peripheries. Urban sanitation infrastructure in Amazonia is precarious at best (Brondizio 2016; Mansur et al. 2018; de Lima et al. 2020). The vast majority of municipalities have less than 10% sewage collection (Mansur et al. 2016), and these issues are becoming more complex, with increasing patterns of climate related deluge rains that cause extensive flooding, overwhelming the infrastructure that does exist, and hammering settled areas near storm and flood-vulnerable waterways. Strong droughts can undermine rural production of various kinds, and droughts with their associated high heat island temperatures make urban areas swelteringly hot, more than 5 °C degrees above adjacent nonurban areas (de Souza and Alvala 2014; Marengo et al. 2024). Air quality issues including limited visibility, breathing problems and increasing asthma hospital admissions, are becoming more important as vast fires proliferate in the dry season (Irga et al. 2015; Butt et al. 2020). The shift into aquaculture near Peruvian towns is raising concerns about resurgence of malaria (Maheu-Giroux et al. 2010). Sea level rise is affecting the lower Amazon estuary (Mansur et al. 2016; de Lima et al. 2020).

Amazonian urban areas experience a great deal of crime and violence, reflecting the dynamics of poverty, and some clandestine economies, including the presence of drug traffickers or organized crime. A recent report by a Mexican-based NGO (El Consejo Ciudadano para la Seguridad Pública y la Justicia Penal) places the Brazilian Amazonian capitals of Manaus (23rd), Belém (26th), and Macapá (48th) among the 50 most violent cities in the world (41 of which are in Latin America) (Brondizio 2016).

Formal, private and spontaneous migration

To western eyes, Amazonia has stood as a kind of El Dorado to adventurers and to the state, a refuge from minifundia, a place for new beginnings and insurgencies (as well as prisons), and of opportunity as well as its negation. There are now literally thousands of planned and unplanned settlements, ranging from formalized private colonization, corporate planned cities, and state-led colonization, to informal settlements, boom town explosions, landless occupations, and do-it-yourself *de facto* agrarian reform (Perz et al. 2010; Simmons et al. 2010).

Early phases of Amazonian colonization involved the importation or dislocation of labor at the regional level through Indigenous peonage, indenture and slavery, and African slavery for forest collection and plantation agriculture (MacLachlan 1997; Acevedo Marin and Castro 1998; Salles 2005; Roller 2010; Roller 2014). This instigated another form of hidden urbanism, initially around fugitive slave communities (*quilombos*), located deep in forests throughout the lower Amazon and in the Guyanas (Agostini 2002; Cavalcante 2011; de la Torre 2012; Florentino and Amantino 2012a; Florentino and Amantino 2012b; Hecht 2013; dos Santos Gomes 2015). The rubber period stimulated formal state and private colonization in Bolivia (Lavalle 1999), and state-organized movements into Peru's Selva Central (Santos-Granero and Barclay 1998). Colombia's Putumayo became infamous for its Indigenous slavery and the international political fallout that this occasioned (Taussig 1984; Goodman 2010). Brazil, especially the state of Acre, was a key supplier of rubber for the global market and relied on massive relocation from the country's northeast and even the US (Martinelli 1998). More than a million people were resettled in Brazilian Amazonia under various labor regimes, spatial configurations and forms of coercion, as well as labor migration of multiple types (including US workers) to assist with railroad construction (Weinstein 1983; Coomes and Barham 1994; Ferreira 2005; Neeleman and Neeleman 2013; Hecht 2013). Similar forms of settlement and labor recruitment (again from the northeastern region of Brazil) occurred during WWII (Garfield 2010) for rubber supply for the US after Asian supplies were no longer available.

More recent migration is linked to agrarian issues. Migration can be categorized as a combination of push and pull factors. The standard discussion of push factors emphasizes livelihood problems, the issues of minifundia, environmental issues of smallholders in Andean zones and the Brazilian Northeast, and political pressure related to violence, as in the spontaneous migrations in Colombia's massive occupation of the Guaviare (Molano 2019) and more general displacements of up to 5 million people in Colombia due to the fifty-year civil war. Rural instabilities and land rights had been instrumental in fueling insurgencies in Latin America in post-WWII Bolivia, Brazil, Colombia and Peru. Agrarian reform as frontier settlement would become a key social policy initiative, as well as a territorial strategy (de Janvry 1981; Pacheco 2009; Hecht and Cockburn 2011).

With the idea of "he who has, keeps" (*uti possedetis* in Roman law), as resources became better known and infrastructure expanded, colonization in Brazil followed the geopolitical orientation of *integrar para não entregar* (integrate in order not to give away). This approach constituted an alternative to agrarian reform in more-developed areas in virtually all Amazonian countries, to avoid expropriation of land from the elites. Colonization appeared to address serious social inequalities and helped frame the states as modern rather than oligarchic, actively seeking to redress inequality in access to land, which was, at mid-century, a striking feature of Latin American societies. It was this strategic use of colonization, from geopolitics to counter-insurgency and "eco-settlement", that gave Amazonian settlement its highly erratic dynamics and often contradictory policy. Yet, this very appealing political narrative was important, even as many colonization areas became rife with conflict. Inconsistent public policy, combined with price volatility for small farms and a general sense of abandonment, has been central in the emergence of clandestine economies of multiple types (Betancur-Corredor et al. 2018; Caballero Espejo et al. 2018; Gootenberg and Dávalos 2018; Kolen et al. 2018).

