

SUSTAINABLE INFRASTRUCTURE IN THE AMAZON

OCTOBER 2020

*Connecting Environmental Protection with
Governance, Security, and Economic Development*

Brazil Country Case Study

AUTHORS

Romina Bandura

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A REPORT OF THE CSIS
PROJECT ON PROSPERITY AND DEVELOPMENT

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Executive Summary

Brazil's Amazon Basin has undergone a rapid process of urbanization and population growth, bringing it from a population of approximately 7 million inhabitants in the mid-1960s to 29 million today. This stems from a policy that the Brazilian military government devised to connect the Amazon to the rest of the country through large-scale infrastructure projects and to encourage migration and economic development in the region. During the 1960s and 1970s, the Brazilian military government was concerned with protecting the Amazon from outside invaders and the overall security of the region. The Amazon Basin was considered a security imperative because of its sheer size and vast unprotected border. At the same time, the economic potential of its untapped natural resources was attractive to the growing mining and agribusiness industries. However, the expansion of economic activity and migration to the Amazon has stressed the ecologically delicate region and marginalized indigenous groups, while the region's relative remoteness means that the Brazilian state still struggles to provide security and deter illegal activity.

Today, there are different threats that are destabilizing the Amazon region, including illegal activities (logging, drug trafficking, and mining) and climate change. Brazil is now the world's second-largest consumer of cocaine after the United States, while neighboring countries such as Colombia, Peru, and Bolivia are the world's main producers. Narco-traffickers use routes through Brazil to export their products to Asia and Europe. Illegal mining is also a major cause of land invasions in the Brazilian Amazon. Sadly, many of these activities take place under the Amazon jungle's dense canopy, causing hidden environmental damage to the forest, rivers, and fauna and affects the security of communities in the basin. At the same time, deforestation in the Amazon threatens to worsen climate change and disrupt rainfall patterns across South America, impacting agricultural production, which accounts for 5.2 percent of Brazil's GDP.

Since the 1960s, Brazil's government has invested in large-scale infrastructure in the sparsely populated Amazon Basin. While infrastructure has produced some benefits for the region, it has also yielded unintended consequences. Dams and road networks in the Amazon have degraded the environment, facilitated illegal enterprises, and provoked social conflicts with indigenous communities. Rapid deforestation has increased the risk of vector-borne and zoonotic diseases, a particularly salient threat in the wake of the Covid-19 pandemic. To promote sustainable development in the Amazon, Brazilian officials must look beyond megaprojects. In consultation with international partners, they must address the underlying governance and security challenges. Better planning and implementation would maximize economic benefits while minimizing the social and environmental costs.

Drawing on a literature review and expert interviews with over 30 organizations, this case study examines the links among infrastructure, deforestation, governance, and security in the Brazilian Amazon. It contributes to a larger report on sustainable infrastructure development in the Amazon.

Infrastructure Development in the Brazilian Amazon

In the 1960s, the Brazilian military government viewed the Amazon Basin as an unguarded entry point for invading superpowers. The president adopted a new motto with respect to the Amazon, “*integrar para não entregar*,” meaning “integrate to prevent surrender.” Over the subsequent decades, Brazilian officials invested in major infrastructure projects and encouraged settlement in the Amazon Basin.

Socioeconomic Challenges in the Brazilian Amazon

With the help of infrastructure and settlement, the Amazon region of Brazil experienced a 5.9 percent annual growth rate in GDP between 1960 and 2015, outpacing the 4.1 percent average growth rate for the country as a whole. However, challenges remain.

Income per capita in the north of Brazil was 26 percent below the national average in 2017. Service delivery is less dependable in the region relative to the rest of the country, in part because successive governments have prioritized roads and dams over water, sanitation, health, and education.

Illegal activities are a further source of harm. Cattle ranching on public lands, logging without a permit, and illicit gold mining are all sources of revenue for armed groups, who not only speed up deforestation but also resort to violent methods to displace local communities. In close proximity to Colombia, Peru, and Bolivia—the main world producers of cocaine—criminal groups take advantage of poor state presence, corruption, and new road networks to traffic their product through the Brazilian Amazon to destination markets.

Planned Infrastructure Projects in the Brazilian Amazon

Brazil has fallen behind in both the quantity and quality of its infrastructure. In 2019, the World Economic Forum estimated that the country invests around 2 percent of its GDP in infrastructure but requires 3.2 percent. The Inter-American Development Bank ranks Brazil at 81st of 137 countries measured in terms of quality infrastructure.

To overcome this gap, President Jair Bolsonaro plans to double investment in infrastructure, reaching around \$65 billion per year by 2022. In addition to borrowing from traditional donors, Brazil has reached out to Chinese lenders under the umbrella of the Belt and Road Initiative. Much of the Bolsonaro government’s investment will go toward railways, airports, roads, waterways, and ports. Energy production will be an additional destination for funds. About 78.8 percent of Brazil’s electricity generation comes from hydroelectric dams. The majority of dams are in the Amazon Basin, and more are in the pipeline.

Improving Infrastructure Planning in the Amazon

While Brazil does have a robust process for planning and executing infrastructure projects, each stage has its own problems. In the planning stage, sectoral plans often lack coordination and come into conflict with the national infrastructure plan. Planners often underestimate environmental and social risks and fail to engage sufficiently with stakeholders. The implementation stage suffers from procurement and budgetary obstacles as well as poor management at the subnational level. At the monitoring and evaluation stage, officials could better apply lessons from audits to future projects.

Social and Environmental Costs of Infrastructure Projects

Infrastructure projects continue to be developed in the Amazon with the stated goals of providing security to the basin, increasing connectivity, and fostering economic growth. However, significant infrastructure gaps remain that if addressed would provide economic and social benefits, including better access to sanitation and clean water, health care, and electricity.

Hydroelectric dams have frequently resulted in flooding and displacement of riverside communities. The Belo Monte Dam, for example, is the third-largest hydroelectric project in the world. When engineers built the dam along the Xingu River in the Amazon region, an estimated 50,000 residents were displaced. Furthermore, while dams are not significant carbon emitters, they produce large amounts of methane, which is more detrimental to the environment than carbon. In particular, the Balbina Dam flooded approximately 2,400 km² (926 mi²) of basin upon completion.

Certain infrastructure projects may even be the cause of their own undoing. By speeding up deforestation, Brazil's push for infrastructure has unintentionally exacerbated climate change. Studies predict that the resulting lower flows of water will impact hydroelectrical production: by 2070, they estimate that Brazil's hydroelectrical potential will decrease by more than 80 percent.

Even transportation infrastructure can have unexpected consequences. One recent study evaluated 75 planned road projects across five countries in the Amazon, concluding that 45 percent of the roads were not economically viable. While they fail to provide an economic benefit to the local community, roads come with a heavy social and environmental cost. Developers must cut down forests to make way for highways, and illegal enterprises are more than happy to use them to transport their products.

Climate change, along with intense deforestation, has been causing prolonged droughts in the Amazon region. With shorter rainy seasons, some of the main rivers of the Amazon Basin are already experiencing low flow of water (e.g., Xingu River). This scenario will directly impact the performance of hydroelectric dams.

Transparency and Corruption in Infrastructure Development

Corruption is a further obstacle to sustainable infrastructure development in the Amazon. After the high-profile "Car Wash" investigation revealed millions of dollars in kickbacks in the Latin American construction industry, the Brazilian and Peruvian governments were forced to halt 22 proposed dams along the Marañón River. Rooting out corruption and offering a more transparent bidding process, as well as consulting the community at earlier stages, would be an important step toward sustainable development.

Governance Challenges and Insecurity in the Brazilian Amazon

Poor Land Governance and Deforestation

Between the 1980s and 2000s, the Brazilian government increasingly recognized the harm that deforestation had caused to the Amazon Basin. Increased regulation and enforcement helped combat the problem, and between 2004 and 2012, the rate of deforestation decreased by 84 percent. Since 2012, however, the government has relaxed their regulations and the pace of deforestation has increased.

State presence is weak across the Amazon, carrying with it environmental, social, and economic repercussions. The illegal appropriation of land (land-grabbing) and the profitability associated with illicit mining, cattle-grazing, and logging have emboldened actors, who mostly function with impunity in a largely lawless region. At the same time, the sheer size of the Amazon makes holding perpetrators accountable very difficult.

Insecurity and Deforestation

Deforestation, and the illegal enterprises that it allows to flourish, has provided greater revenue for criminal groups. As factions such as the Família do Norte (FDN) and Comando Vermelho (CV) compete for control of Amazon drug trafficking routes, violence has escalated. The Pastoral Land Commission (CPT) estimates that about 300 people have been killed in the last 10 years in the Amazon due to criminal activity.

Loggers, cattle breeders, and land speculators often violently displace settlers, indigenous groups, and traditional communities. Additionally, these groups often count on the support of public notaries to register occupied properties in their names. In 2018, 79.6 percent of the conflicts associated with illegal land-grabbing were concentrated in the Brazilian Amazon, principally in Pará, Maranhão, and Amazonas. In the state of Pará, it is estimated that 30 million hectares of land are currently appropriated by “grileiros” (land squatters or invaders).

Developing Sustainable Infrastructure in the Amazon

Brazilian officials must fill the infrastructure gap in the Amazon, but they should do so in a way that minimizes social and environmental costs. They must also address the underlying security and governance challenges so that investments in infrastructure do not go to waste. The following recommendations serve as a starting point for sustainable development in the Brazilian Amazon Basin.

Create a Pipeline of Sustainable Infrastructure Projects

When selecting infrastructure projects, government officials should account for externalities, consider each project in the context of existing infrastructure, consult communities early on, and evaluate several alternatives to ensure that they are choosing the best option. The process for selecting infrastructure projects needs to be strengthened so that: (a) investments make economic sense and minimize environmental and social risks; (b) projects are evaluated as a whole, that is, in conjunction with other projects put forward in the region; (c) communities are brought into the discussion early; and (d) different project alternatives are presented beforehand so that the best designs are pursued.

Strengthen Land Governance and Enforce Property Rights

In the case of infrastructure projects in the Amazon, Brazilian authorities need to apply a territorial and land-use planning approach that provides a more balanced process whereby environmental and social risks are mitigated, benefits are maximized, existing property rights are respected, and the needs of local communities are taken into account.

The Brazilian government should simplify its property rights system and enforce land titles more consistently. A functional database categorizing undesignated land, protected areas, rural territories, and indigenous lands would make it easier for regulators to enforce laws. Satellite imagery can help, but the government must also train personnel and provide them with resources.

Investing Resources in Security and Law Enforcement

The Brazilian government invested greater funds in law enforcement in the Amazon in the past with positive effects. More consistent prosecution and fines allowed deforestation to drop to its lowest levels between 2004 and 2012. Law enforcement was also cost effective: the benefits of protecting the forest exceeded the costs of policing. Brazil should build on the success of the mid-2000s in combatting deforestation.

President Bolsonaro recently reactivated the Amazon Council, a decisionmaking body to coordinate development and security in the region. The Amazon Council offers Brazil’s government an opportunity to explicitly link security to environmental and economic concerns in the basin.

Satellites, radar, and high-speed internet can empower law enforcement officials, and relationships with local communities will make it easier to detect crime. In one model that police could replicate around the country, the state of Maranhão designated representatives from 17 indigenous groups as “Forest Guardians,” who are tasked with collaborating with the military, federal police, and the Brazilian Institute of Environment and Renewable Natural Resources.

Internationally, Brazil can share best practices on law enforcement with its neighbors through platforms such as the Amazon Cooperation Treaty Organization and the Leticia Pact. World leaders in the G7 have already expressed a commitment to aiding Brazil by sharing technology, funds, and expertise.

Better enforcement and accountability require greater political will and a larger financial commitment to the relevant government agencies. Increased staffing and resources will be necessary to ensure that these agencies can levy fines and distribute land titles in accordance with the law.

Infrastructure Supporting a Sustainable Development Model for the Amazon

Brazil's leaders should embed infrastructure projects in a model of sustainable development for the region. Economic development and environmental protection do not have to be competing goals. In a "standing forest economy," Brazilian officials and firms can leverage the Amazon's resources without tearing it down.

The pioneering work of Carlos Nobre blends modern technology with traditional knowledge to promote sustainable growth. His "Creative Amazon Labs," scheduled to start in the state of Pará in late 2020, will allow communities to improve the productivity of cupuaçu and cacao production. Another project, the Rainforest Business School, looks to empower entrepreneurs in the region.

Existing industries such as agribusiness and mining will not end any time soon, but firms must implement practices to mitigate their environmental harms. Currently, low-productivity cattle raising and agriculture account for a high level of land use in Brazil. The government can incentivize firms to improve productivity, allowing them to get the same yield from a smaller plot and contributing to less deforestation. At present, mining results in high levels of mercury contamination in the Amazon and is subject to limited regulation. Modern guidelines and mitigation techniques would decrease the social and environmental costs of mining, bringing the industry in line with a sustainable development vision.

Brazilian officials should consider infrastructure in light of these sustainable practices. Rather than defaulting to roads and railways to transport goods to market, the government should consider waterways and air transport, particularly for remote locations. High-speed internet cables can run parallel to waterways, minimizing their impact on the surrounding forest while still connecting communities to the wider world. With a greater focus on the social and environmental implications of infrastructure, as well as an emphasis on the security and governance challenges that the region faces, Brazilian officials can promote a sustainable future for the Amazon.

Despite these challenges, the encouraging news is that Brazil has the knowledge to balance environmental, security, and economic concerns in the Amazon. Due to efforts mainly undertaken from 2004 to 2012, more than 80 percent of the forest is still standing, and the region has the potential to produce goods and services more sustainably based on a "standing forest economy." Brazil has a significant opportunity to develop the region in a more sustainable way and enable infrastructure to play a positive role in that process. Otherwise, the Amazon Basin risks reaching its tipping point—the level of deforestation after which it will be incapable of producing enough rain to sustain itself, resulting in its degradation into a savannah, with negative implications for the regional economy and global climate.

Introduction

It is well known that the Amazon Basin is home to the world's greatest biodiversity and water resources and serves as the "air conditioning of the earth," storing carbon and regulating rainfall patterns that go beyond its boundaries. At the same time, the Amazon region holds significant economic resources: waterways and fisheries, rich mineral deposits (such as gold, copper, and nickel), oil and gas reserves, forestry products, and medicinal plants. What perhaps is less appreciated is that the Amazon Basin comprises an area approximately the size of the contiguous United States (Map 1). Brazil alone hosts 60 percent of the Amazon Basin across nine states, including Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, and Tocantins as well as parts of Mato Grosso and Maranhão.¹ Approximately 6,000 miles (9,656 km) of Brazil's land border is in the Amazon Basin region.² Moreover, with a total population of 29 million, the Brazilian Amazon is mostly urbanized, with 72 percent of citizens living in cities such as Belém, Manaus, Macapá, and Porto Velho.³ Aside from these urban centers, the rest of the Amazon is still sparsely inhabited.

The process of urbanization and population growth that has occurred in the region has its roots in the mid-1960s. At that time, the population of the Brazilian Amazon comprised approximately 7.5 million inhabitants.⁴ The military leaders that governed Brazil devised a policy to connect the Amazon to the rest of the country through large-scale infrastructure projects and encouraged the settlement of migrants in the region. The Brazilian military considered the Amazon Basin a security imperative because of its sheer size and vast unprotected border. At the same time, the economic potential of the untapped natural resources was attractive to the growing mining and agribusiness industries.

To better secure the border from "outside" international actors, the Brazilian military government promoted infrastructure construction, helped settle new families, and deployed military assets to the region. Large-scale projects, including in transportation infrastructure (such as the 1972 Trans-Amazônia and the 1974 Belém-Brasília highways), aimed to increase regional connectivity, human settlements, and economic development.⁵ This agenda was a nation-building strategy dubbed as "*integrar para não entregar*," meaning to integrate (or connect) the Amazon to protect its natural resource wealth from international actors. The settlement of families in the Amazon was also aimed at providing solutions to pressing social problems emerging elsewhere in Brazil. An unequal distribution of land among farmers and droughts taking place in northeast Brazil prompted the military government to settle "landless men" to "the land

¹ "Brazil and the Amazon Forest," Greenpeace, <https://www.greenpeace.org/usa/issues/brazil-and-the-amazon-forest/>; and Instituto Brasileiro de Geografia e Estatística, "Legal Amazon: Description," Government of Brazil, <https://www.ibge.gov.br/en/geosciences/environmental-information/vegetation/17927-legal-amazon.html?=&t=o-que-e>.

² John A. Cope and Andrew Parks, *Frontier Security: The Case of Brazil* (Washington, DC: National Defense University Press, 2016), *Strategic Perspectives* no. 20, <https://inss.ndu.edu/Portals/68/Documents/stratperspective/inss/StrategicPerspectives-20.pdf?ver=2016-08-17-103324-443>.

