Priorities for governing large-scale infrastructure in the tropics

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The G-20 predict that, at current rates, investment in new infrastructure will amount to $78.8 trillion by 2040 (1). As large as this number appears, the G-20 argue that this leaves an "infrastructure gap" of almost $15 trillion over the same period, hampering possibilities for economic growth. National, intergovernmental, and international bodies have prioritized investment in large-scale infrastructure as a central development

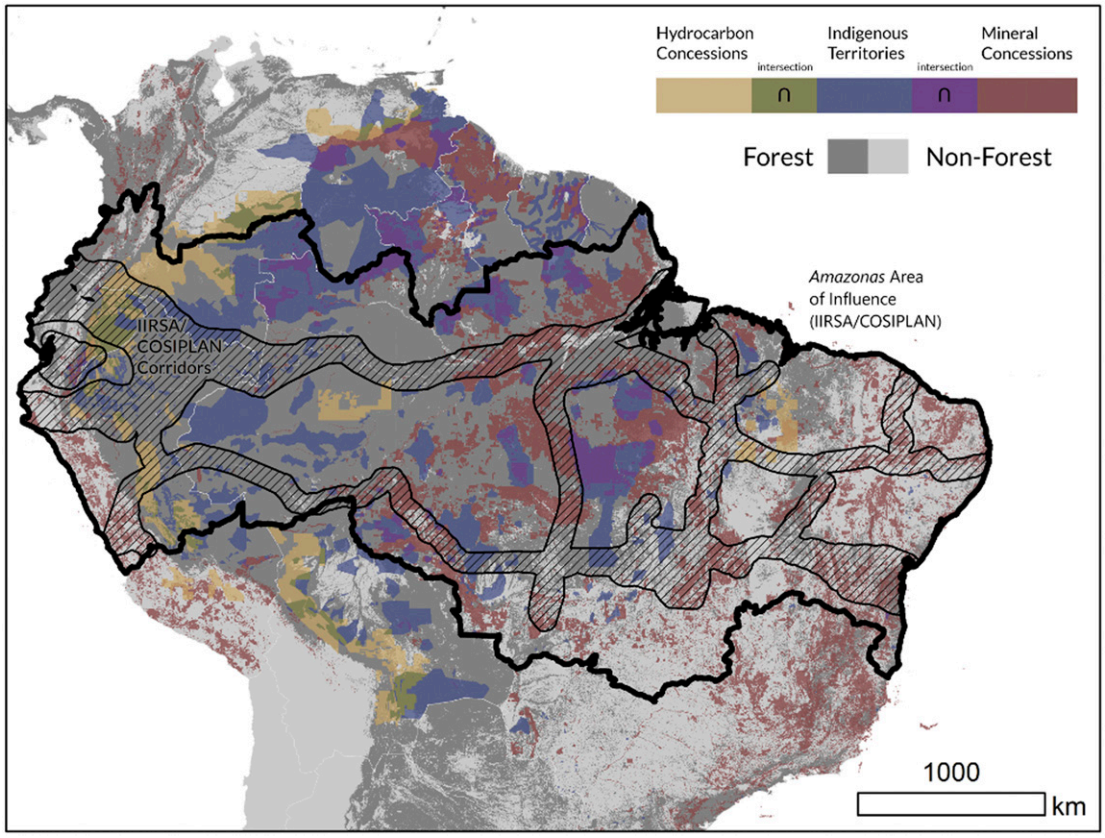

Fig. 1. The map shows the spatial relations among infrastructure, mining and hydrocarbon concessions, and indigenous territories in the Amazon.

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strategy (2). The Chinese government's Belt and Road Initiative, the South American Council for Infrastructure and Planning (COSIPLAN, formerly the Initiative for the Integration of Regional Infrastructure of South America, IIRSA: Figure 1), and the creation of the Asian Infrastructure Investment Bank illustrate this commitment.

Access to infrastructure can enhance human well-being—indeed, an egregious lack of sanitation and health infrastructure contributed greatly to the explosion of coronavirus disease 2019 (COVID-19) in Amazonian cities such as Iquitos, Manaus, and Belem. But the large-scale, "mega"-infrastructure approach to development has enabled projects that have had adverse socio-ecological effects, run over budget, and facilitated corruption made possible by the immense sums of money involved, opaque contracting practices, and land speculation. The "infrastructure as development" model has not always had felicitous outcomes in temperate climates either: Consider, for instance, impacts on forest loss, salmon runs, soil salinization, and land subsidence in the United States.