Settlement policy and practice has undergone significant program shifts, and this is perhaps best exemplified in Brazil, which has by far the largest number of formal settlements, as well as extensive informal settlements, and settlements declared by local states (Figure 5; Supplementary Material, Appendix S2). One of the most consistent outcomes in both formal and informal settlements has been the high degree of colonist attrition, with levels of turnover as high as 77% (Carrero and Fearnside 2011).

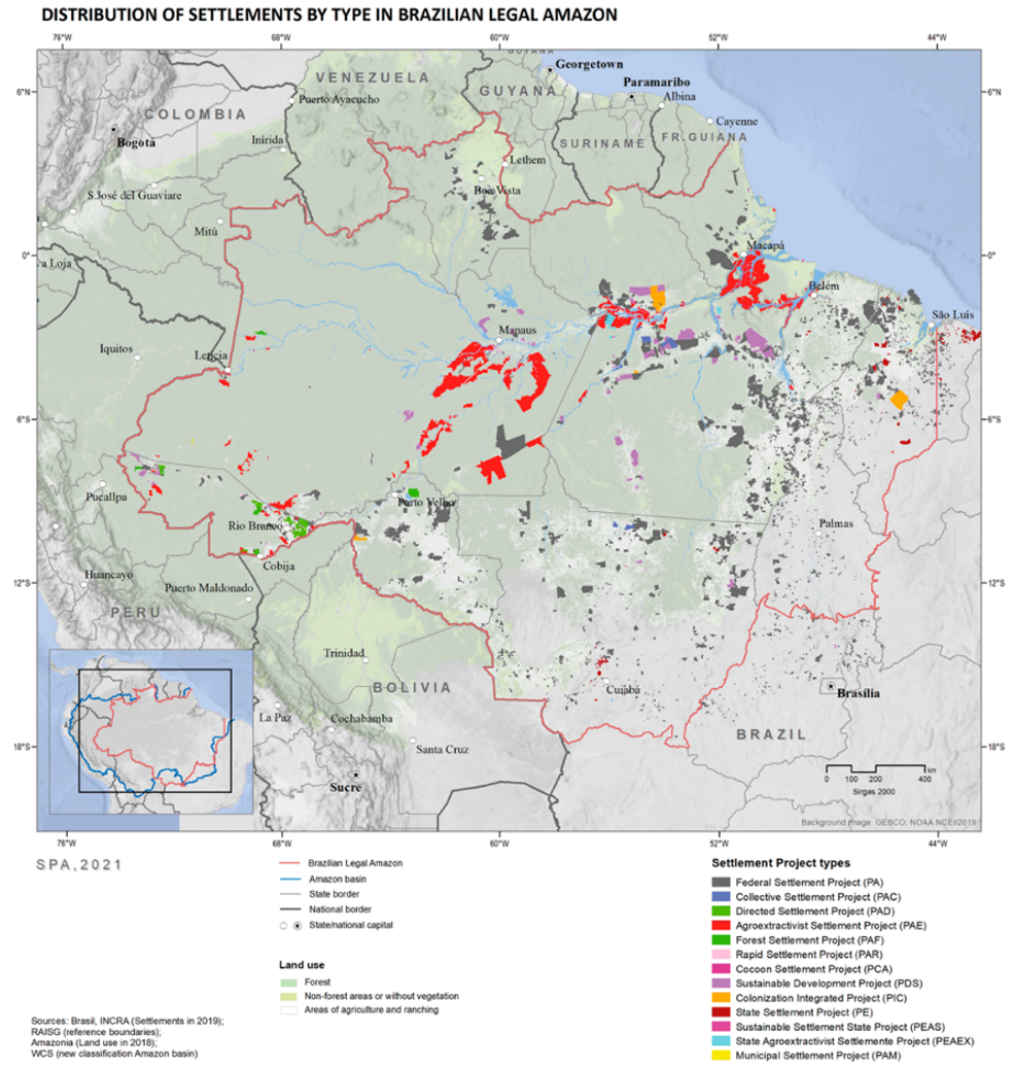

Figure 5. Distribution of settlements by type in Brazil's Legal Amazon region (the Brazilian area of the Amazon biome and areas of Cerrado savanna, Pantanal wetlands and Caatings semi-arid scrubland in the states of Mato Grosso, Tocantins and Maranhão). Source: Yanai et al. 2017.

Social movements, rights and governance

Since colonial times, Amazonian social movements have struggled for rights to land, livelihood, physical security and autonomy, and ultimately for more inclusive and sustainable development approaches (Supplementary Material, Appendix S5). In the 20th and 21st centuries, authoritarian, illiberal governments and regional elites have severely repressed social movements throughout the region, in many cases denying the rights to traditional territories and assassinating their leaders, as in the iconic case of Brazilian rubber-tapper leader Chico Mendes in 1988 (Vadjunec et al., 2011) and, a decade later, also in Brazil, of activist nun Dorothy Stang (LADB 2007; May 2015). Far less noted, in the absence of international profiles, have been the hundreds of assassinations of peasant and IP and LC leaders. Brazil, and Pan-Amazonia more generally, lead in the frequency of murders of human rights activists, Indigenous rights leaders, and forest guardians.

Democratization in the 1980s and 1990s allowed Amazonian civil societies greater opportunity to participate in policy debates in both rural and urban areas. Their social movements have stimulated various efforts to implement more inclusive and just forms of governance in the Amazon. A high point took place in Belém (Brazil), where, between 1997 and 2001, a vibrant participatory budgeting initiative was implemented to discuss small urban infrastructure for community-determined projects. From 1999-2007 the "Forest Government" of the state of Acre (Brazil) inspired by the rubber tappers movement implemented a series of policies to stimulate social, environmental and economic policies designed to support livelihoods based on forest product use and processing (Schmink 2011; Schmink et al. 2014).