³ Instituto Brasileiro de Geografia e Estatística, "Projeção da População," Government of Brazil, https://www.ibge.gov.br/apps/populacao/projecao/index.html?utm_source=portal&utm_medium=popclock&utm_campaign=novo_popclock; and Instituto Brasileiro de Geografia e Estatística, "Pesquisa Nacional por Amostra de Domicílios," Government of Brazil, <https://www.ibge.gov.br/estatisticas/sociais/rendimento-despesa-e-consumo/9127-pesquisa-nacional-por-amostra-de-domicilios.html?=&t=resultados>.

⁴ Instituto Brasileiro de Geografia e Estatística, "Tabulações Avançadas do Censo Demográfico," Government of Brazil, <https://biblioteca.ibge.gov.br/visualizacao/livros/liv84447.pdf>.

⁵ Cope and Parks, *Frontier Security*.

without men,” that is, the Amazon Basin (“*terra sem homens para homens sem terra!*”).⁶ Energy production was also a key focus and was seen as a way to elevate Brazil as a global power. Given the basin’s rich endowment of water resources, the state began investing and developing hydropower at a massive scale between 1960 and 1980.⁷ As a result, by 2003, a total of 139 medium and large hydroelectric power plants were operating in Brazil, making up 12.7 percent of installed capacity in the Amazon.⁸

Map 1: The Size of the Amazon Basin Relative to the United States



Source: Juha Siikamäki et al., *International Willingness to Pay for the Protection of the Amazon Rainforest* (Washington, DC: World Bank, 2019), <http://documents.worldbank.org/curated/en/334711552333303292/pdf/WPS8775.pdf>.

As a result of these developments, the economy of the Amazon region has grown at a faster pace than the rest of Brazil since the 1960s.⁹ However, income levels and most socioeconomic indicators still trail behind the country’s average (Figure 1). Moreover, the provision of basic services such as water, sanitation, health care, education, electricity, and broadband to certain communities remains inadequate. Despite their intended national development and security benefits, large-scale infrastructure projects have also brought about unintended consequences, including environmental degradation, deforestation, and societal conflicts. These projects, in particular road construction, have opened up vast areas of the Amazon to a range of economic activities, including illegal enterprises, creating social conflicts with riverine and indigenous communities native to the forest. In popular culture, the 1988 musical *Yanomamo!* shed light on the tensions between the Yanomami indigenous ethnic group, the oldest surviving indigenous group in the Amazon, and outside settlers clearing the forest for timber and subsequent ranching. Infrastructure projects have also often failed to fulfill human development promises for the local population.

In addition, the national security concerns of the 1970s (i.e., of not being able to control the border) were vastly different from today’s issues (see Box 1 for security definitions). Illegal activities—mainly drug trafficking and gold mining—and climate change are significant threats that are destabilizing the Amazon region. Brazil is now the world’s second-largest consumer of cocaine after the United States, while neighboring countries such as Colombia, Peru, and Bolivia are the world’s main cocaine producers.¹⁰ Narco-traffickers

⁶ Kei Otsuki, *Sustainable Development in Amazonia: Paradise in the Making* (New York: Routledge, 2013); Emilio Moran, “Roads and Dams: Infrastructure Driven Transformation in the Brazilian Amazon,” *Ambiente & Sociedade* 19, no. 2 (April/June 2016), https://www.scielo.br/scielo.php?script=sci_arttext&pid=S1414-753X2016000200207; and Fabrícia Peixoto, “Linha do Tempo: Entenda como ocorreu a ocupação da Amazônia,” BBC, July 23, 2009, https://www.bbc.com/portuguese/noticias/2009/07/090722_amazonia_timeline_fbdt.

⁷ Juliano Assunção, Francisco Costa, and Dimitri Sberman, “Local Socioeconomic Impacts of Brazilian Hydroelectric Power Plants,” (working paper, Fundação Getúlio Vargas, February 18, 2019).

⁸ Agência Nacional de Energia Elétrica, “Energia Hidráulica,” Government of Brazil, http://www2.aneel.gov.br/aplicacoes/atlas/energia_hidraulica/4_5.htm.

⁹ Ricardo Zorzeto, “Crescer sem Destruir,” *Pesquisa FAPESP*, November 5, 2019, <https://revistapesquisa.fapesp.br/2019/11/05/crescer-sem-destruir/>.

¹⁰ Theresa Bradley and Ritchie King, “Brazil Now Consumes 18% of the World’s Cocaine,” Quartz, September 23, 2012, <https://qz.com/5058/brazil-now-consumes-18-of-worlds-cocaine/>; and UNODC, *2019 World Drug Report* (Vienna: 2019), https://wdr.unodc.org/wdr2019/prelaunch/WDR19_Booklet_4_STIMULANTS.pdf.

use routes through Brazil to export their products to Asia and Europe. Illegal mining is also a major cause of land invasions in the Brazilian Amazon. Sadly, many of these activities take place under the Amazon jungle's dense canopy, causing hidden environmental damage to the forest, rivers, and fauna, and affects the security of communities in the basin. At the same time, deforestation in the Amazon threatens to worsen climate change and disrupt rainfall patterns across South America, impacting agricultural production, which accounts for 5.2 percent of Brazil's GDP.¹¹ The ongoing Covid-19 pandemic magnifies the vulnerability of the region and underscores the underlying health insecurity of local populations due to weak health care provisions. Moreover, deforestation and loss of forest cover have heightened the proliferation of vector-borne diseases such as malaria and dengue, while illegal gold mining has led to prevalent mercury contamination of water resources.¹²

Within the present-day economic and social problems, infrastructure “megaprojects” cannot be regarded as the simple solution to security and other concerns in the region since they do not necessarily guarantee the Amazon's economic development. Properly developed infrastructure can create economic and social gains by facilitating human mobility, connecting products to markets, generating jobs, improving communications, providing inroads for security forces to disrupt criminal networks, and offering access to medical, water, and education services to rural areas.¹³ However, in an ecosystem as complex as the Amazon Basin, large-scale infrastructure projects can increase pressure on deforestation and facilitate illegal economic activity if they are not properly planned and managed.¹⁴ A more thorough discussion about and considered approach to the role that infrastructure can play in enabling or hampering sustainable development in the Amazon is needed. This includes addressing underlying governance and security challenges and taking a sustainable infrastructure approach—crafting better planning processes and sound governance frameworks to ensure that projects will provide the maximum economic benefits to the region while minimizing environmental and social costs.¹⁵

Despite these shortcomings, the encouraging news is that Brazil has the knowledge to balance environmental, security, and economic concerns in the Amazon.¹⁶ Due to legislation and government policies during the 2000s, more than 80 percent of the forest is still standing, and the region has the potential to produce goods and services more sustainably based on a “standing forest economy.”¹⁷ The nonprofit Instituto Escolhas and climate scientist Carlos Nobre have proposed several positive initiatives to create a new economic vision for the Amazon based on the bioeconomy. Government actions to enhance security such as the new Amazon Council (“Conselho da Amazônia”—a council of ministers that oversees all activities in the protection, defense, and sustainable development of the region) can complement this approach. In sum, the country has a significant opportunity to develop the region in a more sustainable way and enable infrastructure to play a positive role in that process. Otherwise, the Amazon Basin risks reaching its “tipping point”—the level of deforestation after which the Basin will be

¹¹ “PIB do setor agropecuário cresce 1,3% em 2019,” Governo do Brasil, March 5, 2020, <https://www.gov.br/pt-br/noticias/financas-impostos-e-gestao-publica/2020/03/pib-do-setor-agropecuaria-cresce-1-3-em-2019>.

¹² Jim Robbins, “How Forest Loss Is Leading to a Rise in Human Disease,” *Yale Environment* 360, February 23, 2016, https://e360.yale.edu/features/how_forest_loss_is_leading_to_a_rise_in_human_disease_malaria_zika_climate_change; and Ghali Fikri, Henry Koster, and Wijnand de Wit, *Healthy Rivers, Healthy People: Addressing the Mercury Crisis in the Amazon*, prepared by Dahlberg Advisors (Gland, Switzerland: WWF, 2018), http://d2ouvy59p0dg6k.cloudfront.net/downloads/healthy_rivers_healthy_people.pdf.

¹³ See for example, César Calderón and Luis Servén, *The Effects of Infrastructure Development on Growth and Income Distribution* (Washington, DC: World Bank, 2004), <https://openknowledge.worldbank.org/handle/10986/14136>.

¹⁴ Sue Branford, “Amazon at Risk: Brazil Plans Rapid Road and Rail Infrastructure Expansion,” *Mongabay Environmental News*, February 12, 2019, <https://news.mongabay.com/2019/02/amazon-at-risk-brazil-plans-rapid-road-and-rail-infrastructure-expansion/>.

¹⁵ “The OECD Framework for the Governance of Infrastructure,” OECD, <https://www.oecd.org/gov/the-oecd-framework-for-the-governance-of-infrastructure.htm>.

¹⁶ Juliano Assunção and Clarissa Gandour, “Brazil Knows What to Do to Fight Deforestation in the Amazon,” *Climate Policy Initiative*, November 2019, <https://climatepolicyinitiative.org/publication/brazil-knows-what-to-do-to-fight-deforestation-in-the-amazon/>.

¹⁷ “Perguntas Frequentes,” Instituto Nacional de Pesquisas Espaciais, <http://www.inpe.br/faq/index.php?pai=6>.

incapable of producing enough rain to sustain itself, resulting in its degradation into a savannah, with negative implications for the regional economy and global climate.¹⁸

The present case study analyzes the links between infrastructure development, deforestation, governance, and security challenges in the Brazilian Amazon. The study draws from a wide body of literature as well as expert interviews conducted in January 2020. Thirty organizations, including nongovernmental organizations, law enforcement agencies, industry associations, consulting firms, and government bodies were consulted in Manaus, Rio de Janeiro, Brasília, and Washington, D.C. The country case study informs a larger report on sustainable infrastructure development in the Amazon. This is a complex topic and creates many sensitivities within the Amazon Basin countries. However, the authors hope that it helps change the discourse on the Amazon's future and presents constructive ideas to foster more balanced development of the region.

¹⁸ Dom Phillips, "Amazon Rainforest 'Close to Irreversible Tipping Point'," *The Guardian*, October 23, 2019, <https://www.theguardian.com/environment/2019/oct/23/amazon-rainforest-close-to-irreversible-tipping-point>.

Infrastructure Development in the Brazilian Amazon

For millennia, the Amazon Basin was largely inhabited by indigenous communities that lived on the land for generations. In the 1910s, some Europeans and Americans invested in economic activities in the Amazon, especially the extraction of rubber. The ideology of social Darwinism, then at its peak, allowed one British explorer, Joseph F. Woodroffe, to describe a group he encountered as “the most docile and peace-loving, in that way more easily conquered.”¹⁹ The Peruvian Amazon Company, owned by a Panamanian industrialist and registered in London, subjected hundreds of indigenous people to slavery, flogging, and starvation.²⁰ U.S. auto manufacturer Henry Ford aimed to create a utopia in the Brazilian Amazon in the 1920s, paying higher wages to workers and developing a new source of rubber for tires.²¹ However, tensions between skilled workers and manual laborers soon gave way to violence, and the project ended in failure.²² Up until the 1960s, Brazilian government policy toward the Amazon was largely incoherent, leaving the region sparsely developed.

Socioeconomic Challenges in the Brazilian Amazon

Since the 1960s, successive Brazilian governments have sought not only to secure the Brazilian Amazon’s long border but also to develop the forest through infrastructure projects and economic activities. During the 1960s, Brazil’s new military dictatorship saw the “empty” jungle as a security risk, an unguarded “back door” into the country. The military government created the National Institute of Colonization and Agrarian Reform (INCRA) to settle the basin and promote development.²³ Massive income inequality in Brazil at the time also drove the military government’s decision to open up the basin to otherwise landless farmers as a way to spur economic growth and distributing income to impoverished farmers. The 1964 Land Statute codified the military government’s expansionist agenda in the Amazon, gave it the ability to seize “unproductive” land parcels and allocate them to peasants, and overall gave considerable power to landowners.²⁴ To achieve its goal of settling the country’s interior, the Brazilian military government instituted a campaign to encourage individuals to relocate to the Amazon. Interested families or individuals were required to prove that they intended to make productive use of the land to be granted a land title.²⁵ Newly-built highways and the promise of freedom led to an influx of Brazilians in the Amazon. However, the government lacked adequate capacity to manage the land titling, which in turn led to illegal land invasions and conflicts with traditional communities. Added to the mix, the area lacked the necessary social infrastructure to support sustainable population growth in the basin. The lack of basic social services and rule of law contributed to a volatile environment and an increase in violence between new settlers and existing indigenous populations.²⁶

¹⁹ Javier Farje, “The Putumayo Atrocities,” Latin America Bureau, October 25, 2012, <https://lab.org.uk/the-putumayo-atrocities/>.

²⁰ Ibid.

²¹ Drew Reed, “Lost Cities #10: Fordlandia – The Failure of Henry Ford’s Utopian City in the Amazon,” *The Guardian*, August 19, 2016, <https://www.theguardian.com/cities/2016/aug/19/lost-cities-10-fordlandia-failure-henry-ford-amazon>.

²² Ibid.

²³ Matt Sandy, “The Amazon Rain Forest is Nearly Gone,” *Time*, September 23, 2019, <https://time.com/amazon-rainforest-disappearing/>.

²⁴ USAID Land and Urban Office, *Brazil: Property Rights and Resource Governance* (Washington, DC: USAID, 2016), https://www.land-links.org/wp-content/uploads/2016/09/USAID_Land_Tenure_Brazil_Profile.pdf.

²⁵ Rita Damasceno, Joana Chiavari, and Cristina Leme Lopes, *Evolution of Land Rights in Rural Brazil: Frameworks for Understanding, Pathways for Improvement* (Rio de Janeiro: CPI, 2017), https://climatepolicyinitiative.org/wp-content/uploads/2017/06/Evolution_of_Land_Rights_In_Rural_Brazil_CPI_FinalEN.pdf.

²⁶ Ibid.

At the end of the 1990s, President Fernando Henrique Cardoso introduced multi-year plans for the construction of major infrastructure projects across the country, including “Brazil in Action” (1996) and “Advance Brazil” (2000).²⁷ The plans included a number of projects in the Amazon, such as the construction of the Madeira and Araguaia/Tocantins waterways, the rehabilitation of highways (e.g., BR-163 and BR-364), and the expansion of the Tucuruí hydropower plant. Starting in the 2000s, the Brazilian Amazon was inundated with the expansion of government-sponsored megaprojects, with the rollout of the “Growth Acceleration Program” (PAC) first launched in 2007 by President Luiz Inácio Lula da Silva and renewed in 2011 and 2015 by President Dilma Rousseff.²⁸

In 2001, Brazil was hit by an electric power crisis that encouraged the development of a suite of ambitious hydroelectric power plants (HPPs) and transport infrastructure projects.²⁹ The hallmark projects included Santo Antônio and Jirau (Madeira River - Rondônia), Belo Monte (Xingu River - Pará), and the HPPs located along the Teles Pires River (MT). In addition, stretches of the roads built by the military government were paved, duplicated, and rehabilitated.³⁰

In 2000, Brazil was also part of the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA), created by the now-defunct Union of South American Nations (UNASUR) and funded by the Inter-American Development Bank (IDB) and the Development Bank of Latin America (CAF).³¹ IIRSA was a development plan intended to better integrate highway networks, riverways, and hydroelectric dams throughout South America and promote regional integration. According to the last report released in 2017, IIRSA had an active portfolio with 409 projects, accounting for an investment of more than \$150 billion; at that time, 153 IIRSA projects had already been completed.³²

²⁷ Philip M. Fearnside and William F. Laurance, “Infrastructure in Amazonia: Lessons from Brazil’s Pluri-annual Plans,” *Caderno CRH* 25, no.64 (January/April 2012), https://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-49792012000100007; and Ministério da Economia, “Brasil em Ação,” Government of Brazil, June 18, 2014, <http://www.fazenda.gov.br/noticias/1998/r980901anx3>; and Fernando H. Cardoso, *Avança, Brasil: Proposta de Governo* (Rio de Janeiro: Centro Edelstein de Pesquisas Sociais, 2008), <https://static.scielo.org/scielobooks/62rp6/pdf/cardoso-9788599662687.pdf>.

²⁸ Ministério do Planejamento, “Programa de Aceleração do Crescimento,” Government of Brazil, <http://pac.gov.br>.

²⁹ Moran, “Roads and Dams.”