The current political context challenges any effort to strengthen the socio-ecological governance of large-scale infrastructure, but it also presents opportunities.

Transferred to humid tropical forest environments in times of accelerating climate change, these approaches to development appear questionable: They are largely irreversible in the medium term; they risk aggravating forest loss, freshwater/river fragmentation, anthropogenic climate change, and biodiversity loss; they fuel land conflicts and unproductive land speculation; and they trigger chaotic rural and urban migrations, cause social displacement, and impact vulnerable and culturally diverse populations. Such approaches have delivered infrastructure that is not resilient to climate change. Indeed, this infrastructure's lifespan will be shortened by climate change and ecological instability, making its financial justification more questionable than ever. Our own experiences suggest that these risks are especially acute in South America (Figure 1), where the survival of tropical forests and forest peoples, many of whom play vital roles in forest preservation and regional economies, must be central to local climate resilience and to any viable global strategy to avoid calamitous climate change.

Given these flawed approaches, we advocate for a new agenda of infrastructure governance based on the foundational principles of sustainability science, and that involves: 1) a rethinking of development that assesses infrastructure primarily in terms of its contribution to the flourishing of humans and environments and to ecosystem connectivity and services; 2) a territorially based approach to planning with profound commitment to the participation of affected populations and the value of diverse forms of knowledge; 3) a linking of science and public action that deepens the quality of public debate, addresses the equity implications of infrastructure, and promotes the rights of humans and of nature. Despite the challenges of today's adverse political contexts, we argue that spaces for such innovation exist.

Building Pressure

Even in the midst of the COVID-19 pandemic, we hear intensifying calls to accelerate infrastructure investment. Political and business leaders frame infrastructure as a means of reactivating economies and incentivizing private sector investment. Pressure to weaken social and environmental safeguards linked to "fast-tracking" infrastructure projects—often advanced in national security language—and associated resource extraction is mounting, as already apparent in Brazil and in Peru (3). Political and economic leaders have suggested that public health-related restrictions on public protest, coupled with the press's focus on COVID-19, present opportunities to press forward on regulatory reforms facilitating infrastructure and extraction: Alberta's Energy Minister (4), Brazil's Minister of Environment (5), and various participants in the recent La Jolla Energy Conference on investment trends in Latin America have explicitly stated as much.

The current political context challenges any effort to strengthen the socio-ecological governance of large-scale infrastructure, but it also presents opportunities. COVID-19 creates space to reassess the environmental underpinnings of sustainable prosperity and the relationships between infrastructure, forests, and development. Taking advantage of this space requires "big" thinking that reimagines the meaning of development, as well as "detail" thinking to reevaluate how, when, and where infrastructure projects are pursued. It also requires an assessment of alternatives; an understanding of how social and environmental impacts are anticipated, acknowledged, and mitigated; an awareness of how as well as by and for whom decisions about investments are made; and clarity on where unviable projects should not proceed.

The accumulated work of sustainability researchers shows that the community has the capacities to contribute to such thinking, big and detailed, and to shift policy priorities and institutional forms towards integrative, sustainability-oriented outcomes across scales (6). The infrastructure–development nexus demands a response from sustainability science that combines *research with action* and links science to the platforms from which a new agenda for infrastructure governance can genuinely advance.

Infrastructure's Rewards and Risks

The infrastructure investment anticipated for Latin America includes highways, waterways, railways, ports, dams, power stations, infrastructure supporting extractive industry, and urban infrastructure for expanding cities, including in the Amazon basin. Most of the investment focuses on rural projects, in spite of the reality that most of the Amazonian population resides in cities.

The historical record shows that this human-made infrastructure has expanded the geographic scope, and increased the economic scale, of other investment. It has also compromised natural and socio-political infrastructure, understood as "the social and political norms, values, rules, and relationships that undergird and structure the myriad decisions made by public and private actors" (7).

The potential of infrastructure to provide market connection and mobility attracts support from some segments of local populations, as in the case of the proposed *Hidrovía Amazónica* in Northeastern Peru. In other cases, populations are more skeptical. Many Indigenous Miskitu in Honduras are resistant to road investments because they fear they will drive in-migration, new settlements, land grabbing, and deforestation. Their preference for a simple improvement in existing transportation services rather than new roads is similar to that expressed by Indigenous populations affected by the Camisea gas project in Peru. The construction and use of infrastructure has particularly serious effects on Indigenous peoples living in isolation, increasing exposures to disease and reducing opportunities for hunting and collecting forest and river products. Traditional, non-Indigenous, Amazonian populations have also been adversely affected and displaced from their lands, as high rates of deforestation and Amazonia's patterns of urbanization in informal and precarious settlements attest.