In rural areas, new kinds of land claims gained traction following Brazil's 1988 Constitution, which recognized the territories of many kinds of traditional peoples, including Indigenous, afro-descendent, rubber tappers, non-timber forest product extractivists of many kinds, traditional fishers and communities in sustainable development reserves. Better area protection legislation allowed new conceptualizations of socio-environmental forms of conservation in inhabited landscapes that were emulated in other parts of the world (Allegretti and Schmink 2009; Supplementary Material, Appendix S5).

CONCLUSIONS

The great Brazilian writer Euclides da Cunha noted that Amazon countries would never really come into their own histories and identities until they began to understand the implications of their Amazonias. The Amazonian transformations presented in this review are framed by the complexity of Amazonia's environment, the antiquity of human co-existence with the region's natural resources, and now the powerful forces that have imposed dramatic, and in many ways novel, configurations on Amazonian peoples and nature, especially over the past half century. While forms of government have shifted among authoritarian, illiberal and liberal regimes from the left and the right, the Amazonian question remained essentially the same: What to do with a vast illegible national territory, infused with the myths and realities of riches, barely understood, historically inhabited and with extremely complex ecologies that generated a long history of settlement collapse and instability. Populations reflect millennial traditions and deep adaptations, as well as those who have arrived much more recently. What to do with an ecologically exuberant terrain that is largely incomprehensible to planners, capitalists, farmers and the political classes located in the capitals and regional centers, who often decide its fate? Over the last 50 years, Amazonia was thrust into the current world through the ideologies and practices of modernization, and massive ecological, socio-cultural and economic simplifications. This resulted in the shredding of the fabric of Amazonian lives, and turned complexity into monocultures and mines, degraded pastures, struggling smaller farms, and precarious cities. The largest tropical forest on the planet became one of the most urbanized places in the developing world. What was one of the great carbon absorbers has now become an emitter.

For modernization to advance, the complexity of forests had to be reduced from multiplicities to landscapes of a few species at most, and much of this devoted to animal feed of soy, corn and grass. Over huge areas, land was stripped of DNA and carbon stocks through fire, producing enough ash to darken cities thousands of kilometers away. This was done in the name of bringing civilization to the tribal, religion to the heathen, taming the wild, national sovereignty, nation building, geopolitics, poverty alleviation, national integration, agrarian reform, territorial governance, market triumphalism, and transformation of the means and the modes of production into a mostly capitalist idiom. It also meant that Amazonia would become one of the largest planning terrains on the planet, second only to China, and in many ways, the graveyard of failed regional plans. Modernization has moved Amazonia from its traditional forms into a caricature of modernity (urban, secular, waged, monetized), largely lacking the larger welfare improvements that politically and economically justified ravaging Amazonian lands and waters. As nation states made their mark on Amazonian lands, gridding them out, creating new settlements, and punching roads through forests, Amazonian countries have reinvented resource dependency as national economic strategies, key elements of their foreign exchange. This has been achieved through the expansion of mining, fossil fuel extraction, monoculture agriculture, and infrastructure to support the export and flight of national wealth, and the creation and re-creation of inequalities. Large clandestine economies of plundered timber, stolen lands, illegal gold and its mercury-laden waters,

clandestine coca production, and continuing streams of migration, seasonal labor, and a bricolage of urban and rural livelihood tactics frame the contours of the precarity of much of the region's population. The modernization development model, as it is currently deployed, incarnates externalities as an essential feature of the process, with the true costs borne at multiple scales, from local ecological destruction and species extinctions, social dislocations, and emiseration to regional and global climate change. The prevailing definitive forms of destruction lock in what may be irreversible landscapes and lock out alternative ideas and practices that would allow regional populations to advance as multiple and hybrid forms of modernity based on systems of local knowledge, social innovations and equitable outcomes that support environmental services rather than the systems of almost colonial plunder that currently dominate.

In spite of their importance, cities, towns and villages remain more or less out of the discussion, even as they are now home, at least part of the time, to the large majority of Amazonian inhabitants. How these urban areas will adapt and shape their hinterlands, and how people's complex livelihoods will unfold under increasing social instability and exceptionally high vulnerability to climate events, are still largely off the radar. Moving forward, the insights and interests of local people, both urban and rural, native and migrant, and especially the region's diverse and highly organized Indigenous peoples, are the key touchstone for a dramatic shift in the approach for sustainable development and conservation in the Amazon.

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SUPPLEMENTARY MATERIAL

Hecht *et al*. Amazonia in motion: Changing politics, development strategies, peoples, landscapes and livelihoods

Appendix S1. Amazon ascendency: shifts in Amazonian resource conservation

The late 20th century Amazon was seen as a solution to several kinds of ideological, political and economic national problems by Pan Amazon countries, including some which were more-or-less resolved. These included 1) national integration; 2) geopolitical concerns over boundaries after the Peru Ecuador boundary dispute had been largely resolved; 3) problems of political insurgencies, whether real or imagined (although Plan Colombia had reconfigured Cold War politics into the War on Drugs); 4) issues of Indigenous populations, especially human rights, in ways that were nominally satisfying to international observers; 5) potential economic gains and exploratory resources including extractive resources and global commodities; 6) means of resolving agrarian issues without engaging structural reform in other, more politically delicate, regions, and where reform was vigorously resisted by national elites; 7) a means of "modernizing traditional agriculture" in new spatial contexts that would not antagonize local landed oligarchs, a critical element in national political alliances; 8) the elaboration of the technologies that would fuel the agro-industrial sectors of the economies via innovations in soy/corn rotations, new pasture grasses and the introduction of oil palm; and 9) rhetorical and actual environmental policies and institutional development as new parts of nation-state building.