³⁰ See PAC 1 and 2 reports at: Governo do Brasil, PAC: *Balanço 4 anos (2017-2010)*, <http://pac.gov.br/pub/up/relatorio/b701c4f108d61bf921012944fb273e36.pdf>; and Governo do Brasil, PAC2: *Balanço 4 anos (211-2014)*, <http://pac.gov.br/pub/up/relatorio/f9d3db229b483b35923b338906b022ce.pdf>.

³¹ Global Forest Atlas, “Roads in the Amazon Basin,” Yale School of the Environment, <https://globalforestatlas.yale.edu/amazon/land-use/roads-amazon-basin>.

³² COSIPLAN, *Informe de Actividades 2017* (Buenos Aires: UNASUR, 2017), <https://www.flipsnack.com/IIRSA/informe-de-actividades-2017.html>.

Box 1: Defining Security

There are different definitions of security, and when analyzing the Amazon, different terms are employed. Security can be defined more traditionally as national security, that is, “the ability of a state to cater for the protection and defense of its citizenry.”³³ This view of security is focused on external threats to the state such as extremism, terrorism, inter-state conflicts, drug trafficking, and cybersecurity. These are threats to a nation’s sovereignty and to its borders, based on the integrity of its geographical whole.³⁴ The definition also includes the protection of the geopolitical and economic interests of the state.

Another concept of security that is linked to national security is that of “human security,” which refers to protecting “the vital core of all human lives in ways that enhance human freedoms and human fulfillment.”³⁵ A UN General Assembly Resolution defines human security as “an approach to assist member states in identifying and addressing widespread and cross-cutting challenges to the survival, livelihood, and dignity of their people.”³⁶ The idea is built on four principles: it is people-centered, comprehensive, context-specific, and prevention-oriented. The United Nations lists seven types of security challenges: economic security, food security, health security, environmental security, personal security, community security, and political security.³⁷ Promoting human security requires collaboration among states, international organizations, and civil society, but does not include the use of force.

What is the relationship between these two approaches? Are they separate issues or are they interlinked? What is the order of priority, that is, what comes first: national security or human security? According to Lama (2018), in the national security view, the state is at center stage and national security precedes all other critical human-centric needs including food, the environment, and energy.³⁸ On the other hand, advocates of human security contend that the state does not function outside of people, thus human beings should be the primary referents. The basics of human security are guaranteed by meeting the needs that people value the most, which include food, shelter, good health, education, protection from violence, and freedom from fear. In this situation, the state-society relationship is separated from “international relations” and the domestic setting becomes more important and exclusive to human security. Proponents of the human security view argue that these nontraditional elements of security are the ones that determine the state of security of a country, followed by national security.

In practice, there is a fine line between both notions of security. In today’s complex world, these two separate conceptions of security are interlinked. Localized problems can threaten to destabilize regions and the overall national security of a country. Similarly, nonconventional external threats can impact individual and communities’ security. The questions policymakers need to ask are: whose security are the

³³ Segun Osisanya, “National Security Versus Global Security,” United Nations, <https://www.un.org/en/chronicle/article/national-security-versus-global-security>.

³⁴ Mahendra P. Lama, “Human vs. National Security,” *Global-E* 11, no.22, April 17, 2018, <https://www.21global.ucsb.edu/global-e/april-2018/human-vs-national-security>.

³⁵ United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), *Human Security in Theory and Practice: Application of the Human Security Concept and the United Nations Trust Fund for Human Security* (New York: UNOCHA, 2009), <https://www.unocha.org/sites/dms/HSU/Publications%20and%20Products/Human%20Security%20Tools/Human%20Security%20in%20Theory%20and%20Practice%20English.pdf>.

³⁶ United Nations Trust Fund for Human Security, “What is Human Security,” <https://www.un.org/humansecurity/what-is-human-security/>.

³⁷ UNOCHA, *Human Security in Theory and Practice*.

³⁸ Lama, “Human vs. National Security.”

national borders protecting and where do individual (and community) insecurity and national insecurity intersect?³⁹

Since the 1960s, the Amazon economy has grown at a faster pace than the rest of the country, with GDP increasing at an annual average of 5.9 percent between 1960 and 2015 versus 4.1 percent for Brazil overall.⁴⁰ However, the Amazon region is very heterogeneous and accounts for a small portion of Brazil's economy, at 8.9 percent of total GDP.⁴¹ According to the Brazilian Institute of Geography and Statistics (IBGE), the government agency tasked with providing geographic and statistical information, services were the main economic activity in all the states of the Amazon as of 2017, including in cities such as Santarém, Belém, and Manaus.⁴² Services represent 36 percent of the total GDP of the region, followed by the manufacturing sector (20 percent) and agriculture (11 percent).⁴³ Industrial activities are concentrated in a few metropolitan areas; In 2017, Manaus accounted for 21 percent of the total industrial output of the region.⁴⁴ In the rural areas of the Amazon, indigenous and quilombola groups (Afro-Brazilian communities largely descendants from slaves), as well as small and large farmers, engage in a variety of economic activities.⁴⁵ These center mostly on natural resource extraction and commodities.

The region has also had significant population growth, especially in urban areas. Between 1980 and 2000, the population of urban areas in the Brazilian Amazon tripled from 4.7 million to 13.7 million.⁴⁶ Approximately 72 percent of the population of the Brazilian Amazon lives in urban areas.⁴⁷ In tandem with increased urbanization in the Amazon has come pressure to create jobs, deliver public services, and provide infrastructure to citizens.

Yet despite its high economic growth rates, the Amazon trails behind the rest of the country in terms of human development: income per capita in the north of Brazil was 26 percent below the national average in 2017 (Figure 1), while the region's Human Development Index scores are the lowest in the country.⁴⁸ Poverty rates in the Amazon states range between a low of 15 percent in the state of Mato Grosso to a high of 53 percent in the state of Maranhão.⁴⁹ According to the Fundação Getúlio Vargas (FGV) and the International Finance Corporation (IFC), 98 percent of municipalities in the Amazon register a Social Progress Index below the national average.⁵⁰ Illiteracy rates in the seven Amazon states, while not the worst in Brazil, show that there is still more progress to be made in education. The two states with the

³⁹ Ibid.

⁴⁰ Zorzeto, "Crescer sem Destruir".

⁴¹ Instituto Brasileiro de Geografia e Estatística, "Produto Interno Bruto – PIB," Government of Brazil, <https://www.ibge.gov.br/explica/ PIB.php>.

⁴² Instituto Brasileiro de Geografia e Estatística, "Produto Interno Bruto dos Municípios," Government of Brazil, <https://www.ibge.gov.br/estatisticas/economicas/contas-nacionais/9088-produto-interno-bruto-dos-municipios.html?t=destaques>.

⁴³ Ibid.

⁴⁴ Ibid.

⁴⁵ Carlos Gomes et al., *Oportunidades de Apoio a Atividades Produtivas Sustentáveis na Amazônia* (Brasília: Fundo Amazônia, 2012), http://www.fundoamazonia.gov.br/export/sites/default/pt/galleryes/documentos/biblioteca/GIZ_Estudo_Oportunidades_APS.pdf. The term "Quilombolas" refers to Afro-Brazilians who descend from Afro-Brazilian slaves. Their ancestors established "quilombos," or rural settlements that were built by escaped slaves. The Quilombolas population today in Brazil is estimated to be 2,962. See more at: Sue Branford and Maurício Torres, "Brazilian Supreme Court Ruling Protects Quilombola Land Rights for Now," Mongabay Environmental News, February 13, 2018, <https://news.mongabay.com/2018/02/brazilian-supreme-court-ruling-protects-quilombola-land-rights-for-now/>.

⁴⁶ "A Key Factor at the Heart of Amazon Deforestation," World Wildlife Forum, https://wwf.panda.org/knowledge_hub/where_we_work/amazon_threats/poorly_planned_infrastructure/resettlement_amazon/#:~:text=Between%201980%20and%202000%2C%20urban,processing%20and%20mining%20take%20place.

⁴⁷ Instituto Brasileiro de Geografia e Estatística, "Pesquisa Nacional por Amostra de Domicílios."

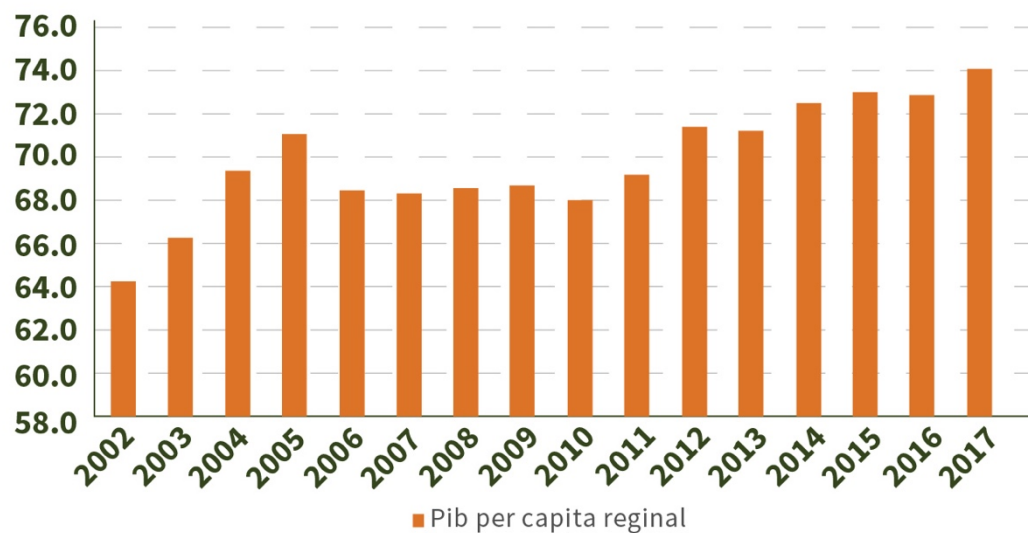
⁴⁸ FGV and IFC, *Large-Scale Projects in the Amazon: Lessons Learned and Guidelines* (São Paulo: FGV and IFC, 2017), http://mediadrawer.gvces.com.br/grandes-obras/original/grandes-obras-da-amazonia_resumo_inglesv2_miolo_digital_04.pdf.

⁴⁹ "Alagoas é o segundo estado brasileiro com maior índice de pobreza, aponta IBGE," *Cada Minuto*, November 6, 2019, <https://www.cadaminuto.com.br/noticia/348820/2019/11/06/alagoas-e-o-segundo-estado-brasileiro-com-maior-indice-de-pobreza-aponta-ibge>.

⁵⁰ FGV and IFC, *Large-Scale Projects in the Amazon*.

highest illiteracy rates are Maranhão at 16.3 percent and Acre at 12.1 percent.⁵¹ Poor working conditions and high crime rates also paint a sobering societal picture: the state of Pará had one of the highest homicide rates in Brazil in 2017 at 54.7 homicides per 100,000 inhabitants, while Acre's rate was 62.2.⁵² Moreover, from 2016 to 2017, murder rates increased by 39.9 percent in Acre, 19.6 percent in Roraima, 13.5 percent in Amazonas, and 7.5 percent in Pará.⁵³ The city of Altamira, in Pará, is the second most violent city in Brazil with more than 100,000 inhabitants, with 133.7 deaths per 100,000 inhabitants in 2017.⁵⁴ The construction of the Belo Monte Dam led to an increase in the population of the nearby city of Altamira, with migrants looking for jobs in the project. The increase in population was not accompanied with proper urban investments, while other activities, such as drug trafficking, led to an increase in crime. As a result, the murder rate went from 50 deaths per 100,000 inhabitants in 2005 to 107 in 2015.⁵⁵

Figure 1: Brazilian Amazon GDP Per Capita as a Proportion to the National Average



Source: Tatiana Pinheiro, *Brasil-Amazônia Legal* (Sao Paulo: Banco Santander, 2018), https://cms.santander.com.br/sites/WPS/documentos/arq-estudos-macro-download-03-09-18/18-09-03_204721_180903-amazonia-legal.pdf.

Illegal economic activities are also widespread and include cattle-ranching on undesignated public lands, logging, and mining. Loggers, cattle breeders, and land speculators often use violent methods to displace settlers, indigenous groups, and traditional communities.⁵⁶ Additionally, these groups often count on the support of public notaries to register the occupied properties in their names. In 2018, 79.6 percent of the locations that had conflicts associated with illegal land-grabbing were concentrated in the Brazilian Amazon, principally in Pará, Maranhão, and Amazonas.⁵⁷

⁵¹ "Taxa de analfabetismo no Brasil por Estados," *Gazeta do Povo*, July 16, 2019, <https://infograficos.gazetadopovo.com.br/educacao/taxa-de-analfabetismo-no-brasil-por-estados/>.

⁵² Instituto de Pesquisa Econômica Aplicada, "Taxa de Homicídios," Government of Brazil, <https://www.ipea.gov.br/atlasviolencia/dados-series/20>.

⁵³ Instituto de Pesquisa Econômica Aplicada, "Taxa de Homicídios."

⁵⁴ Daniel Cerqueira et al., *Atlas da Violência: Retratos dos Municípios Brasileiros* (Brasília, DF: IPEA, 2019), https://www.ipea.gov.br/portal/images/stories/PDFs/relatorio_institucional/190802_atlas_da_violencia_2019_municipios.pdf.

⁵⁵ Kelly Lima, "Belo Monte põe Altamira no topo do Mapa da Violência," *Projeto Colabora*, June 5, 2017, <https://projetocolabora.com.br/ods11/belo-monte-provoca-explosao-de-violencia-no-para/>.

⁵⁶ "Grilagem de terras na Amazônia: Negócio bilionário ameaça a floresta e populações tradicionais," *Greenpeace*, <http://greenpeace.com.br/amazonia/pdf/grilagem.pdf>.

⁵⁷ Comissão Pastoral da Terra, *Conflitos no Campo Brasil 2018* (Goiânia: CPT, 2019), <https://cptnacional.org.br/component/jdownloads/send/41-conflitos-no-campo-brasil-publicacao/14154-conflitos-no-campo-brasil-2018?Itemid=0>.

Planned Infrastructure Projects in the Brazilian Amazon

Across the world, countries are increasing their efforts to develop infrastructure in energy, transport, and social services. Countries have committed to building resilient infrastructure as signatories of UN's Sustainable Development Goals, specifically Goal #9. Brazil is no exception. In the case of Brazil, the World Economic Forum estimates that the country invests around 2 percent of its GDP in infrastructure but requires investments of 3.2 percent of GDP.⁵⁸ According to the Global Infrastructure Hub Brazil's total infrastructure investment gap in the period 2016 to 2040 is \$1.2 trillion.⁵⁹ This implies a significant scale-up in investment is needed.

Along with the quantity of infrastructure, there are significant gaps in the quality of infrastructure services. Brazil ranks very low in terms of quality infrastructure, placing 81st out of 137 countries in the world, according to the Inter-American Development Bank.⁶⁰ Airports and ports in Brazil are considered congested, while roads are cracking under the pressure of traffic. Furthermore, there are disparities in infrastructure investment in rural areas compared to urban areas, with the exception of electricity, which has significantly improved after the implementation of the program *Luz para Todos*, meaning “electricity for all” (Box 2).

⁵⁸ World Economic Forum and IDB, *Improving Infrastructure Financing in Brazil* (Geneva: World Economic Forum and IDB, 2019), http://www3.weforum.org/docs/WEF_Brazil_Infrastructure_financing_study_Report_2019.pdf.

⁵⁹ “Country Infrastructure Summary,” Global Infrastructure Hub, <https://www.gihub.org/countries/brazil/>.

⁶⁰ Paula Castillo and Felipe Ezquerro Plasencia, eds., *Building Big: Brazil's Challenges and Opportunities in Infrastructure – A Public-Private Perspective* (Washington, DC: IDB Invest, June 2019), <https://www.idbinvest.org/en/publications/report-building-big-brazils-challenges-and-opportunities-infrastructure-public-private>.

Box 2: Electricity for All (“Luz para Todos”) Program

The *Luz para Todos* program was created in 2003 with the objective of promoting access to electricity using renewable energy sources for families living in rural areas, with nearly 80 percent of the costs subsidized by the federal, state, and local governments.⁶¹ Because the first phase of the program (2003–2011) did not meet the initial goal of providing electricity to 2 million families, it was extended through 2018. The priority of the second phase was to reach quilombolas and indigenous communities, riverside dwellers, small farmers, families living in extractive reserves, and areas with community wells (shared water wells).