Infrastructure projects in undisturbed forests have been associated with loss of connectivity in natural ecosystems, disturbance of fish and animal migrations, reduced environmental resilience to climate change, surface and soil degradation, water contamination, disproportionate adverse impacts for women, and the emergence of new infectious diseases (8). In this sense, it would be ironic if one response to COVID-19's economic impacts is to intensify infrastructure investment in forests and thus *increase* possibilities for transmission of zoonotic infections (9, 10). Dams in the Amazon have led to increased methane emissions, concentration of mining pollutants such as mercury, interrupted patterns of fluvial deposition, disturbance to aquatic life, and increased malaria loads. These impacts are cumulative across space and time, an aggregate effect rarely captured in project-based social and environmental impact assessments (11). For instance, beyond its direct impacts on aquatic life, downstream sedimentation, and community rights, the Belo Monte dam in Brazil has catalyzed a large-scale mining complex and intensified urbanization, the expansion of precarious settlements, and in-migration processes, each placing pressure on surrounding forest cover and livelihoods.

Infrastructure investment can also reduce socio-political resilience to climate change. By eroding community cohesion, these investments compromise local adaptive capacities, whereas national capacities are weakened by the corruption that has often accompanied these projects—the iconic example being the sweeping bribery scandal led by a Brazilian-based international construction firm, Odebrecht, which has seriously undermined institutional legitimacy across many countries in Latin America. Focusing government attention on large-scale physical infrastructure also diverts public action away from investments in strengthening socio-political infrastructure (7). To promote infrastructure investment, some governments are deliberately passing reforms that weaken the institutions and organizations that offer protections to vulnerable populations and ecologies (see examples, Table 1).

Beyond such opportunistic rollbacks of protections, many factors lead to systematic understatement of the full costs of infrastructure. These include the political incentives that governments face to deliver public works within the electoral cycle and to respond to the pressures of local constituencies, the fear of losing private sector investment, the often unestimated socioeconomic consequences of the externalities of projects, and the temptations of corruption. The resulting undercounted costs are mostly related to undervaluation of: the natural and socio-political infrastructures and other social factors that make

Table 1. Reforms promoting infrastructure investment

Reform Type	Implications
Redefining projects as being in national interest/public utility	Allows for "fast-tracking" of large-scale infrastructure projects/investments that governments deem of national import; environmental impact assessment or participation processes may be "streamlined" to facilitate rapid project start (e.g., Brazil; Mexico)
Promoting public–private partnerships	Facilitates foreign direct investment in a range of activities, including electricity generation, intermodal transport, construction, etc. Generous reforms giving access to resources (land, water) and relaxing regulations to attract private investors. Modification of tax liabilities (e.g., Brazil, Colombia, Honduras, Mexico, Peru)
Restricting civic space	Undermines efforts by nongovernmental organizations (NGOs) and activists to investigate, publicize, and resist large-scale projects by facilitating government classification of such actions as political (and therefore in violation of rules governing NGOs) or a threat to public order or national security (e.g., Brazil, Guatemala, Nicaragua)
Easing protected area downgrading, downsizing, and degazettement	Allows governments to more easily change the status of protected areas and Indigenous lands to reduce "burdensome" regulations and prohibitions on infrastructure expansion and extraction etc. [e.g., Bolivia, Brazil, Colombia (12)]

development sustainable, institutions that protect the rights of peoples and nature, cumulative impacts of multiple infrastructure projects in the same watershed or region, and climatic and social factors that can shorten the productive life of investments.

An Agenda for Infrastructure Governance

A new agenda for infrastructure governance is urgently needed to better account for these costs and enhance the likelihood that infrastructure investment in tropical environments recognizes socio-ecological realities and enhances the resilience of socio-ecological systems. As a team of social scientists, grant makers, and civil society actors, we propose three dimensions to this agenda.

First, all stakeholders must rethink the relationship between infrastructure and development. Development must be thought of in ways that recognize the imperatives and impacts of climate and global environmental change. There is clearly a place for infrastructure within development understood as a process that enhances the rights and well-being of humans and of nature and that builds socio-ecological resilience. However, this thinking is quite different from the role that infrastructure plays within an idea of development which equates large-scale infrastructure with progress, emphasizes brick and mortar projects and the opening up of "empty" spaces and landscapes to settlement, and accepts disorganized and often violent processes of social change as normal. Assessing infrastructure in terms of its contribution to the flourishing of humans and environments, and to ecosystem connectivity and services, would lead to quite different forms of infrastructure enhancement (see partial examples below).