We can perhaps summarize aspects of these shifts in the following points that evolved in the post-authoritarian period, in terms of conservation, development approaches, and emergent regulations. As part of this process of economic change and increasing engagement in civil societies, a series of other shifts, although contested, portended a new kind of uneasy politics. These can be summarized as "epistemic shifts" in institutional development at the level of the states and new market dynamics. These also produced emergent properties and new drivers that now shape Amazonia.

Epistemic shifts

1 - In a profound shift from the set-aside--- reserve or park--- conservation model, inhabited landscapes were now recognized to have conservation value, as well as economic value, and their stewards deserved rights and recognition, substantively changing land rights for traditional and Indigenous populations (Brondizio 2008; Cronkleton et al. 2008; Padoch et al. 2011; Vadjunec and Schmink 2012; Easdale and Domptail 2014; Hecht 2014b; Bruzaca and Sousa 2015; Schmink et al. 2017; Bebbington et al. 2018b; Brondízio et al. 2021b; Domingues and Sauer 2023).

2 - Agroecological and socioecological critiques of monoculture agriculture and livestock development models have been accompanied by the rise of agroecological experiments and sustainable alternatives as a response to externalities, and to enhance the subsistence and ecosystem-services subsidy from nature and support of environmental services. These have received national as well as international support and are summarized in the actions of the Pilot Project for Amazon development (PPDAM) (https://infoamazonia.org/en/2023/04/14/ppcdam-new-plan-against-deforestation-includes-techhttp) and figure as well in Brazil's role in formal international agreements such as the Paris Climate Accords (https://www.un.org/en/climatechange/paris-agreement), and Aichi (now Montreal) Biodiversity agreements (https://www.nytimes.com/2023/08/08/climate/amazon-rainforest-belem-protections.html), among others.

3 - Nature has been granted standing and legal rights, at least at the rhetorical level: The *Pachamama* earth mother and other rights of nature have legal standing in the constitutions of Ecuador and Bolivia. Other kinds of rights of organisms, mountain places, and rivers are also being integrated into doctrines of rights and as forms of non-human beings and entities. These represent a movement of Indigenous ideas into mainstream jurisprudence at least conceptually (Heckenberger 2013b; Berros 2021; Fitz-Henry 2022). These also underpin new forms of arguing for territorialities and complexities in forms of social organizations and increasingly at the level of international organizations (Escobar 1999; Canessa and Picq 2014; de la Cadena 2015; Jensen et al. 2017; Demaria et al. 2020; Escobar 2020).

4 - Traditional tenurial regimes and territories became legally and constitutionally recognized through historical rights and ancestral use (i.e., *quilombos*, Palenque or Maroon lands; traditional and extractive reserves). These also ratified Indigenous rights and autonomy. In the Brazilian constitution these are elaborated in Article 231 (Indigenous land rights) and Article 68 (Quilombola Land rights).

5 - Amazonia has been increasingly recognized as a "socio-environment" constructed through people's historical geo-biotic transformations of forests, soils and engineering works, based on archeological, ethnographic and historical research (Balée 1998; Fausto and Heckenberger 2007; Heckenberger et al. 2007; Parssinen et al. 2009; Neves 2011; Clement et al. 2015; Athayde et al. 2017; Watling et al. 2017; de Souza et al. 2018; Levis et al. 2018; Maezumi et al. 2018; de Paula Moraes and Neves 2019; Saunaluoma et al. 2021; Lombardo et al. 2022).

Emergent legislative and regulatory apparatus

1 - New ministries were created in all Pan Amazonian countries, allied to ideas of sustainability and resilience.

2 - Existing ministries took on expanded environmental portfolios (Hecht 2012).

3 - New technologies for land demarcation such as Terra Legal (Legal Land) and CAR (*Cadastro Ambietal Rural*) in Brazil, as well as social mapping and historical claims (Oliveira 2013; Arima et al. 2014; Oliveira and Hecht 2016; Azevedo et al. 2017) were used to mediate and regularize land claims; however: this geolocated land required access to GIS systems that might not be available to many rural people. Further, land demarcation did little to slow land grabbing and land fraud (Grajales 2015; Carrero et al. 2022; Costa et al. 2023; Kröger 2024).

4 - Environmental legislation expanded and Pan Amazonian countries were integrated into international environmental agreements at national and local jurisdictional levels, including the Kunming- Montreal biodiversity targets (https://www.nature.com/articles/s44185-024-00039-5) and ILO Indigenous informed and prior consent (https://www.un.org/esa/socdev/unpfii/documents/workshop_FPIC_ILO.doc#:~:text=The%20Convention%20requires%20that%20indigenous,to%20their%20cultures%20and%20characteristics), among many others.

5 - Enhanced international support emerged for alternative development models (Amazon Pilot project) and other sustainable research and practices mentioned earlier.

6 - Enhanced deforestation and land use monitoring and modeling emerged as a key technologies for understanding land-use change (Turner et al. 2007; Plieninger 2012; Dutrieux et al. 2015; Floreano and de Moraes 2021; Feng et al. 2022).