According to a 2013 survey, 97.20 percent of the beneficiaries said that they were satisfied with the initiative.⁶² More than 40 percent of the population surveyed think that the program was also responsible for the creation of more job opportunities and an increase in family incomes.⁶³ During the seven years of the second phase (2011–2018), *Luz para Todos* accomplished a total of 344,904 electric connections in the Brazilian Amazon, reaching approximately 1.3 million people.⁶⁴ In the Brazilian Amazon, most of the connections were in the state of Pará (37.5 percent), followed by Maranhão (21.6 percent) and Amazonas (19.5 percent). By 2018, 19 projects had been concluded, including 5 in the Amazon (in Acre, Amazonas, Maranhão, Mato Grosso, and Pará).⁶⁵

In 2018, the program was extended for another four years, aiming to reach more people living in rural areas and to conclude construction and contracts that were in progress.⁶⁶ Currently, 10 projects are still under construction, including 5 in the Amazon Legal (the area that contains the nine Brazilian Amazonian states), in the states of Acre, Amapá, Maranhão, Rondônia, and Roraima.

Citizens in Latin America are broadly dissatisfied with the quality of infrastructure services, with Brazil topping the list. Results from the 2019 Global Infrastructure Index (GII), conducted by the Global Infrastructure Investor Association (GIIA) and Ipsos Mori, indicate that only 31 percent of the population in Latin America is satisfied with infrastructure.⁶⁷ For Brazil, 22 percent of the population reported being satisfied, while 52 percent were dissatisfied. Brazil’s dissatisfaction ranking was the highest out of the 28 countries surveyed. Peru and Colombia’s satisfaction ratings were slightly higher at 30 percent and 29 percent, respectively.

Infrastructure projects continue to be developed in the Amazon with stated goals of providing security to the basin, increasing connectivity, and fostering economic growth. In the Amazon region, there are significant infrastructure gaps that if addressed would provide economic and social benefits.⁶⁸ For example, access to basic infrastructure services in the Brazilian Amazon paints a sobering picture. Less than 10

⁶¹ Carla Mereles, “Luz para Todos: você conhece esse programa social?,” *Politize*, July 12, 2017, <https://www.politize.com.br/luz-para-todos-programa-social/>; and André Luís Alves de Melo, “Programa Luz para Todos? A face oculta de uma Justiça desviada e os sítios de recreio,” Associação Nacional dos Membros do Ministério Público (CONAMP), November 25, 2014, <https://www.conamp.org.br/pt/biblioteca/artigos/item/419-programa-luz-para-todos-a-face-oculta-de-uma-justica-desviada-e-os-sitios-recreio.html>.

⁶² Ministério de Minas e Energia, *Impactos do Programa Luz para Todos* (Brasília, DF: Ministério de Minas e Energia, 2013), https://www.mme.gov.br/luzparatodos/downloads/pesquisa_de_satisfacao_2013.pdf.

⁶³ Ibid.; and Carla Mereles, “Luz para Todos?”

⁶⁴ Instituto de Energia e Meio Ambiente, “Estimativa da Exclusão Elétrica na Amazônia,” (slide presentation, IEMA, September 2019), https://static.poder360.com.br/2019/11/20191111_EEL_SISOL_estimativa_v10.pdf.

⁶⁵ Ministério do Planejamento, “Luz para Todos,” Government of Brazil, <http://pac.gov.br/infraestrutura-social-e-urbana/luz-para-todos>.

⁶⁶ Maurício Godoi, “Luz para Todos é prorrogado até 2022,” *Canal Energia*, April 31, 2018, <https://www.canalenergia.com.br/noticias/53059649/luz-para-todos-e-prorrogado-ate-2022>.

⁶⁷ GIIA and Ipsos, *Global Infrastructure Index 2019: Public Satisfaction and Priorities* (GIIA and Ipsos, 2019), <http://giia.net/wp-content/uploads/2019/11/261119-Global-and-G8-results.pdf>.

⁶⁸ See for example, Calderón and Servén, *The Effects of Infrastructure Development on Growth and Income Distribution*.

percent of people have access to sanitation (e.g., sewage collection) in the states of Amapá, Amazonas, Pará, and Rondônia, with the worst states being Rondônia (4.5 percent) and Pará (6.3 percent).⁶⁹ In the case of water, an average of 60 percent of residents have access to water, with Amapá and Pará being the worst states, at 37.1 percent and 45.7 percent, respectively.⁷⁰ More than 90 percent of cities in Amapá are plagued by epidemic and endemic diseases.⁷¹ Moreover, 19 percent of people living in indigenous territories in the Amazon and 22 percent of people living in conservation areas lack access to electricity.⁷²

Access to health services is precarious in both the urban and rural areas of the Amazon. The existence of the Special Secretariat for indigenous Health (SESAI) guarantees that indigenous groups have access to the public health system—Brazil's Sistema Único de Saúde (SUS). However, many of the remote indigenous health centers lack professionals and materials needed to treat common health hazards such as snakebites.⁷³ Moreover, SESAI's health workers recently reported a lack of protective equipment and hand sanitizer needed to deal with the Covid-19 crisis.⁷⁴ While the national average is 470.5 inhabitants per doctor, in the northern region of Brazil, the average is 953.3 inhabitants per doctor.⁷⁵ Only 15.6 percent of the Brazilian public hospitals are located in the Amazon.⁷⁶

The current administration of President Jair Bolsonaro has made increasing total infrastructure investment a key priority of his presidency. The government's ambitious plan to boost the economy includes doubling investment in infrastructure to approximately \$65 billion per year by 2022.⁷⁷ The Ministry of Infrastructure currently has 69 infrastructure projects in the pipeline including concessions, public-private partnerships (PPP), and privatization initiatives, encompassing airports, railways, ports, highways, defense, power generation and transmission, and oil and gas ventures.

In the Amazon region, the Brazilian government is pushing ahead with several large transportation infrastructure projects such as railways, roads, and waterways. Many of these projects have been planned since the military dictatorship. Such initiatives have also been supported by China's recent interest in financing infrastructure projects. As a consequence of the ongoing trade war with the United States, China has become more dependent on Brazil's soy production and sees this scenario as an opportunity to expand its Belt and Road Initiative (BRI).⁷⁸ It aims to create a network of railways, roads, and ports that will reduce transport costs and make Brazil more competitive against other global soy producers. Currently, Brazil has two BRI-designated deals, both in the Amazon, and a possible third deal could be the controversial construction of the "Ferrogrão" railway, which would open up a new route to transport the soy produced in Mato Grosso to the northern ports of the Amazon. During a meeting of the BRICS group, which includes

⁶⁹ "Infográfico: a realidade do saneamento básico no Brasil," Agência de Notícias CNI, <https://noticias.portaldaindustria.com.br/especiais/infografico-a-realidade-do-saneamento-basico-no-brasil/>.

⁷⁰ Ibid.

⁷¹ Ibid.

⁷² "Um milhão estão sem energia elétrica na Amazônia, mostra IEMA," Instituto de Energia e Meio Ambiente, November 25, 2019, <http://energiaambiente.org.br/um-milhao-estao-sem-energia-eletrica-na-amazonia-20191125>.

⁷³ Thais Borges and Sue Branford, "Amazon Indigenous Groups Feel Deserted by Brazil's Public Health Service," Mongabay Environmental News, August 5, 2019, <https://news.mongabay.com/2019/08/amazon-indigenous-groups-feel-deserted-by-brazils-public-health-service/>.

⁷⁴ Richard Pearshouse and Jurema Werneck, "Land Seizure and COVID-19: The Twin Threats to Brazil's Indigenous Peoples," Amnesty International, April 6, 2020, <https://www.amnesty.org/en/latest/news/2020/04/land-seizures-and-covid-19-the-twin-threats-to-brazils-indigenous-peoples/>.

⁷⁵ Ana Carolina Moreno, "Nº de habitantes por médico no Norte é quase 3 vezes o do Sudeste; veja o raio-x da carreira," *G1*, July 20, 2017, <https://g1.globo.com/educacao/guia-de-carreiras/noticia/n-de-habitantes-por-medico-no-norte-e-quase-3-vezes-o-do-sudeste-veja-o-raio-x-da-carreira.ghtml>.

⁷⁶ "Número de Hospitais Brasil – SUS," Conselho Nacional de Secretários de Saúde (CONASS), 2014, <http://www.conass.org.br/consensus/numero-de-hospitais-brasil-sus/>.

⁷⁷ "Brazil's Infrastructure and Privatization Market is Heating Up," KPMG, March 2019, <https://home.kpmg/xx/en/home/insights/2019/03/brazils-infrastructure-and-privatization-market-is-heating-up.html>.

⁷⁸ Melissa Chan and Heriberto Araújo, "China Wants Food. Brazil Pays the Price," *The Atlantic*, February 15, 2020, <https://www.theatlantic.com/international/archive/2020/02/china-brazil-amazon-environment-pork/606601/>.

Brazil, Russia, India, China, and South Africa, China “pledged \$100 billion to Brazilian infrastructure and agribusiness projects,” and Chinese state-owned companies have already indicated their interest in bidding for railway construction contracts.⁷⁹ The Ferrogrão railway will radically increase Brazil’s capacity to export grain and minerals in the north of the country, increasing pressure substantially on the Amazon and Cerrado (i.e., savanna region) biomes.

In September 2019, the Brazilian Minister of Infrastructure and the Climate Bonds Initiative signed a memorandum of understanding to use green bonds to fund green infrastructure projects.⁸⁰ Railways will be the first to be evaluated for certification, and then consideration will be expanded to other projects in the Ministry of Infrastructure’s portfolio. Electric public passenger transport (rail, trams, and buses) as well as electric freight railway lines are automatically certified. Railroad projects that are not automatically certified must prove passenger-kilometer (p-km) emissions under an appropriate threshold to receive certification. Additionally, the Brazilian government intends to sign contracts with the private sector for \$27 billion in road construction projects over the next four years.⁸¹ Some of the projects include paving the BR-319 highway through the Madeira Basin rainforest or extending the BR-163 highway across the Amazon River to the Suriname border, which could open that region to agribusiness and mining.

In terms of energy sources, approximately 78.8 percent of Brazil’s electricity generation comes from hydroelectric dams.⁸² Most of Brazil’s untapped hydropower capabilities are in rivers in the Amazon Basin. Brazil has 48 hydroelectric dams planned, 30 of them in the Amazon Basin. Of the five largest dams that are currently operating in Brazil, four are located in the Amazon region: Belo Monte (11,233 MW), Tucuruí (8,535 MW), Jirau (3,750 MW), and Santo Antônio (3,568 MW). Three of them were built in the last seven years. Some of the planned ports and dams in the Amazon include Bem Querer, Tabajara, Castanheira, Oriximiná, and the Tapajós Basin Project (which includes railways, ports, and hydroelectric dams) (Maps 2 and 3).⁸³

⁷⁹ Ibid.

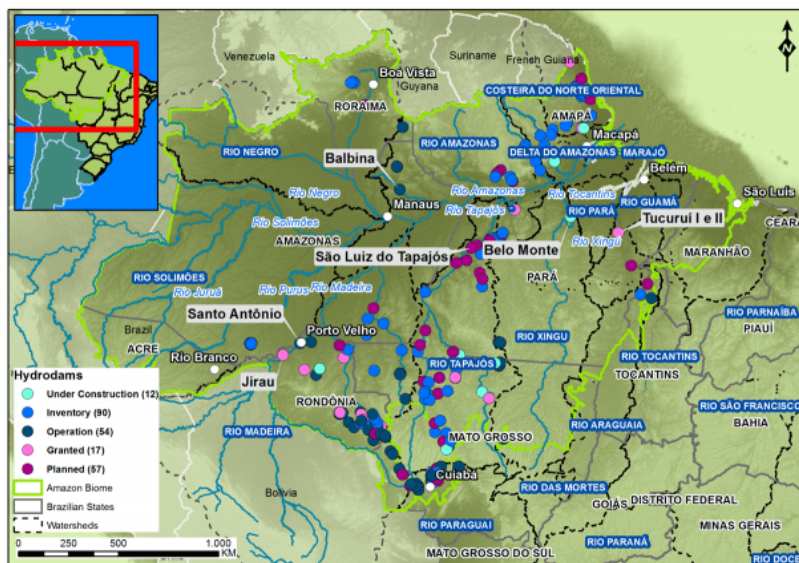
⁸⁰ Luiza Mello, “Shifting Pathways: Brazil to Review \$54 Billion Infrastructure Portfolio in Line with International Green Standards,” Climate Bonds Initiative, September 17, 2019, <https://www.climatebonds.net/2019/09/shifting-pathways-brazil-review-54-billion-infrastructure-portfolio-line-international-green>.

⁸¹ Branford, “Amazon at Risk.”

⁸² “The Rights and Wrongs of Belo Monte,” *The Economist*, May 4, 2013, <https://www.economist.com/the-americas/2013/05/04/the-rights-and-wrongs-of-belo-monte>.

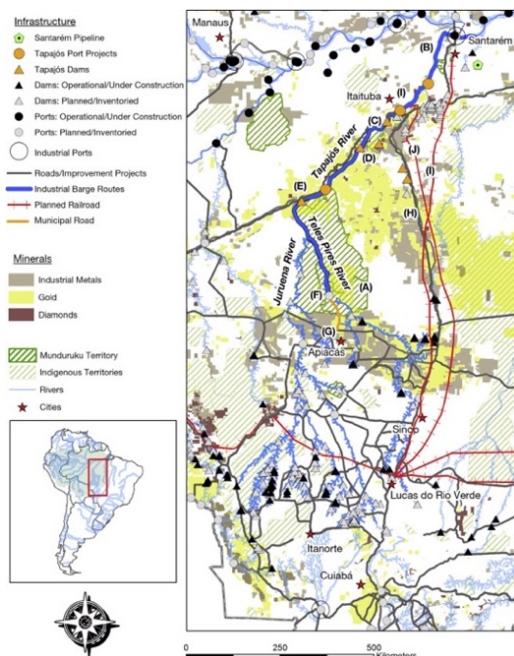
⁸³ Luciano Costa, “Brazil Eyes New Amazon Dam in Roraima Amid Venezuela Crisis,” Reuters, March 26, 2019, <https://www.reuters.com/article/us-brazil-power-dam/brazil-eyes-new-amazon-dam-in-roraima-amid-venezuela-crisis-idUSKCN1R72RV>; “Bolsonaro retoma plano de erguer grandes hidroelétricas na Amazônia,” *Epoca Negócios*, August 22, 2019, <https://epocanegocios.globo.com/Brasil/noticia/2019/08/epoca-negocios-bolsonaro-retoma-plano-de-erguer-grandes-hidreletricas-na-amazonia.html>; “Castanheira,” Instituto de Estudos Socio-Economicos, <http://amazonia.inesc.org.br/banco-de-dados-hidreletricas-na-amazonia/castanheira/>; and “Governo anuncia nova hidrelétrica na Amazônia que impactará Terras Indígenas e Quilombolas,” Comissão Pró-Índio de São Paulo, January 23, 2019, <http://cpisp.org.br/governo-anuncia-nova-hidreletrica-que-impactara-terras-indigenas-e-quilombolas/>.

Map 2: Current and Planned Hydropower Dams in the Amazon



Source: Helle Abelvik-Lawson, "Brazil Gets Carbon Credits for 'Methane Factory' Amazon Dams," *Unearthed-Greenpeace*, August 3, 2016, <https://unearthed.greenpeace.org/2016/08/03/brazil-carbon-credit-methane-amazon-dams/>.

Map 3: Current and Planned Infrastructure in the Tapajós Basin



Source: Walker, Robert Toovey, Cynthia Simmons, Eugenio Arima, Yankuic Galvan-Miyoshi, Aghane Antunes, Michael Waylen, and Máira Irigaray, "Figure 4. Infrastructure Plans for the Tapajó's River Valley," *map, One Earth* 1, no. 2 (October 2019): 209. <https://doi.org/10.1016/j.oneear.2019.09.009>.

Improving Infrastructure Planning in the Amazon

The Brazilian national government develops ambitious long-term plans for growing the economy and is equipped with very knowledgeable technical staff in the infrastructure field, especially at the federal level. For example, the Ministry of Infrastructure's *Plano Nacional de Logística* (PNL) lays out the country's key infrastructure transport needs in considerable detail. The Ministry of Mines and Energy (MME) prepares a 10-year plan setting out Brazilian energy production and supply needs. In short, there is no shortage of planning initiatives. Furthermore, Brazil boasts advanced legislation and comprehensive regulatory procedures across the spectrum.

However, infrastructure development in Brazil faces several deficiencies at different stages of the investment cycle. In the planning stage, part of the challenge is that plans follow a top-down approach while different sectoral plans (energy, transport, etc.) lack coordination, that is, they are insufficiently interlinked and assessments of their impacts are disconnected. This generates inconsistencies and redundancies and results in weak project design as well as selection and misalignment in budgets. Moreover, inadequate appraisal of environmental and social risks with weak stakeholder engagement and opaque practices can lead to conflicts and impacts down the line. At the implementation stage, there are

weaknesses in procurement and budget execution at the federal level and management capacities at the subnational level. Finally, at the monitoring and evaluation stage, audits are conducted, but better ex-post project evaluations could be implemented to gauge the impacts of such projects to guide and better inform future endeavors.