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Second, the processes for planning and deciding on infrastructure projects must prioritize territorial planning that incorporates analysis of cumulative impacts and involves those populations most impacted by new investments in decision making. Territorially based planning of infrastructure makes trade-offs explicit and would determine what roles territories are going to play within a more human- and nature-centered understanding of development. Such planning would acknowledge no-go areas for new infrastructure. Recognizing the equity consequences of infrastructure, and the grossly inadequate participation of affected communities, especially women, in infrastructure decisions to date, this planning would include local populations before preinvestment phases of the project cycle.

In many instances, this planning will result in calls for smaller-scale, multi-modal transport of benefit to local populations and for a more efficient use of the infrastructure that already exists, as opposed to new, highly disruptive large-scale investments. It is also likely to call for greater protections for Indigenous, Afro-descendent, and traditional land and territorial rights, as well as for conservation areas. To be effective, such planning will require coordination across diverse national and subnational government agencies, strengthened institutions, and bodies with the teeth to enforce these plans and ensure rights protection.

Third, the infrastructure agenda must be infused by the approaches of sustainability science, its socio-ecologically integrative approach to development and the explicit connections it makes between science and a politics of action (6). In our own case, this implies bridging analysis and grant-making to: 1) deepen public debate and communication, with a view to challenging dominant ideas of development and fostering new discussions of the place of infrastructure in enhancing socio-ecological resilience and flourishing; 2) address the equity consequences of infrastructure; and 3) support civil and public sector actors seeking to change territorial planning processes and enforce laws and regulations that protect and promote the rights of humans and nature.

Assessing infrastructure's impacts demands robust and comparative analysis of environmental, social, and human rights risks and benefits (13), calculated within models of socio-ecological systems that comprehensively capture proximate and cumulative interaction effects between infrastructure, societies, climate, and environment. At the same time, sustainability science must create space for more diverse forms of knowledge and ideas about development, be explicit in recognizing the political factors that drive the forms of infrastructural investment that compromise climate change mitigation and community rights, explore existential and ethical dimensions of socio-natural well-being, and link science with profoundly novel ideas about what neo-tropical forests could be in the future (14).

At first glance, there would appear to be little political space for this agenda. If it has not been pursued to date, why should it be pursued now? Political settlements among elites have prioritized resource extraction, agribusiness, and infrastructure, especially in Brazil but across all Amazonian and Mesoamerican countries (15). Militaries in the basin share these commitments to infrastructural integration, whereas civil society actors consistently struggle to find adequate responses to the scale and international configurations of these infrastructure investments. There are exceptions to this pattern, however, and they suggest how infrastructure could be governed differently.

For example:

- The Camisea gas project in southeastern Peru, notwithstanding its many critics, used an offshore approach to develop wells. This meant that rivers, helicopters, and other noninvasive means of access were used during site construction, rather than the building of roads which would have catalyzed

further colonization of the forest. This was in response to social protest and engaged science demonstrating the impacts that road infrastructure would have on biodiversity, forests, and Indigenous peoples.

- The designation of protected territories for Indigenous peoples living in isolation constitutes a form of territorial planning that establishes no-go areas for infrastructure. Legislation enabling such territories exists in several countries in the Amazon basin and, albeit currently under political pressure, is a result of long-term efforts combining science, advocacy, and social mobilization (6).
- The BR 319 road links Manaus (Amazonas) with Porto Velho (Rondonia). First opened in 1973, it became impassible a decade later. In 2008, the Brazilian government decided to repair the road but civil society organized itself. Their proposals to create new protected areas were implemented, thus minimizing deforestation. Currently, there is an effort to pave the road, and a participatory territorial planning process is underway to avoid rampant deforestation.

Finally, the work of groups such as the Amazonian Network for Socio-Environmental Information (RAISG), Law, Environment, and Natural Resources (DAR) and the Wildlife Conservation Society in Peru, the Project on Organizing, Development, Education, and Research (PODER) in Mexico, or the National Institute of Amazonian Research (INPA) in Brazil each embody the sort of agenda we call for: a combination of analysis, coalition building, crafting of common agendas, work with grassroots organizations most impacted by the new infrastructure agenda, and promotion of scientifically informed public debate.

These examples, although imperfect and incomplete, point to ways in which engaged science can provide evidence to support broad campaigns of public pressure and targeted advocacy to elicit new ways of governing infrastructure and imagining development.

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