7 - Reassessment of forest codes, rural land codes and property laws (Soares-Filho et al. 2014; Schmidt and McDermott 2015; Brito 2017; Santiago et al. 2018; Brito 2020).

Market dynamics

1 - Increased integration into global markets (especially China) for non-traditional Amazonian commodities (e.g., soy, African oil palm) as well as timber, gold and beef; decline in the US as main trading partner (Fearnside et al. 2013; Kuepper et al. 2019; Marimón et al. 2021; McKay and Colque 2016; Søndergaard et al. 2022; Moreira et al. 2023; Wesz Jr et al. 2023).

2 - Expansion of clandestine markets. (https://www.unodc.org/unodc/en/data-and-analysis/world-drug-report-2024.htmlhttps://brasil.mapbiomas.org/en/2023/09/22/amazonia-concentra-mais-de-90-do-garimpo-no-brasil/).

3 - New attentiveness to supply chains and their pressure points (like the soy moratorium), deforestation-free products and ecological/bioeconomy products like açaí and organic cacau (Gibbs et al. 2015; Garrett et al. 2018; Lambin et al. 2018; Heilmayr et al. 2020; Costa et al. 2024).

4 - Expansion of green fair-trade markets (açaí, cacau, rubber, Brazil nuts (Abramovay et al. 2021; Costa et al. 2022; Araujo et al. 2024; Fonseca and Lima 2024).

5 - Increased certification, but continuing problems especially with timber (Clark and Kozar 2011; VanWey and Richards 2014; Brancalion et al. 2018).

6 - Expanded demand for fast-growing timber from small farms (Sears et al. 2018).

7 - Leakage into less-regulated systems triggered significant deforestation in non- Amazonian forests (Fearnside 2009b; de Waroux et al. 2016; Miranda et al. 2019; Meyfroidt et al. 2020; Moffette and Gibbs 2021; Villoria et al. 2022).

Appendix S2. Traditional and environmental settlement programs in Brazilian Amazonia

Brazil's National Institute for Colonization and Agrarian Reform (INCRA) classifies federal settlements into two groups. The traditional model consists basically of gridded areas divided into distinct parcels (*lotes*), usually part of a plan involving an *agrovila* (a planned agricultural village). These involve settlement projects (*projetos de assentamento*, PAs), integrated colonization projects (*projetos integrados de colonização*, PICs) and directed settlement projects (*projetos de assentamento direcionados*, PADs). The latter include resettlement projects. These settlements allow colonists to acquire formal possession of the parcel after a few years. The justification for these settlements usually involves arguments about social justice, modernization, and regional food production. These settlements are based on private property regimes for the most part and are dominated by annual crops and pasture. Land rights associated with spontaneous occupation usually involve clearing land for claiming and recognition of the holding by INCRA.

Environmentally distinctive settlements arose more recently in Brazil due to the pressure from traditional populations to recognize historical land rights over forest-based populations and their livelihoods. These kinds of settlement are meant for traditional populations, to support activities with low deforestation impacts, such as agro-extractive activities and sustainable forest management - agro-extractivist settlement projects (*projetos de assentamento agroextrativista*, PAEs), sustainable development projects (*projetos de desenvolvimento sustentável*, PDSs) and forest settlement projects (*projetos de assentamento florestal*, PAFs). These can either be new kinds of settlement or involve regularization of existing holdings, which are often characterized by collective rights or long-term access rights. Environmentally distinctive settlements can be

installed in areas of primary forest, whether or not the areas have previously been inhabited by traditional populations, and may be organized around *agrovilas*, where the families live. Lots destined for the settlers' production are located elsewhere in the settlement, in some cases far from the *agrovila.* Settlements with collective land rights can be divided into individual parcels if settlers request an individual area, or if division into parcels is needed to avoid territorial conflicts between settlers.

Environmentally distinctive settlements are associated with the language of sustainability and are less deforested than traditional settlements, but the dynamics of deforestation follow the classic pattern: taking out the valuable timber, clearing for annual cropping and or pasture, producing forest fragmentation, and shifting to pasture over the long-term (Costa 2021). These proximate drivers can also reflect indirect non-legal processes such as illegal logging, land grabbing through clearing to claim and other forms of land fraud, money laundering and single owners acquiring multiple lots. Recurrent problems include limited credit for activities other than livestock, poor levels of technical assistance, limited monitoring of ownership patterns and clearing size, as well as widespread clearing in protected areas (BenYishay et al. 2017; Nogueira et al. 2018b; Domingues and Sauer 2023). The literally devastating result is that settlements contributed to 17% of the total forest clear-cutting and 20% of the total carbon loss in Legal Amazonia (Yanai et al. 2017). Despite only 8% (397,254 km^2) of Legal Amazonia being occupied by settlements, and most of the cumulative deforestation (83%, 806,593 km^2) being outside of the settlements analyzed, the contribution of these settlements to deforestation rates and to carbon loss were both substantial and increased over time. Most of the carbon stock loss (2.2 Pg C or 86% of the total carbon loss in settlements) occurred in settlements situated in the arc of deforestation, where deforestation pressure is intense and the number of settlements is large (2190 settlements or 80% of the total) (Yanai et al. 2017).