A 2017 World Bank assessment of infrastructure gaps in Brazil found that infrastructure development could be improved at all stages of the project life cycle, but particularly in the planning phases and selection of projects to the later stages in allocating budgets, executing, and evaluating projects.⁸⁴ This includes strengthening the way projects are appraised, selected, and overseen. The same study cites inefficiencies found in infrastructure projects from audits conducted at the federal and municipal levels. At the federal level, problems arise from weak planning (e.g., low-quality work plans, incomplete designs, inadequate funding) and implementation (e.g., irregularities in financial execution, procurement problems, and delays in contract management). At the subnational level, the audits identified insufficient managerial capacity on the part of local government officials as the main problem. The Amazonian states are particularly ill-equipped to manage projects.

Similarly, an FGV/IFC study on large-scale projects in the Amazon identified some gaps that need to be addressed in order to establish a new relationship between infrastructure projects and the environment.⁸⁵ The study found that infrastructure planning in the Amazon rarely takes into consideration local and regional demands. Instead, projects follow a top-down approach and are planned according to sectoral expectations and macroeconomic goals. Moreover, the study identified a lack of reference points for good practices or a mechanism that facilitates the sharing of lessons learned from previous mistakes so that socioenvironmental impacts can be mitigated. Regarding environmental licensing, the researchers point out that a large amount of resources is allocated to this process; however, because of poor governance and planning, projects end up not delivering the expected outcomes. Other issues include the lack of a long-term vision in megaproject planning as well as the difficulty that the subnational level has in going beyond the minimum requirements for environmental licensing.

Social and Environmental Costs of Infrastructure Projects

Megaprojects in the logistics, energy, and mining sectors, such as extensive road networks, large hydropower dams, transmission lines, ports, and others, are undertaken on the premise that they will generate automatic economic and social benefits for all citizens. As the Office of the United Nations High Commissioner for Human Rights (OHCHR) notes, large-scale regional infrastructure plans aim to integrate markets, create jobs, and ultimately bolster economic growth.⁸⁶ But sometimes these benefits fail to materialize, and instead, the projects produce unintended social and environmental costs. In addition, many projects in the pipeline in the Amazon Basin may not directly benefit the local population.⁸⁷ smaller

⁸⁴ Martin Raiser et al., *Back to Planning: How to Close Brazil's Infrastructure Gap in Times of Austerity* (Washington, DC: World Bank, July 12, 2017), <http://documents.worldbank.org/curated/en/386151499876913758/pdf/117392-REVISED-PUBLIC-Back-to-Planning-How-to-Close-Brazil-s-Infrastructure-Gap-in-Times-of-Austerity-with-cover-page.pdf>.

⁸⁵ FGV and IFC, *Large-Scale Projects in the Amazon*.

⁸⁶ Office of the United Nations High Commissioner for Human Rights, *The Other Infrastructure Gap: Sustainability Human Rights and Environmental Perspectives* (Switzerland: OHCHR, 2018), https://www.ohchr.org/documents/Publications/TheOtherInfrastructureGap_FullLength.pdf.

⁸⁷ Motoko Aizawa, "Sustainable Development through Quality Infrastructure: Emerging Focus on Quality over Quantity," *Journal of Mega Infrastructure & Sustainable Development* (January 2020), doi:10.1080/24724718.2019.1706922. See for example, Brent Millikan, "Ocekad: Hydroelectric Dams, Socioenvironmental Conflicts and Resistance in the Tapajós Basin," *International Rivers*, June 25, 2016, <https://www.internationalrivers.org/resources/ocekad-hydroelectric-dams-socio-environmental-conflicts-and-resistance-in-the-tapajós>; Atif Ansar et al., "Should We Build More Large Dams? The Actual Costs of Hydropower Megaproject Development," *Energy Policy* 69 (June 2014): 43-56, doi:10.1016/j.enpol.2013.10.069; Felipe A.M. de Faria et al., "The Local Socio-Economic Impacts of Large Hydropower Plant Development in a Developing Country," *Energy Economics* 67 (August 2017): 533-534, <https://www.cmu.edu/ceic/assets/docs/publications/published-papers/2017-and-2018/faria-et-al-2017.pdf>; Assunção, Costa, and Szerman, *Local Economic Impacts of Brazilian Hydroelectric Power Plants*; Emilio Moran, "Roads and Dams"; and Eric Kuhn and John Fleck, *Science be Dammed: How Ignoring Inconvenient Science Drained the Colorado River* (Tucson, AZ: University of Arizona Press: 2019).

and more sustainable projects focused on renewable energy; access to water, internet, and sanitation; and other social infrastructure (health care and education) are not the focus of planners.

Hydroelectric dam projects in the Amazon have been responsible for flooding significant areas of the forest and displacing many riverine communities. In the Tapajós river basin in Brazil, for example, dam projects underway have questionable economic projections and have caused socio-environmental conflicts with communities and indigenous people in the area.⁸⁸ Former President Dilma Rousseff downsized the Amazon National Park in 2012 to make way for the Tapajós Hydroelectric Complex, a key component of the IIRSA plan.⁸⁹ In the nearby Xingu river basin, the Belo Monte Dam caused significant changes to the economy, natural resources, and social structures of the surrounding area (Box 3). In 2015, construction of the Belo Monte Dam was responsible for the displacement of approximately 235 riverine families that depended on the Xingu river for their subsistence.⁹⁰ Some of the evident major shortcomings include the dam's weak design and dubious economic rationale along with high associated corruption and an opaque contracting process.⁹¹ While dams are not significant carbon emitters, they produce large amounts of methane, which is more detrimental to the environment than carbon. In particular, the Balbina Dam flooded approximately 2,400 km² (926 mi²) of the Amazon Basin on completion.⁹² In its first three years of operation, the reservoir emitted 23,750,000 tons of carbon dioxide and 140,000 tons of methane.⁹³

⁸⁸ Millikan, "Ocekiadi: Hydroelectric Dams, Socioenvironmental Conflicts and Resistance in the Tapajós Basin."

⁸⁹ Robert T. Walker, "Unless Brazil's Environmental Policies Change, the Worst Fires are Likely Still to Come in the Amazon," *Business Insider*, September 12, 2019, <https://www.businessinsider.com/fires-in-brazil-amazon-to-get-worse-scientist-says-2019-9>.

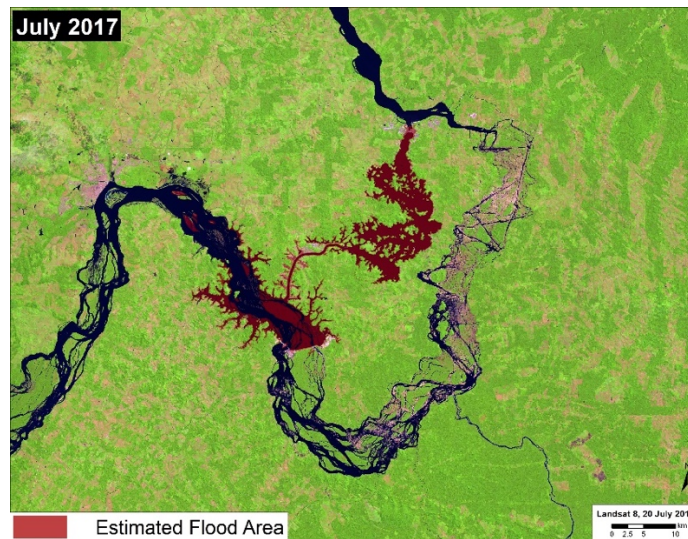
⁹⁰ "Ribeirinhos atingidos por Belo Monte exigem retomar seu território," *Instituto Socioambiental*, February 9, 2018, <https://www.socioambiental.org/pt-br/noticias-socioambientais/ribeirinhos-atingidos-por-belo-monte-exigem-retomar-seu-territorio>.

⁹¹ Anthony Boadle, "Brazil's Rousseff Benefited from Belo Monte Dam Graft: Report," *Reuters*, March 11, 2016, <https://www.reuters.com/article/us-brazil-corruption-belomonte-idUSKCN0WE04U>.

⁹² Tiffany Roufs, "Las represas en el trópico son una falsa solución al cambio climático," *Mongabay Latam*, August 15, 2012, <https://es.mongabay.com/2012/08/las-represas-en-el-tropico-son-una-falsa-solucion-al-cambio-climatico/>.

⁹³ *Ibid.*

Map 4: Flooding Created by the Belo Monte Dam



Source: “MAAP #66: Satellite Images of Belo Monte Dam Project (Brazil),” Monitoring of the Andean Amazon Project (MAAP), August 26, 2017, <https://maaproject.org/2017/belo-monte>.

Climate change, along with intense deforestation, has been causing prolonged droughts in the Amazon region. With shorter rainy seasons, some of the main rivers of the Amazon Basin are already experiencing low flow of water (e.g., the Xingu River). This scenario will directly impact the performance of hydroelectric dams; studies estimate that before 2070, Brazil’s hydroelectric potential may decrease by more than 80 percent.⁹⁴

⁹⁴ Shanna Hanbury, “Scientists Warn That the Amazon’s Tipping Point Puts Brazil’s Agribusiness, Energy Sector at Risk,” The Rising, February 26, 2020, <https://therising.co/2020/02/26/amazon-tipping-point-brazil-at-risk/>.

Box 3: The Belo Monte Hydroelectric Project

Located in the Xingu River, the Belo Monte Dam is the third-largest hydroelectric dam in the world, with an installed capacity of 11,233 MW.⁹⁵ The construction of Belo Monte was an outgrowth of Brazil's "Accelerated Growth Program," designed to advance infrastructure projects throughout Brazilian territory, including the construction of a number of dams and roads in the Amazon region.⁹⁶ The HPP of Belo Monte is only one of 60 dam projects that are planned by the Brazilian government.⁹⁷ With an initial budget of \$2.88 billion (R\$16 billion), it is estimated that over \$7.2 billion (R\$40 billion) was allocated to the construction of the Belo Monte complex.⁹⁸ The project was mostly financed by the Brazilian National Bank for Economic and Social Development (BNDES).

The dam faced widespread protests from indigenous communities and environmental activists throughout its construction.⁹⁹ In 2012, protestors conducted a sit-in at one of the construction sites, demanding consideration for those displaced by the project.¹⁰⁰ As previously estimated in environmental impact studies, the construction of the Belo Monte complex caused extreme flooding in the surrounding towns and displaced thousands of indigenous people. A local nonprofit, Xingu Vivo, reported that 50,000 people were displaced by the time the project was completed.¹⁰¹ Most of the population migrated to downstream towns such as Altamira, where the population increased from 100,000 to 160,000 in two years.¹⁰² The dam caused significant changes to the economy, natural resources, and social structures of the surrounding area.¹⁰³ The increase in population was accompanied by a rise in prostitution, health disparities, and violence. Moreover, the Xingu River's ecosystem began diminishing, eliminating the unique fish species that fed the population, and inter-tribal feuds occurred due to the newly established compensation funds directed to affected indigenous communities.¹⁰⁴

In the Amazon, road expansion has been problematic due to associated negative environmental externalities.¹⁰⁵ Weak infrastructure planning and the absence of state authority in some parts of the region have given way to a network of informal and illegal roads.¹⁰⁶ Usually, when one main road is constructed, secondary adjacent roads are built around them, exacerbating deforestation and creating a "fishbone" pattern (Figure 2). Estimates point out that approximately 95 percent of all deforestation occurs within 50 kilometers of highways or main roads in the Brazilian Amazon.¹⁰⁷

⁹⁵ "Belo Monte Dam," International Rivers, <https://www.internationalrivers.org/campaigns/belo-monte-dam>.

⁹⁶ "PAC: Growth Acceleration Program," Invest & Export Brazil, <http://www.investexportbrasil.gov.br/pac?l=en>; and Ricardo Verdum, *As obras de infraestrutura do PAC e os povos indígenas da Amazônia Brasileira* (Brasília, DF: INESC, 2012), <https://www.amazonia.org.br/wp-content/uploads/2012/10/Obras-de-Infraestrutura-do-PAC-e-Povos-Indigenas.pdf>.

⁹⁷ "Belo Monte Dam," International Rivers.

⁹⁸ Reinaldo Azevedo, "Orçado em R\$16 bilhões, custo da Usina de Belo Monte já supera os R\$ 30 bilhões," *Veja*, May 13, 2013, <https://veja.abril.com.br/blog/reinaldo/orcado-em-r-16-bilhoes-custo-da-usina-de-belo-monte-ja-supera-os-r-30-bilhoes/>; and Rafael Oliveira, "O que a última turbina inaugurada de Belo Monte significa para o Xingu," *Exame*, January 4, 2020, <https://exame.com/brasil/o-que-a-ultima-turbina-inaugurada-de-belo-monte-significa-para-o-xingu/>.

⁹⁹ Maximo Anderson and Aaron Vincent Elkaim, "Belo Monte Legacy: Harm from Amazon Dam Didn't End with Construction (photo story)," Mongabay Environmental News, February 26, 2018, <https://news.mongabay.com/2018/02/belo-monte-legacy-harm-from-amazon-dam-didnt-end-with-construction/>.

¹⁰⁰ "Belo Monte Hydroelectric Power Plant, Xingu River," Power Technology, <https://www.power-technology.com/projects/belomontehydroelectr/>.

¹⁰¹ Anderson and Elkaim, "Belo Monte Legacy."

¹⁰² Ibid.

¹⁰³ Ibid.

¹⁰⁴ Ibid.

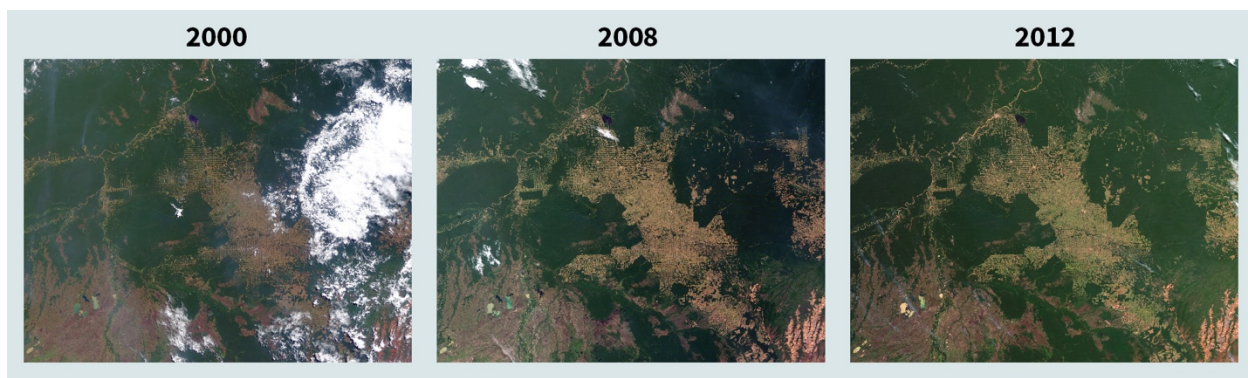
¹⁰⁵ Geoffrey Gallice et al., "The Threat of Road Expansion in the Peruvian Amazon," *Oryx* 53, no. 2 (April 2019): 284-292, doi:10.1017/S0030605317000412.

¹⁰⁶ Fernando Franco et al., *Megaproyectos: La Amazonia en la Encrucijada* (Bogotá: Universidad Nacional de Colombia – Instituto Imani, 2012), http://biblioteca.clacso.edu.ar/Colombia/imani-unal/20170804053911/pdf_715.pdf.

¹⁰⁷ Global Forest Atlas, "Roads in the Amazon Basin."

Although roads can spur economic development by facilitating the transport of goods, mobility of people, and creation of jobs, many of the roads constructed in the Amazon show no economic benefits. A recent study evaluated 75 planned road projects spanning 12,000 kilometers in five countries of the Amazon and concluded that 45 percent of the roads were not economically viable—even without accounting for the environmental and social costs.¹⁰⁸ The same study found that all roads would cause negative environmental impacts and avoiding construction of the riskiest roads would prevent losses of more than \$7.6 billion and more than 1 million hectares of deforestation. Only a small subset of carefully selected road projects would bring economic benefits while minimizing environmental and social costs.

Figure 2: “Fishbone Pattern” in Rondônia State, Brazil



Source: "World of Change: Amazon Deforestation," NASA Earth Observatory, 2000-2018, <https://earthobservatory.nasa.gov/world-of-change/Deforestation/show-all>.