Appendix S3. IIRSA/COSIPLAN: Highways and waterways of integration

The Initiative for Regional Infrastructure Integration in South America (IIRSA), created in 2000 and managed by the South American Council of Infrastructure and Planning (COSIPLAN) since 2009, established a framework to promote a series of coordinated strategic mega-infrastructure investments at a continental scale. The initiative breathed new life into longstanding development narratives of connectivity, integration, and economic growth, but now combined with the urgency of increasing competitiveness in a globalizing world. IIRSA/COSIPLAN proposed to support the transformation of Amazonia through a series of ten strategic integrated development corridors or hubs connecting countries in the region with each other and to global markets (Killeen 2007; Bebbington et al. 2018b, Marimón et al. 2021). The portfolio of projects included some 544 priority investments totaling over USD 130 billion (http://www.iirsa.org/proyectos). The larger vision included the creation of navigable waterways, a system of ports and logistical centers, a transcontinental railway with over 15,000 km of new track, and improvements to ~2 million km of roads, in addition to modernizing the telecommunication systems and standardizing and harmonizing regulations in support of the efficient flow of goods and services. The initiative also encourages private sector participation and introduces innovative financing arrangements to overcome the types of bottlenecks experienced in publicly funded infrastructure projects.

One of the greatest challenges to continental integration has been the construction of terrestrial transport corridors connecting Atlantic and Pacific ports. The Southern Interoceanic Highway, spanning over 2,600 km, and connecting Brazilian and Peruvian ports, was inaugurated in 2011 to great fanfare. More recently, the highway has drawn criticism for overstating the amount of commerce that would travel the highway, the lack of social and environmental safeguards, and for the significant deforestation and illegal gold mining that it has induced. In addition to the Southern Interoceanic Highway, Peru continues to develop a Northern Interoceanic route involving a combination of investments in road building, river navigation (the proposed Amazon waterway) and port development. Finally, a third route, the Central Interoceanic Highway has improved the road network linking Lima to Pucallpa, leaving open the possibility of a terrestrial connection to Cruzeiro do Sul in Acre (Wilson and Bayón 2015; Jensen et al. 2018; Oliveira et al. 2019; Perz and Hurtado 2023).

In Brazil, as with the other Pan Amazonian countries, national infrastructure plans complement and reinforce larger regional integration objectives. Brazil's Agenda for Priority Integration Projects earmarked nearly 70% of its USD 20 trillion budget to support the construction of multi-modal systems of transport (roads, rail and waterways) (Bebbington et. al. 2018). Investments in these systems of transport are attractive because they are high-value projects, highly visible, and create synergies with other potential investments including land speculation. They have also been sites of spectacular corruption (Durand 2019; Campos et al. 2021; Jacopo 2022).

The vast infrastructure network envisioned for Amazonia is intended to connect remote sites of production and extraction, reduce transport costs, and increase the efficiency of transporting commodities destined for foreign markets, especially China. Improving access infrastructure in Pan-Amazonia is clearly a priority for both subnational and national governments; however, a recent study found that many of the proposed roads – out of an analyzed portfolio of 75 proposed road projects - did not include sufficient impact assessments

of social and environmental impacts, nor were the projects found to be financially viable (Vilela et al. 2020).

Appendix S4. The social impacts of dams

Displacement of population

Displacement of population is the most dramatic human consequence of hydroelectric dams. The full weight of this impact falls on those who have the misfortune of living in a place chosen for flooding by a dam reservoir, while the benefits of the dam go to people in distant cities and industries. Environmental justice has become one of the primary concerns with Amazonian dams and especially the mega-dams of Brazil (Fearnside 2020), but the story is a good deal longer and of global reach (Lobach 2023). The 23,000 people displaced by the Tucuruí Dam in 1984 still suffer the consequences of their displacement (Santos et al. 1996; Fearnside 1999). Those displaced by the Madeira River dams in the 2000s are also suffering (Baraúna 2014; Simão and Athayde 2016). For the Belo Monte Dam, a large population of riverside dwellers was displaced and moved to urban settlements distant from the river, with dramatic consequences both from the loss of livelihood and from the loss of their physical and social environment (Magalhães and da Cunha 2017). Meantime a massive influx of migrants moved into the regions of dam construction, local displacements and social unrest became rampant and the value of the dam itself was brought into question (Calvi et al. 2020; Weißermel 2020; Mayer et al. 2021; Mayer et al. 2022).

Loss of livelihoods from fisheries

Dams have severe impacts on natural ecosystems. These changes lead to a loss of the fisheries that sustain much of the human populations in areas flooded by reservoirs, and in the river stretches both below and above the reservoir. In the case of the Tucuruí Dam, in Pará (Brazil), the fisheries below the dam declined precipitously, both for fish and for freshwater shrimp, eliminating the fishing fleet at Cametá (the main city in the lower Tocantins) (Odinetz-Collart 1987; Fearnside 1999, 2001b). Fish-landing data along the length of the Tocantins River show that the fish production in the Tucuruí reservoir never compensated for the loss of fish production in the natural river (Fearnside 2001b; Cintra 2009). The fish production in Amazonian reservoirs is minimal. At the Balbina Dam (Amazonas state, Brazil), commercial fishing had to be banned beginning in 1997 due to the fish population's precipitous decline (Weisser 2001). The Santo Antônio and Jirau dams on the Madeira River (Rondônia state, Brazil) destroyed one of the world's most productive fluvial fisheries that had supported large populations of fishers in Brazil and upriver in Bolivia and Peru. Impacts come from blocking fish migration, including the famous giant catfish of the Madeira River, from impeding the descent of fish larvae spawned in the river's headwaters, from the reservoirs' unfavorable environment for many species, and from reduction of nutrients associated with the sediments (Fearnside 2014; Forsberg et al. 2017; Faleiros and Isensee e Sá 2019). Hydropower development can negatively affect perceptions of fishery sustainability and exacerbate existing weaknesses in fisheries governance (Doria et al. 2021).