Transparency and Corruption in Infrastructure Development

Many of these projects were also mired in corruption. Odebrecht, one of Latin America's largest construction companies, was recently implicated in "Operation Car Wash," arguably the biggest corruption scandal in recent history.¹⁰⁹ Millions of dollars in kickbacks and bribes were funneled between Brazilian construction firms, political parties, and politicians. Odebrecht and others overcharged Petrobras (Brazil's oil company) for construction contracts (e.g., for highways, roads, ports, and dams), laundered the money through small businesses (such as gas stations), and then funneled those bribes to politicians and Petrobras.

This is part of a familiar pattern of corruption in infrastructure projects in the Amazon. Studies show that corruption was common within the innumerable infrastructure projects implemented by the military government in the 1970s.¹¹⁰ Due to Operation Car Wash and local population resistance, nearly 22 proposed dams along the Marañón River in the Amazon were halted.¹¹¹ In 2017, an investigation carried out by the Brazilian newspaper *Folha de São Paulo* disclosed that at least 15 infrastructure projects in the country had evidence of overbilling.¹¹² Irregularities in these projects cost the public coffers at least \$3

¹⁰⁸ Thais Vilela et al., "A Better Amazon Road Network for People and the Environment," *PNAS* 117, no. 13 (February 2020): 7095-7102, <https://www.pnas.org/content/pnas/117/13/7095.full.pdf>.

¹⁰⁹ Daniel Gallas, "Brazil's Odebrecht Corruption Scandal Explained," BBC, April 17, 2019, <https://www.bbc.com/news/business-39194395>.

¹¹⁰ Luis Barrucho, "50 anos do AI-5: Os números por trás do 'milagre econômico' da ditadura no Brasil," BBC, December 13, 2018, <https://www.bbc.com/portuguese/amp/brasil-45960213>.

¹¹¹ Saul Elbein, "Of Concrete and Corruption: Resistance Kills Andes Amazon Dams," Mongabay Environmental News, January 24, 2019, <https://news.mongabay.com/2019/01/of-concrete-corruption-peoples-resistance-kills-andes-amazon-dams/>.

¹¹² Maira Martini, "The Real Cost of Corruption in Brazil," Transparency International, December 22, 2017, <https://voices.transparency.org/the-real-cost-of-corruption-in-brazil-f3def6d17c94>.

billion. These large infrastructure projects are complex undertakings, and often corruption in the project preparation stage continues and trickles down to the implementation stage.¹¹³

“Operation Car Wash” spurred a number of new anti-corruption measures. In the first half of 2019, the Ministry of Infrastructure launched the program “Anticorruption Radar” to fight the embezzlement of federal funds.¹¹⁴ The initiative was developed in cooperation with the Ministry of Justice and Public Security, General Comptroller’s Office, General Attorney’s Office, and the federal police. It includes information sharing among ministries, the establishment of compliance rules to be followed by the Ministry of Infrastructure, and the definition of technical criteria to nominate individuals to new functions. Moreover, it has created a guide of ethical conduct and a transparency portal to receive complaints against corruption.¹¹⁵

These examples underscore the need for greater transparency and better infrastructure planning and execution processes, especially in a vulnerable ecosystem such as the Amazon. A study by Watkins et al. (2017) evaluated environmental and social conflicts in 200 large infrastructure projects in Latin America, ranging from grassroot campaigns and protests to hostile confrontations and eventually the halting of projects.¹¹⁶ The study found that these conflicts typically materialize from the interaction of environmental, social, governance, and economic drivers over time and are mainly caused by four factors: poor planning and governance, limited access to resources, overall lack of community benefits, and lack of adequate consultation.¹¹⁷ Conflicts can arise at any point during a project’s life cycle (e.g., in planning, exploration, pre-feasibility, feasibility, construction, operations, expansion, closure, or post-closure), but the early- and mid-cycle phases such as feasibility and construction are most likely to experience conflict. Moreover, conflict arising within those phases is more likely to cause the project to be postponed or cancelled and hurt companies, investors, and national economies.

The lack of adequate stakeholder engagement is a key factor for environmental degradation and social conflicts in Amazon Basin countries. Although consultation with affected communities is regulated by law in Brazil, these communities are often consulted too late in the planning process and their demands are either minimized or disregarded altogether. This contributes to tension between indigenous ethnic groups and project planners and sponsors. Stakeholder engagement processes should be able to incorporate community consultations early in the development of the project by not only sharing information, but also giving stakeholders the opportunity to impact project design and implementation. To ensure transparency and accountability, it is essential to provide public access to environmental reports and allow stakeholders to fully participate in community consultations.

¹¹³ John Butterworth and Jean de la Harpe, “Grand Designs: Corruption Risks in Major Water Infrastructure Projects,” Chr. Michelsen Institute, *U4 Brief* 27, November 2009, <https://www.u4.no/publications/grand-designs-corruption-risks-in-major-water-infrastructure-projects.pdf>.

¹¹⁴ Ministério da Infraestrutura, “Radar Anticorrupção encaminha 23 denúncias no primeiro mês do programa,” Government of Brazil, June 17, 2019, <http://transportes.gov.br/ultimas-noticias/8794-radar-anticorrupcao-encaminha-23-denuncias-no-primeiro-mes-do-programa.html>.

¹¹⁵ Ministério da Infraestrutura, “Radar Anticorrupção,” Government of Brazil, May 16, 2019, updated June 1, 2020, <http://infraestrutura.gov.br/radar-anticorrupcao.html>.

¹¹⁶ Graham Watkins et al., *Lessons from 4 Decades of Infrastructure Project Related Conflicts in Latin America and the Caribbean* (Washington, DC: IDB, 2017), <https://publications.iadb.org/publications/english/document/Lessons-from-Four-Decades-of-Infrastructure-Project-Related-Conflicts-in-Latin-America-and-the-Caribbean.pdf>. See, for example, an interesting case of the World Bank and IDB’s history in the “Polonoroeste project,” Stephen Schwartzman, “World Bank Holds Funds for Development Project in Brazil,” *Cultural Survival Quarterly*, March 1986, <https://www.culturalsurvival.org/publications/cultural-survival-quarterly/world-bank-holds-funds-development-project-brazil>; and Robert H. Wade, *Boulevard of Broken Dreams: the Inside Story of the World Bank’s Polonoroeste Road Project in Brazil’s Amazon* (London: Grantham Research Institute on Climate Change and the Environment, 2011), http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/WP55_world-bank-road-project-brazil.pdf.

¹¹⁷ According to Watkins et al. (2017), the main *governance* drivers of conflicts are: deficient planning (86 percent of cases) and lack of adequate consultation (74 percent of cases), while lack of transparency and corruption led to conflicts in 68 percent of cases and 34 percent of conflicts, respectively.

Community consultation is particularly important when carrying out the feasibility studies for infrastructure projects. The primary purpose of feasibility studies—also known as technical, economic, and environmental feasibility studies (in Portuguese: EVTEA)—is to weigh the economic, social, and environmental costs and benefits of infrastructure projects.¹¹⁸ Feasibility studies provide assessments of the technical and engineering aspects of an infrastructure project as well as the key social, environmental, economic, and financial risks to determine the potential impacts of the project and weigh risks against benefits.¹¹⁹ Strengthening the feasibility study phase could lead to a more robust pipeline of projects.¹²⁰

Despite these shortcomings, there have been some positive developments regarding sustainable infrastructure at the federal level. The 2020 creation of Brazil’s Sustainability Guidelines and Sustainability Agenda, for example, is a result of the recent incorporation of topics related to socio-environmental responsibility and territorial integration into the Ministry of Infrastructure’s Transportation Strategic Plan.¹²¹ Thematic areas include governance and planning, climate change, projects and studies, environmental licensing, and territorial management. They are focused on diverse initiatives such as incorporating socio-environmental considerations into public policies and inter-sectoral transport infrastructure plans, improving the quality of socio-environmental studies and strengthening the management of environmental licensing processes. Furthermore, in 2019, the Environmental Management Committee (COGEA) was established to guarantee the implementation of the Sustainability Guidelines and manage issues related to licensing processes, environmental regularization, and the execution of programs.¹²² Moreover, in 2019, the National Congress took up three bills with the potential to change the legislation and guidelines regulating the country’s infrastructure sector.¹²³ The bills aim to regulate the different phases of the project life cycle, including environmental licensing, concessions and public-private partnerships, and bidding procedures.

¹¹⁸ Joana Chiavari et al., *The Future of Infrastructure in Brazil under Discussion: An Integrated Vision of Proposed Legislation is Needed to Ensure Progress* (Rio de Janeiro: CPI, 2019), <https://climatepolicyinitiative.org/wp-content/uploads/2019/10/The-Future-of-Infrastructure-in-Brazil-under-Discussion-2.pdf>.

¹¹⁹ See “Assessing Project Feasibility and Economic Viability,” PPP Knowledge Lab, <https://pppknowledgelab.org/guide/sections/50-assessing-project-feasibility-and-economic-viability>; and “Improving Feasibility Studies Could Help the Sustainability of Hydropower Projects in Lao PDR,” IFC, https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/improving+feasibility+studies+could+help+the+sustainability+of+hydropower+projects+in+lao+pdr.

¹²⁰ In the case of Brazil, the nonprofit climate think tank Climate Policy Initiative (CPI) recommends three main improvements that could be undertaken at the feasibility phase. First, include areas of *indirect* environmental impact of the project. Currently, only *direct* environmental impact is considered in the environmental licensing phase; this could be broadened to cover indirect impacts of the project as well. Moreover, the concept of “areas of influence” (areas of direct and indirect impacts) should be applied to all phases of the project life cycle. Second, community consultations should be undertaken early in this phase (as opposed to later stages when environmental licensing is prepared) so that communities understand the project and can influence its design and local governments can better prepare for the impacts, including implementing policies to mitigate any negative effects and compensation mechanisms for affected communities. Third, a law should be created to regulate the communication between the results of the feasibility studies and the terms of the Environmental Impact Studies. Chiavari et al., *The Future of Infrastructure in Brazil under Discussion*.

¹²¹ Ministério da Infraestrutura, “Diretrizes de Sustentabilidade,” Government of Brazil, March 13, 2020, <https://infraestrutura.gov.br/diretrizes-de-sustentabilidade.html>; and Ministério da Infraestrutura, *Agenda de Sustentabilidade do Minfra: Período 2020-2022* (Brasília, DF: 2020), https://infraestrutura.gov.br/images/2020/documentos/AgendaSustentabilidade_20_22.pdf.

¹²² Ministério da Infraestrutura, “Comitê de Gestão Ambiental – COGEA,” Government of Brazil, March 13, 2020, <https://infraestrutura.gov.br/comite-de-gestao-ambiental-cogea.html>.

¹²³ Chiavari et al., *The Future of Infrastructure in Brazil under Discussion*.

Governance Challenges and Insecurity in the Brazilian Amazon

The challenges and deficiencies in infrastructure planning are compounded by a weak state presence across the Amazon, carrying with it environmental, social, and economic repercussions. Illegal land-grabbing and the profitability of transnational activities such as illicit gold mining, drug trafficking, and logging have empowered actors, who mostly function with impunity in a “lawless” region.¹²⁴ At the same time, the sheer size of the Amazon makes holding perpetrators accountable very difficult. To understand the magnitude of the security and enforcement challenge, Brazil’s land border spans 10,000 miles (16,093 km) over 10 countries, nearly twice the combined length of the U.S.-Mexico and U.S.-Canada borders (not including Alaska).¹²⁵ Within this context, approximately 6,000 miles of Brazil’s land border is in the Amazon Basin region.

While environmental agencies and the federal and local police have the authority to inspect and shut down illegal economic activities in the Amazon, criminal actors have turned to new methods to evade detection (for example, the use of submarines and submersibles by narcotraffickers). Moreover, many loggers are connected to vast criminal networks that have security forces to protect their interests. Therefore, it is very difficult to enforce environmental laws due to the security capabilities of these illegal networks, lack of resources in local states, and the magnitude of the Amazon.

Land Governance and Deforestation

Deforestation is a multi-step process driven principally by illegal land occupation often undertaken for speculative purposes. Specifically, individuals move into areas, occupy lands illegally, strip them of their vegetation, sell the most valuable wood, and hold on until they can receive a good price for the remaining land. Additionally, deforestation is influenced in no small measure by wealthy interests in and outside the region.

High rates of deforestation in the 1970s and 1980s and international pressure prompted the Brazilian government to pass laws to protect the Amazon. The majority of these laws were passed between the late 1980s and the early 2000s (see Annex B).¹²⁶ As a result of this legal framework, half of the land in the Brazilian Amazon is now protected, either as indigenous territories or conservation units. The remaining half of the land is privately owned or is undesignated public land (Map 4). However, a lack of enforcement of regulations, loopholes in the existing land titling framework, and weak institutional capacity in the Brazilian Amazon create an environment in which deforestation can flourish, leading to added security challenges.

Land titling in the Amazon is complicated due to many claims to the land and “squatter rights.” To streamline the land title process, the Terra Legal System was created in 2009 to provide titles to small landowners in occupied forest territory.¹²⁷ These titles are contingent upon compliance by landowners

¹²⁴ Cope and Parks, *Frontier Security*.

¹²⁵ *Ibid.*

¹²⁶ “Governance-Brazil,” Monitoring of the Andean Amazon Project, <https://maaproject.org/governance-brazil/>.

¹²⁷ Sue Branford and Maurício Torres, “If Brazil Okays Terra Legal Changes, Land Grabbers Win, Amazon Loses, Say Environmentalists,” *Mongabay Environmental News*, June 16, 2017, <https://news.mongabay.com/2017/06/if-brazil-okays-terra-legal-changes-land-grabbers-win-amazon-loses/>.

with the 2012 Forest Code, which stipulates that residents must maintain 80 percent rainforest cover. The Forest Code is the latest update to the original 1965 Forest Code, which outlines rules for private property holdings in the Amazon.¹²⁸ The new update decreases the total protected area needed on each private property. Additionally, the Forest Code outlines a new national system (the Rural Environmental Registry) that allows landowners to register their properties with high-resolution satellite images. Failure to comply with this standard can lead to loss of agricultural credits and product embargoes. However, the Rural Environmental Registry can be used as a vehicle for corruption and land-grabbing, especially of undesignated public lands.¹²⁹

Despite the legal protections for the Amazon, CPI has found that most deforestation occurs on public lands, both in undesignated areas (25 percent) and agrarian settlements (30 percent) (Figure 3).¹³⁰ An estimated 54.6 million hectares of public land is undesignated, a large part of which is in the Amazon.¹³¹ These areas lack management plans or management councils to monitor their activities. The issue is not the number of laws, but the lack of enforcement, resources, and personnel to protect the land. The issue of ownership of Brazilian land in general has negative implications for reducing deforestation in the Amazon. A recent survey of Brazilian land tenure found that there is “a substantial overlap between these undesignated lands and lands registered under public and private tenure.”¹³²

¹²⁸ Frederico Machado and Kate Anderson, *Brazil's New Forest Code: A Guide for Decision-makers in Supply Chains and Governments* (Brasília, DF: WWF, 2016), http://assets.wwf.org.uk/downloads/wwf_brazils_new_forest_code_guide_1.pdf.

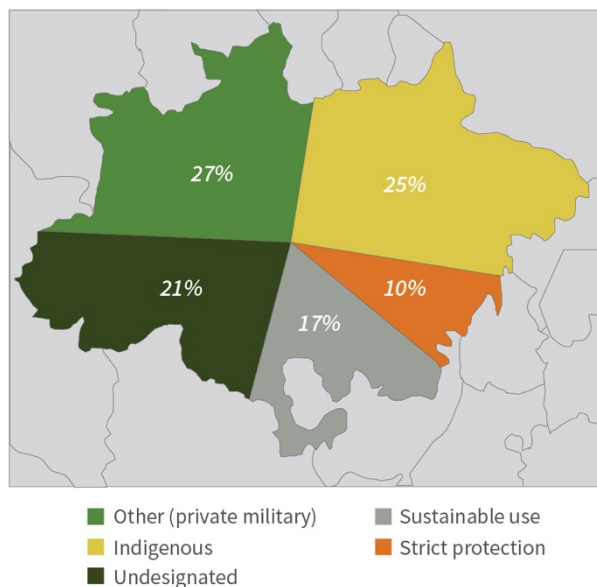
¹²⁹ Damasceno, Chiavari, and Leme Lopes, *Evolution of Land Rights in Rural Brazil*.

¹³⁰ Juliano Assunção and Clarissa Gandour, *Combating Illegal Deforestation: Strengthening Command and Control is Fundamental* (Rio de Janeiro: CPI, 2019), <https://climatepolicyinitiative.org/wp-content/uploads/2019/04/white-paper-Combating-Illegal-Deforestation-Strengthening-Command-and-Control-Is-Fundamental.pdf>; and Juliano Assunção and Romero Rocha, *Rural Settlements and Small-Scale Deforestation* (Rio de Janeiro: CPI, 2016), https://climatepolicyinitiative.org/wp-content/uploads/2017/02/Rural_Settlements_and_Small_Scale_Deforestation_Brief_EN_FINAL.pdf.