Indigenous populations

Indigenous peoples suffer the same impacts as other dam-affected people, plus some that are unique to these groups. The loss of sacred sites is particularly serious, and this is not even considered as an impact in the environmental impact assessments (EIAs), as in the case of the proposed São Luiz do Tapajós Dam, in Brazil, which would flood the site where the great ancestor of the Munduruku people created the Tapajós River (Fearnside 2015b). Most traumatic for the Munduruku was the dynamiting in 2013 and flooding in 2014 of the Sete Quedas falls to make way for the Teles Pires Dam (Branford and Torres 2017). This is the place where the spirits of deceased tribal elders reside – the equivalent of Heaven for Christians. Sacred sites were also destroyed in 2017 by the São Manoel Dam 40 km downstream, and tensions with the residents of the Kayabi Indigenous Land, located only 700 m from the dam, have resulted in Brazil's National Force being deployed to the site to protect the dam (Fearnside 2017c; Mondo 2018). These cases illustrate the problem of sites located outside of Indigenous lands that are vital to the Indigenous groups, in these cases destroying both fisheries and sacred sites.

Dam impacts can result in severe losses of Indigenous cultures. In the case of the Balbina Dam, the two largest Waimiri-Atroari villages were flooded, and the displaced population moved to the roadside of the BR-174 (Manaus-Boa Vista) highway, where they were on their way to cultural as well as physical elimination. After a disastrous delay, the hydropower company (Eletronorte) financed a program that convinced the group to leave the roadside and build a new village in the forest (Fearnside 1989b). The group has survived and increased in population but has paid a heavy price in cultural loss under the influence of the power company's program (Rodrigues and Fearnside 2014). Less known is the complete replacement of the venerable Saramaka polities in Suriname, were multiple villages were flooded for a dam for a short-lived aluminum enterprise that later collapsed (Lobach 2023).

The Belo Monte Dam (Pará state, Brazil) did not flood Indigenous land, but it diverted 80% of the water in the Xingu River to flow to a powerhouse 100 km downstream from the main dam, leaving the "Big Bend of the Xingu" (*Volta Grande do Xingu*) with very little water. Two Indigenous lands are located along this stretch, and a third group on a tributary that joins the Xingu River in this stretch also lost the fishery grounds on which the group depends (de Oliveira and Cohn 2014; Villas-Bôas et al. 2015). As severe as these

impacts were, they were dwarfed by the impact that would be caused by planned dams on the Xingu River upstream of Belo Monte (Fearnside 2006). Belo Monte is completely unviable economically without water stored in upstream dams, making it clear that official denials of the original plans for these dams represent disinformation (de Sousa Júnior et al. 2006; Fearnside 2017b). The first priority would be the Babaquara Dam (officially renamed as the Altamira Dam, but best known by its original name), which would flood 6140 km^2, twice the size of the Balbina or Tucuruí reservoirs, almost all of which is Indigenous land (Fearnside 2006).

Health impacts

Dams have health impacts on people who live around reservoirs or eat fish from them. Mercury is naturally present in Amazonian soils because they are millions of years old and have been receiving mercury in the rain as a result of volcanic eruptions that injected mercury into the atmosphere (Gerson et al. 2022). Additions of mercury from its use in alluvial gold mining can also occur, but they are not necessarily present in substantial amounts at the bottom of reservoirs. The water in reservoirs like Tucurui or Balbina stratifies into layers based on temperature, and the cold water at the bottom does not mix with the warm water near the surface (Fearnside 2001b; Moreno-Brush et al. 2020; Crespo-Lopez et al. 2021). The result is that oxygen in the water at the bottom is soon depleted as leaves and other forms of organic matter are converted to CO_2. In this environment without oxygen, mercury is converted into the highly toxic methylmercury, which is absorbed by plankton, and passes up the food chain to fish, increasing approximately ten-fold in concentration with each link in the food chain (Maurice-Bourgoin et al. 2000). High concentrations of mercury have been found in reservoir fish and in the hair of people who eat these fish at Tucurui (Arrifano et al. 2018; Leino and Lodenius 1995) and Balbina (Forsberg et al. 2017; Weisser 2001).

Insects represent another health risk from reservoirs. The dramatic mosquito plague at Tucuruí was an enormous explosion of mosquitos of the genus *Mansonia* that were breeding in the floating macrophytes in the reservoir (Tadei et al. 1991). Mosquitos have a painful bite, but the main disease they can transmit (filariasis or elephantiasis) is not yet present in Brazil, although it is present in Surinam and French Guiana. Other mosquitoes, such the *Anopheles* species that spread malaria, can also breed in reservoirs (Sánchez-Ribas et al. 2012).

Downstream impacts

The river downstream of a dam changes in ways that have negative impacts for the many human residents of these areas. These include fish die-offs, as well as retention of sediments in dams that deprive the downstream river of the nutrients associated with these particles, thus jeopardizing the base of the food chain for fish production. The Madeira-River dams in Brazil reduced downstream sediments (Latrubesse et al. 2017), and downstream fish catches have declined markedly (Santos et al. 2020). The sediment retention by dams planned in Peru and Bolivia would have impacts on fisheries along the entire length of the Amazon River in Brazil (Forsberg et al. 2017).