¹³¹ Gerd Sparovek et al., “Who Owns Brazilian Lands?,” *Land Use Policy* 87 (September 2019), doi:10.1016/j.landusepol.2019.104062.

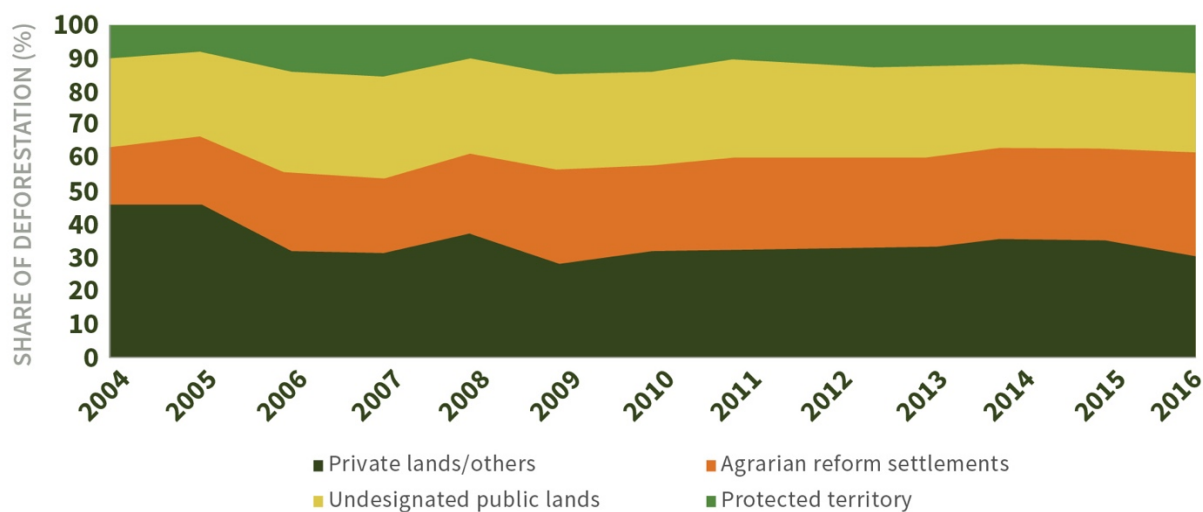
¹³² Ibid.

Map 5: Land Tenure in the Brazilian Amazon



Source: Juliano Assunção and Clarissa Gandour, *Large-Scale Reforestation: Starting with Public Lands in the Brazilian Amazon* (Rio de Janeiro: CPI, 2019), https://climatepolicyinitiative.org/wp-content/uploads/2019/01/INPUT_Insights_Large-Scale_Reforestation_EN.pdf.

Figure 3: Land Tenure Category and Deforestation



Source: Juliano Assunção and Clarissa Gandour, *Combating Illegal Deforestation: Strengthening Command and Control is Fundamental* (Rio de Janeiro: CPI, 2019), <https://climatepolicyinitiative.org/wp-content/uploads/2019/04/white-paper-Combating-Illegal-Deforestation-Strengthening-Command-and-Control-Is-Fundamental.pdf>.

Yet land tenure reform alone will not be sufficient to deter deforestation. The rate of deforestation in the Amazon dropped 84 percent from 2004 to 2012 due to greater political will and better enforcement of environmental laws.¹³³ A boycott on soy produced on illegally deforested land, credit restrictions for landowners, and increases in protected and indigenous lands all contributed to the decrease in deforestation rates in Brazil. In 2008, the Brazilian government increased monitoring of key municipalities and restricted credit to those in violation of environmental regulations.¹³⁴ It also confiscated assets such as cattle. The decline in deforestation can also be attributed to economic conditions and income distribution policies. The growing efficiency of Brazilian agriculture also was a factor in decreasing the demand for land in the Amazon, as were rising commodity prices (despite deforestation remaining low until 2012).

Since 2012, deforestation levels have steadily increased, despite it causing few economic benefits. Many environmentalists blame the weakening of the 2012 Forest Code (with the updated 2016 provisions), which decreased the forest cover requirements for farmers and timber companies.¹³⁵ It also gave amnesty to people who cut down the rainforest illegally before 2008, which further emboldened loggers. These conditions combined with the economic and political crises in Brazil in 2017 have led to fewer resources to effectively monitor and punish illegal deforestation activities. Since 2018, fines for deforestation have decreased nearly 38 percent, reaching the lowest levels in two decades.¹³⁶ Illegal logging activities have expanded as many loggers are increasingly confident that they will not face fines or sanctions due to the loosening of environmental regulations. In addition, decreases in the number of personnel and inspectors at agencies such as the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and Fundação Nacional do Índio (the National Indian Foundation, or FUNAI) have made enforcement efforts increasingly limited (Box 4).¹³⁷ Deforestation in the Amazon has increased since the outbreak of Covid-19, as the effects of the virus have combined with a particularly dry season. An increase in agricultural expansion and illegal mining operations, in part driven by the evaporation of other economic opportunities, has taken advantage of reduced enforcement efforts. Deforestation in Brazil is now at a nine-year high, and Colombia saw the amount of fires in March double compared to the previous year.¹³⁸

¹³³ Philip Fearnside, "Business as Usual: A Resurgence of Deforestation in the Brazilian Amazon," *Yale Environment* 360, April 18, 2017, <https://e360.yale.edu/features/business-as-usual-a-resurgence-of-deforestation-in-the-brazilian-amazon>.

¹³⁴ Instituto do Homem e Meio Ambiente da Amazônia, *Our Heritage Endangered: Why Amazon's Conservation Units Are at Risk* (Belém, Brazil: Imazon, 2019), <https://k6f2r3a6.stackpathcdn.com/wp-content/uploads/2019/06/Dossiê-Imazon-ENG.pdf>.

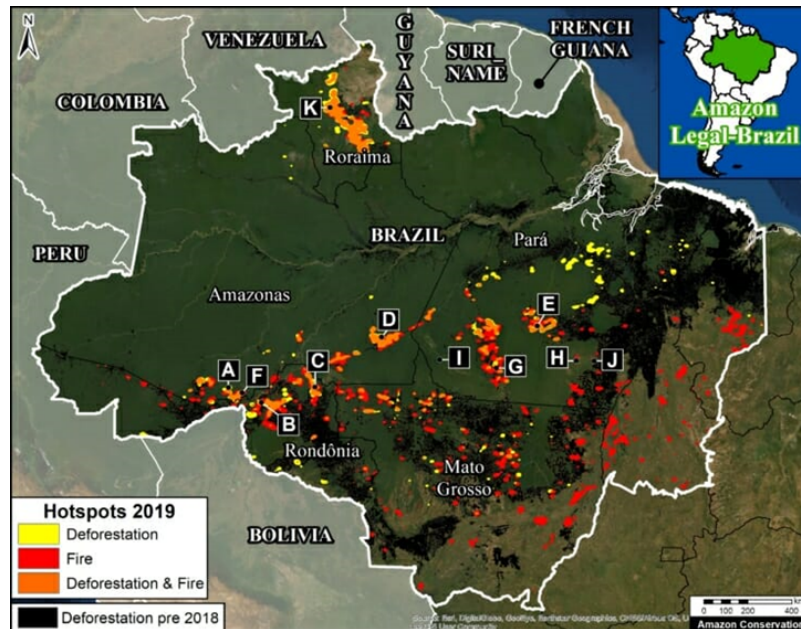
¹³⁵ Claire Asher, "Brazil's New Forest Code Puts Vast Areas of Protected Amazon Forest at Risk," *Mongabay Environmental News*, March 4, 2019, <https://news.mongabay.com/2019/03/brazils-new-forest-code-puts-vast-areas-of-protected-amazon-forest-at-risk>.

¹³⁶ Human Rights Watch, *Rainforest Mafias: How Violence and Impunity Fuel Deforestation in Brazil's Amazon* (New York: September 2019), <https://www.hrw.org/report/2019/09/17/rainforest-mafias/how-violence-and-impunity-fuel-deforestation-brazils-amazon>.

¹³⁷ *Ibid.*; and Asher, "Brazil's New Forest Code."

¹³⁸ "Conservation International Reports Increase in Poaching and Tropical Deforestation Due to Covid-19 Restrictions," *Conservation International*, April 21, 2020, <https://www.conservation.org/press-releases/2020/04/21/conservation-international-reports-increase-in-poaching-and-tropical-deforestation-due-to-covid-19-restrictions>.

Map 6: 2019 Deforestation in Brazil



Source: “MAAP #109: Fires and Deforestation in the Brazilian Amazon, 2019,” Monitoring of the Andean Amazon Project, September 10, 2019, <https://maaproject.org/2019/fires-deforestation-brazil-2019/>.

Box 4: Federal Agencies on Environmental Protection and Indigenous Peoples’ Rights in the Amazon

- The Ministry of Environment and Ministry of Agriculture can both establish and enforce public policy in the Amazon.
- The Ministry of Environment’s administrative department, the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), is one of the most ardent opponents of deforestation in the government and is often called Brazil’s environmental protection agency. Its mandate is to ensure the implementation of the 1981 National Environmental Policy and to safeguard the vitality of the Brazilian environment. IBAMA has the authority to issue environmental licenses. While IBAMA only has civil law enforcement powers, IBAMA agents can detain and bring citizens who commit crimes related to the environment to the police.
- Another important agency with civil enforcement authority is the Chico Mendes Institute for the Conservation of Biodiversity (ICMBio). Both ICMBio and the Brazilian National Park Service are responsible for protecting parks in Brazil. Both ICMBio and IBAMA can levy fines against loggers, revoke licenses, or destroy logging equipment.
- The Fundação Nacional do Índio (FUNAI, or the National Indian Foundation) is the official government agency that ensures that indigenous peoples’ rights under the constitution are respected it establishes and executes policies relating to indigenous peoples. FUNAI is responsible for mapping out and protecting lands traditionally inhabited and used by these communities, and preventing invasions of indigenous territories by outsiders.

Insecurity and Deforestation

Due to the challenges of poor land governance, criminal networks operate in the Amazon, driving deforestation and inflicting social harm on rural communities. Powerful mafias that are often connected through intricate networks conduct activities such as illegal mining as well as drug and wildlife trafficking. According to a recent Human Rights Watch report, these networks have the capability to process these commodities and enough technology and security personnel to protect their interests.¹³⁹ Weak state presence and oversight, pervasive corruption, and the geography of the Amazon itself present challenges to effective control of the illegal activities that exacerbate deforestation.

Most of the illegal activity in the Amazon has transnational reach that affects neighboring countries in the region.¹⁴⁰ Illegal gold mining, for example, is prevalent in the Amazon, bringing an estimated \$1 billion a year to the Brazilian economy. The price of gold has increased sixfold in the last decade, dramatically increasing incentives for illegal mining.¹⁴¹ There are both small-scale and large-scale gold mining operations. Individuals and small enterprises conduct these activities using limited technology in private and protected areas of the Amazon.¹⁴² In addition, powerful mafia groups are involved in large-scale mining and other illegal activities including cocaine smuggling and wildlife trafficking. Illegal gold is melted together with gold from other sources, a process sometimes referred to as “gold-laundering.”¹⁴³

Moreover, although the Brazilian constitution protects indigenous reserves from industrial activities, illegal activities still occur in these lands, which creates conflicts with existing communities as illegal actors encroach on these lands. For example, gold is a commodity of interest in the Kayapó, Munduruku, and Yanomami reserves and gold miners (or their proxies) are suspected of murdering indigenous leaders who fight back against invaders in their territories.¹⁴⁴

In addition to illegal gold mining, drug trafficking in the Amazon is strongly associated with increasing levels of violence in the region along the approximately 6,000 miles of border shared with the three major global producers of cocaine: Colombia, Peru, and Bolivia.¹⁴⁵ For years, drug trafficking routes in the Amazon have been contested by criminal factions such as the Família do Norte (FDN) and Comando Vermelho (CV).¹⁴⁶ The state of Amazonas is the principal corridor for cocaine flowing from Peru and Colombia into Brazil. According to the Brazilian federal police, it is difficult to monitor and control narco-trafficking in the Amazon because of its extensive territory and natural barriers.¹⁴⁷ Moreover, criminal factions build clandestine ports and airports and recruit civilians living close to the borders to assist them. *Ribeirinhos*

¹³⁹ Human Rights Watch, *Rainforest Mafias*.

¹⁴⁰ For example, among illegal crops, the major producers of cocaine are Colombia and Peru while the United States and Brazil are the top two consumers. Among legal crops, 80 percent of Brazilian soybeans are exported to China. Source: Bradley and King, “Brazil Now Consumes 18% of the World’s Cocaine”; UNODC, *2019 World Drug Report*; and Ana Mano, “Exclusive: Brazil Soybeans Lose Protein, China Sales at Risk,” Reuters, July 19, 2019, <https://www.reuters.com/article/us-brazil-soybeans-exclusive/exclusive-brazil-soybeans-lose-protein-china-sales-at-risk-idUSKCN1UE1SR>.

¹⁴¹ Donovan Webster, “The Devastating Costs of the Amazon Gold Rush,” *Smithsonian Magazine*, February 2012, <https://www.smithsonianmag.com/travel/the-devastating-costs-of-the-amazon-gold-rush-19365506>.

¹⁴² Fikri, Koster, and de Wit, *Healthy Rivers, Healthy People*.

¹⁴³ Livia Wagner, *Organized Crime and Illegally Mined Gold in Latin America* (Geneva, Switzerland: The Global Initiative Against Transnational Organized Crime, 2016), https://arcominero.infoamazonia.org/GIATOC-OC_Illegally-Mined-Gold-in-Latin-America-3c3f978eef80083bdd8780d7c5a21f1e.pdf.

¹⁴⁴ John C. Cannon, “Gold Mining Threatens Indigenous Forests in the Brazilian Amazon,” *Mongabay Environmental News*, April 8, 2020, <https://news.mongabay.com/2020/04/gold-mining-threatens-indigenous-forests-in-the-brazilian-amazon>.

¹⁴⁵ Cerqueira et al., *Atlas da Violência*; FUNAG, “Brasil: Fronteiras Terrestres,” Government of Brazil, <http://www.funag.gov.br/ipri/images/informacao-e-analise/fronteiras-terrestres-brasil.pdf>; and UNODC, *2019 World Drug Report*.

¹⁴⁶ “Rota da cocaína peruana atrai facções a Amazônia e gera um lucro bilionário,” *Amazônia*, January 13, 2017, <https://amazonia.org.br/2017/01/rota-da-cocaina-peruana-atrai-faccoes-a-amazonia-e-gera-um-lucro-bilionario>.

¹⁴⁷ Aiala Colares Couto and Isabela de Souza Oliveira, “A Geografia do Narcotráfico na Amazônia,” *Geographia Opportuno Tempore* 3, no. 01 (December 2017), <http://www.uel.br/revistas/uel/index.php/Geographia/article/view/31774>.

and boatmen, for instance, often facilitate the transport of drugs on the Amazon's waterways in exchange for "easy and quick money."¹⁴⁸

In recent years, the two Amazon states with the highest levels of deforestation, Pará and Mato Grosso, also registered significant growth in illegal logging activities. According to the nongovernmental organization Instituto Centro Vida (ICV), 85 percent of logging activities in the state of Mato Grosso between August 2018 and July 2019 were not authorized.¹⁴⁹ A study released by the São Paulo Research Foundation (FAPESP) estimates that illegal logging activities in the state of Pará yielded a total of \$52 million dollars from 2012 to 2017.¹⁵⁰

Vast criminal networks exploit resources and displace local indigenous populations that legally inhabit the region (Box 5).¹⁵¹ The Pastoral Land Commission estimates that about 300 people have been murdered in the last 10 years in the Amazon.¹⁵² Only 14 cases have been tried thus far. The crimes occur mostly in indigenous territory at a significant distance from police stations. Many environmentalists are concerned with the trend of rising violence between loggers and indigenous ethnic groups.¹⁵³

Notwithstanding this broad lack of enforcement, studies show that deforestation is much lower in land securely held by Indigenous peoples than in other areas of the Brazilian Amazon.¹⁵⁴ For that reason, indigenous groups are "effective barriers" against logging, compensating for the lack of public resources to adequately enforce and monitor conditions on the ground. With the rise in deforestation in recent years and the lack of enforcement by security agencies, indigenous people have resorted to defending themselves and patrolling their territories for intruders. This has led at times to violent clashes. Despite their efforts to defend their land, in July 2019 alone, indigenous territories lost 52 km² of forest.¹⁵⁵

¹⁴⁸ Ibid.