Social effects of migration

Social effects of migration to the dam construction area are notable. While a few entrepreneurs can earn fortunes from the local economic boom during the construction phase, most of the population loses heavily. Altamira, the city nearest to the Belo Monte Dam, experienced increases in prices of rents for housing and of basic household expenses, making the city unaffordable for many original residents. There was also an explosion of violence, with Altamira being rated the most violent city in Brazil (Sales 2017). A long list of urban problems accompanied the dam construction (Miranda Neto 2015; do Nascimento 2017; Gauthier and Moran 2018; de Souza and da Costa Oliveira 2021).

Appendix S5. Insurgent citizenship (Holston 2009): Social movements and social change

While the fiscal crisis of the 1980s and 90s implied diminishing availability of funds for big infrastructure (except roads), the situation started to change in the mid-2000s, especially in Brazil. With the creation of the Program for Growth Acceleration (*Programa de Aceleração do Crescimento* -PAC) in 2007, major funds became available for both urban and regional large-scale infrastructure in Brazil. These initiatives have met with massive and highly-publicized popular resistance from the lowlands to the Andes (Canessa 2014; Jerez et al. 2015). In the mid-1980s, social and environmental movements in Brazil joined together to protest the Cuiabá-Porto Velho highway (BR-364), attracting international and national attention (Hecht and Cockburn 1989; Schmink and Wood 1992; Hochstetler and Keck 2007). In Ecuador, the Waorani people have been struggling for reparations from Texaco/Chevron and PetroEcuador for the devastating impacts of drilling operations, including a lawsuit under litigation in US court since 1993 (Kimerling 2005; Pellegrini et al. 2020). More recently, grassroots groups have protested the construction of a road in the Isobore Sécure National Park and Indigenous Territory –TIPNIS in Bolivia (McNeish 2013), the Camisea pipeline in Peru (Urteaga-Crovetto 2012), and the mega-hydroelectric power plant of Belo Monte in Brazil (Fearnside 2017a), to name just a few contentious projects.

National and subnational governments in the Pan-Amazon have generally resisted attempts to create more robust participatory institutions through which affected communities can engage in informed consent around big infrastructure projects (Bebbington et al. 2018, 2019). In Brazil, community

participation in decision-making about such projects is almost entirely reduced to environmental permitting hearings late in the process, with little practical impact on decision-making (Zhouri 2011; Abers 2016). Land-use zoning efforts, popular in the 1990s, were an opportunity to engage community participation, but these plans were frequently overturned or approved without effective participation (Bratman 2019).

In the 2000s, left-leaning national governments throughout the region promised a more participatory and sustainable approach to mega-projects. One example was the BR-163 road paving project in Pará and Mato Grosso states in Brazil. The federal government approved a Sustainable Development Plan for the region designed by civil society groups through extensive consultations. Unfortunately, it was never implemented (Abers et al. 2017). This area was critical due to the threat of soy expansion into smallholder, Indigenous lands, extractive reserves, and *ribeirinho* lands, and later, during the Bolsonaro regime, ranchers and soy producers embarked on a *dia de fogo* in a show of resistance to the forest support initiatives (https://www.greenpeace.org/brasil/florestas/dia-do-fogo-completa-um-ano-com-legado-de-impunidade/). Similar promises were made about the Belo Monte dam, and a Regional Development Plan for the Xingu (PDRSX) was modeled after the defunct BR-163 plan. Civil society groups, however, have reported difficulties getting their proposals approved through the participatory mechanisms created to implement the plan and the meanings of sustainability are themselves contested (Bratman 2019).

In the absence of effective participatory structures, local and especially Indigenous movements have sometimes made headway through protest. The Indigenous March of 1990 (*Marcha por el Territorio y la Dignidad*) influenced Bolivia's forestry law (1996) and struggles for territorial recognition and control (Barroso 2014). In Ecuador, *La Gran Marcha* of 1992 won the recognition of Indigenous land rights. Recent protest caravans by Indigenous populations in Europe have focused on the impacts of European consumption patterns, the encroachment on lands and violence against Amazonian indigenous peoples, and the lack of prior consent. These contributed to questions about the large-scale MERCOSUR trade agreements, especially deforestation, in light of Amazonian destruction and human rights problems (https://www.euractiv.com/section/eet/news/eu-mercosur-deal-likely-to-include-legally-binding-deforestation-clampdown/). The 2024 Ecuadoran national referendum supported leaving Yasuni oil in the ground (https://www.oneearth.org/ecuadors-yasuni-oil-referendum-a-climate-game-changer/.)

Another way in which Amazonian movements have influenced political institutions is through the dissemination of the concept of *Buen Vivir* (Good Living), which has been included in the constitutions of Ecuador, Bolivia, Colombia, and Peru. Throughout the Andes and Amazonia, Indigenous cultures have concepts of a healthy life based on traditional knowledge and lifeways, and of caring for the environment: in Quechua (Ecuador), *Sumak Kawsay,* in Aymara (Bolivia), *Suma Qamaña;* in Guarani, *Teke Porã;* and in Baniwa (Brazil), *Manakai* (Ihu 2010; Cruz and Pereira 2017). These ideas have been translated into Spanish as *Buen Vivir,* a paradigm that deprioritizes economic growth and puts people's lives, nature, and basic rights to education, health, and social equity at the center of development (Alcantara and Sampaio 2017: 232). These ideas reside at the heart of many Amazonian cultures and represent different kinds of episteme, a normative and foundational principle that informs behavior. *Buen Vivir* is an important example of how social movements can contribute to debates about alternative models of development.