¹⁴⁹ Phillippe Watanabe, "Maior parte do desmatamento da Amazônia no Mato Grosso é ilegal," *Folha de S. Paulo*, December 11, 2019, <https://www1.folha.uol.com.br/ambiente/2019/12/maior-parte-do-desmatamento-da-amazonia-no-mato-grosso-e-ilegal.shtml>.

¹⁵⁰ Victória Flório, "Amazônia ilegal: Estudo acusa fraudes no comércio de madeira nobre no Pará," *Pesquisa FAPESP*, August 17, 2018, <https://revistapesquisa.fapesp.br/amazonia-ilegal>.

¹⁵¹ Human Rights Watch, *Rainforest Maftas*.

¹⁵² César Muñoz Acebes, "Brazil's Amazon – and Its Defenders – Are under Attack from Illegal Loggers," *Foreign Policy*, November 14, 2019, <https://foreignpolicy.com/2019/11/14/brazil-amazon-indigenous-defenders-deforestation-illegal-loggers>.

¹⁵³ Jeffrey T. Lewis, "Brazil Killings Spur Concerns over Development Tensions in the Amazon," *Wall Street Journal*, December 9, 2019, <https://www.wsj.com/articles/brazil-killings-spur-concerns-over-development-tensions-in-the-amazon-11575936902>.

¹⁵⁴ Rhett A. Butler, "People in the Amazon Rainforest," Mongabay, April 1, 2019, https://rainforests.mongabay.com/amazon/amazon_people.html; Woods Hole Research Center, "Satellites Show Amazon Parks, Indigenous Reserves Stop Forest Clearing," *ScienceDaily*, <https://www.sciencedaily.com/releases/2006/01/060126200147.htm>; and Luciana Porter-Bolland et al., "Community Managed Forests and Forest Protected Areas: An Assessment of Their Conservation Effectiveness across the Tropics," *Forest Ecology and Management* (2011), http://www.cifor.org/publications/pdf_files/articles/AGuariguata1101.pdf.

¹⁵⁵ Human Rights Watch, *Rainforest Maftas*.

Box 5: Indigenous Communities in the Brazilian Amazon

The Brazil constitution of 1988 under title VIII, “Of the Social Order,” chapter VIII “of the Indians,” recognizes indigenous communities as the first and natural owners of the land and guarantees them their right to land. The constitution stipulates that the Brazilian National Congress and that communities need to be heard and guaranteed benefits from the mining activities. The constitution prohibits the eviction of indigenous people may not log or conduct economic activities on indigenous lands. However, only specific indigenous peoples’ populated areas are recognized as legal reserves.

The Fundação Nacional do Índio (FUNAI, the National Indian Foundation) is the official government agency that ensures that Indigenous rights under the constitution are respected. It establishes and executes policies relating to Indigenous peoples. FUNAI is responsible for mapping out and protecting lands traditionally inhabited and used by these communities and preventing invasions of Indigenous territories by outsiders.

The total indigenous population in Brazil, according to the 2010 IBGE Census, adds up to 896,917 individuals, which corresponds to approximately 0.47 percent of the country’s total population.¹⁵⁶ About 60 percent of the indigenous population in Brazil lives in the Amazon.¹⁵⁷ The main indigenous ethnic groups include the Guarani, Yanomami, and Tikuna.¹⁵⁸ Some indigenous ethnic groups remain in isolation, such as the Awá-Guajá, Uru Eu Wau Wau, Piripkura, Kawahiva, and Korubo.¹⁵⁹ FUNAI estimates that are 69 indigenous groups in isolation in the Brazilian Amazon.¹⁶⁰

¹⁵⁶ “How Many are They?,” Instituto Socioambiental, February 16, 2018, https://pib.socioambiental.org/en/How_many_are_they%3F.

¹⁵⁷ Ruben Caixeta de Queiroz, *Programa de Capacitação em Proteção Territorial: Vigilância e proteção de terras indígenas* (Brasília, DF: FUNAI, 2015), http://www.funai.gov.br/arquivos/conteudo/cgmt/pdf/Vigilancia_e_Protecao_de_TIs.pdf.

¹⁵⁸ “Brazilian Indians,” Survival International, <https://www.survivalinternational.org/tribes/brazilian>.

¹⁵⁹ “The Uncontacted Indians of Brazil,” Survival International, <https://www.survivalinternational.org/tribes/uncontacted-brazil>.

¹⁶⁰ “Who are,” Fundação Nacional do Índio, <http://www.funai.gov.br/index.php/indios-no-brasil/quem-sao>.

Developing Sustainable Infrastructure in the Amazon

The environmental, security, and infrastructure complexities of the Amazon require rethinking the approach to economic development in the region. Although infrastructure investments are needed to support economic growth and social development, baseline conditions such as security, governance, and territorial planning also need to be addressed. Otherwise, investments in infrastructure would be wasted, and economic growth in the region will not be realized. At the same time, there is a need to strengthen the planning processes in order to develop a pipeline of quality and sustainable infrastructure projects for the basin.

Over the years, sustainable or quality infrastructure has gained importance as a concept and process. In its basic form, infrastructure that is sustainable is built with greater consideration for environmental, social, and economic externalities while also promoting community engagement and social benefits. International quality infrastructure frameworks and standards such as those laid out by the G20, OECD, and Bretton Woods institutions can be important tools to improve infrastructure planning in the Amazon Basin. These frameworks focus on governance aspects such as strengthening institutional sustainability, including the planning and procurement processes, as well as the social impacts such as community consultation, job creation, capacity building, and transfer of expertise and knowhow to local communities. Currently, there are about 30 different initiatives that are designed to increase sustainable infrastructure investment.¹⁶¹

Organizations such as the United Nations, the OECD, and multilateral development banks, as well as intergovernmental fora (such as the G7 and G20), have been engaging national governments and private actors to rethink their approach to infrastructure. These institutions have developed and adopted environmental and social standards for the planning and execution of large national infrastructure projects. Many of these frameworks include a strong emphasis on upstream planning, improved governance, and better enabling conditions to ensure that countries can develop a pipeline of “good” projects. Those same elements should also positively impact environmental, social, and economic outcomes and attract responsible actors to invest in such projects.¹⁶²

“We need infrastructure that is compatible with environmental preservation and human security, developed with high quality standards and benefiting the community.”

-Anonymous Interviewee

¹⁶¹ Aizawa, “Sustainable Development through Quality Infrastructure.”

¹⁶² “The OECD Framework for the Governance of Infrastructure,” OECD.

Creating a Pipeline of Sustainable Infrastructure Projects

To that end, when developing infrastructure projects, the following questions should be asked: What kind of infrastructure is needed for the Amazon and for Brazil? Whom will it benefit? How can planning be improved and what are the expected outcomes? What are different and alternative design options? How will these projects be monitored and evaluated? These are complex questions to answer since, at the moment, there is no unified development vision for the basin, although the nonprofit Instituto Escolhas and climate scientist Carlos Nobre have proposed positive initiatives to create a new economic path for the Amazon based on the bioeconomy.

The region remains socially underdeveloped, and there are substantial gaps in the provision of basic services, including clean water and sanitation, health infrastructure, renewable energy, schools, and communication (e.g., radios, internet, and cell phones). Given these gaps, investments in social infrastructure could raise the quality of life in the region. But this does not necessarily mean that social development projects in these areas must be prioritized to the exclusion of projects in other sectors (i.e., choosing health projects over transport projects or sanitation over energy) since these projects can offer significant complementary effects.

The selection process for infrastructure projects needs to be strengthened so that: (a) investments make economic sense and minimize environmental and social risks; (b) projects are evaluated as a whole, that is, in conjunction with other projects put forward in the region; (c) communities are brought into discussion early; and (d) different project alternatives are presented beforehand so that the best designs are pursued.

In this regard, experts have recommended taking a life cycle approach to project planning and integrating environmental and social requirements early on, at the stage when feasibility studies are conducted. This would reduce the risk of having to change or cancel infrastructure projects at a later stage in the project life cycle. Overall, more targeted community participation in the planning process would help address potential sources of conflict or community unrest before it occurs. Projects likely would take more time to complete because of the added measures, but this process will guarantee quality (over quantity), with more sustainable outcomes.

The role of civil society is paramount since it can be an important intermediary between communities and government planners. Civil society organizations can become conduits for increasing public understanding and awareness of new infrastructure projects in the Amazon. One of the main reasons local communities lack a voice in the public consultancy process is their lack of awareness of the implications and potential harmful or beneficial effects of a new infrastructure project, which stems from a lack of communication from the planners. Even when public forums are held, the project is usually far along at that point, which disincentivizes project leaders from receiving or acting upon local community pushback. There is also a lack of political will in some cases to adequately enforce the rules and regulations. Better and more effective public communication will increase the government-community dialogue and elevate the individual voices of the population.

Planners should also consider alternative designs for projects and the integration of disparate infrastructure plans. One more constructive approach for civil society to engage with government planners is to help authorities develop a robust pipeline of projects by presenting project alternatives and designs that ensure more lasting development solutions in the basin. In addition, civil society organizations must be better equipped with technical experts such as engineers, economists, and project developers who are knowledgeable about both infrastructure and the fabric of the community.

Some of these alternative infrastructure designs for the Amazon could include: (1) improving waterways and airports instead of constructing new large roads that cross protected territories of the Amazon; (2) providing wind and solar power to supply energy to remote communities; and (3) introducing technology

and innovative programs to deliver health care and schooling services. One successful example of a solution to the lack of basic health care was in 2006 when the nonprofit civil initiative Projeto Saúde e Alegria (the Health and Happiness Project, or PSA) launched its first hospital boat, known as Abaré I, to assist residents of the Tapajós Basin. The project was later integrated into the SUS (Unified Health System) and recognized as the first Basic Fluvial Health Unit (UBSF) in Brazil. Since 2017, Abaré I has also been operating as a teaching hospital.¹⁶³

Strengthening Land Governance and Enforcing Property Rights

Better infrastructure planning must be accompanied by strengthened land governance. As mentioned above, the property rights system in the Amazon is complex, and the region lacks a cohesive land registry system. There are also gaps in the process for resettling communities displaced by infrastructure projects and a failure to evaluate the indirect deforestation such projects cause. Moreover, the presence of different government actors in the Amazon territory with diverse degrees of capacity, plans, and interests can create more confusion and ineffectiveness. In the case of large infrastructure projects in the Amazon, these weaknesses in land governance need to be taken into account, requiring better land-use zoning and regulations beforehand to avoid conflict later on.

A large amount of land in the Amazon remains undesignated, which can lead to illegal settlement and land usage if not carefully monitored.¹⁶⁴ The creation of a functional database that categorizes undesignated land, protected areas, rural territories, and indigenous lands would strengthen property rights and make it easier for regulatory agencies to enforce land-use laws. Satellite imagery has made this process significantly easier, but the issue of a lack of personnel and resources for successful execution remains. Amending the Forest Code to make the dissemination of land titles contingent upon environmental compliance would incentivize landowners to abide by the law or face a fine. At the local level, each municipality should employ a qualified individual or team to distribute land titles. In practice, this would require bolstering the number of personnel at both the local and state levels.

The FGV and the IFC propose applying a “territorial and land use planning” approach for large projects in the Amazon via a set of guidelines.¹⁶⁵ These include aspects such as enhancing mechanisms for social participation, considering possible processes for landscape intervention, identifying a common approach among local sectoral interests, strengthening individual and institutional capacities, and ensuring that the project has adequate funding and effective monitoring mechanisms. Land-use zoning must be carried out before project implementation and must be publicly available so that it can contribute to planning processes. It should include strategies to control indirect environmental degradation, prevent the downgrading of protected areas and land conflicts, and set up mechanisms to ensure fair compensation for displaced families. Lastly, it is essential that various stakeholders and different institutions are represented in the governance fora and that all have access to information and capacity strengthening tools. A more dynamic and inclusive decisionmaking approach must be applied in communities with planned infrastructure projects.

¹⁶³ “Forest Economy: Socioproductive Units,” Projeto Saúde & Alegria, <https://saudeealegria.org.br/en/forest-economy/socioproductive-units/>.

¹⁶⁴ Sparovek et al., “Who Owns Brazilian Lands?”

¹⁶⁵ FGV and IFC, *Large-Scale Projects in the Amazon*.

Investing Resources in Security and Law Enforcement

“A new role for the military and security forces is needed in the Amazon . . . it is not building infrastructure projects but securing our borders from criminal activity, protecting indigenous people from mafias, and enforcing the law.”

-Anonymous Interviewee

Actions to improve infrastructure planning and strengthen land governance must be complemented by increased efforts in the security space. In order to combat illegal activities that contribute to deforestation and insecurity in the basin, more military and police presence will be needed on the ground, as will increased budgetary resources for law enforcement efforts, including prosecution and fines for environmental crimes. This approach has proven effective, particularly between 2004 and 2012, when deforestation dropped to its lowest levels in years.¹⁶⁶ It has also proven cost effective, that is, the benefits of protecting the forest have been greater than the additional costs for law enforcement.¹⁶⁷

Increased Security Personnel and Technology

From 2009 to 2019, Brazil's defense expenditures have followed the country's economic growth and increased by more than 100 percent.¹⁶⁸ In 2017, total state public security expenditures in the Brazilian Amazon totaled \$2 billion (R\$10.2 billion), amounting to 14.6 percent of the country's total public security expenditures for the year.¹⁶⁹ In the Brazilian Amazon, military forces are deployed in several large- and small-scale operations to prevent and combat environmental crimes.

Increased monitoring of the Amazon—both on the ground and through satellite imagery and remote sensing—is necessary to police illegal activities and to ensure impacts are measured more accurately. In practice, this could mean random military or police incursions, interception of communications of illegal groups, money tracking, destruction of machinery, and improvements in local and satellite surveillance capabilities. With regard to innovative security technologies, Brazil has one of the world's largest land monitoring projects today.¹⁷⁰ The project includes four major Amazon programs and is carried out by the National Institute of Spatial Research (INPE). One of the programs is PRODES-Amazon, which uses satellite images to monitor the deforestation of the Brazilian Amazon.¹⁷¹ It is supported by a second initiative, called TerraClass, which is responsible for investigating the factors driving deforestation (e.g., agriculture, urban expansion, and mining activities).¹⁷² Besides PRODES and TerraClass, INPE has developed DETER and TerraBrasilis. DETER is a satellite-based system that provides near real-time imagery

¹⁶⁶ Human Rights Watch, *Rainforest Mafia*.

¹⁶⁷ Assunção and Gandour, “Brazil Knows What to Do to Fight Deforestation in the Amazon.”

¹⁶⁸ “Quanto o Brasil gasta com defesa?,” *FORTE*, <https://www.forte.jor.br/2015/01/22/quanto-o-brasil-gasta-com-defesa/>; and “Defesa registra maior reforço de caixa da Esplanada, com R\$ 6,3 bi a mais gastos em 2019,” Defesanet, <http://www.defesanet.com.br/front/noticia/35932/Bolsonaro-privilegia-gastos-com-militares-no-primeiro-ano-de-governo/>.

¹⁶⁹ Fórum Brasileiro de Segurança Pública, *Anuário Brasileiro de Segurança Pública: 2014-2017* (Fórum Brasileiro de Segurança Pública, 2018), http://www.forumseguranca.org.br/wp-content/uploads/2018/09/FBSP_ABSP_edicao_especial_estados_faccoes_2018.pdf.

¹⁷⁰ “Brasil vigila la deforestacion de la Amazonia com satélites,” *Andina*, December 2018, <https://andina.pe/agencia/noticia-brasil-vigila-deforestacion-de-amazonia-satelites-735951.aspx>.

¹⁷¹ “PRODES-Amazônia,” Coordenação Geral de Observação da Terra – INPE, <http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes>.

¹⁷² “Projetos e Pesquisas,” Coordenação dos Centros Regionais – INPE, http://www.inpe.br/cra/projetos_pesquisas/dados_terraclasse.php.

of deforestation “hot spots” in the Brazilian Amazon.¹⁷³ The imagery is subsequently sent to local police and law enforcement agencies. The TerraBrasilis platform allows the public to interact with the spatial data generated by DETER and PRODES.¹⁷⁴ Lastly, it is estimated that by the end of this year the institution will launch the first “Earth Observation satellite completely designed, integrated, tested and operated by Brazil.”¹⁷⁵

In December 2019, the China-Brazil Earth Resources Satellite (CBERS) bilateral cooperation program launched its sixth satellite, which, according to Chinese authorities, will be used to support Brazil’s work monitoring the Amazon Basin.¹⁷⁶ According to a 2017 CPI simulation, 22,200 km² of tropical forest area was preserved each year between 2007 and 2011 through extensive satellite monitoring.¹⁷⁷ Therefore, investments in monitoring and evaluation of the Amazon are effective and necessary for the conservation of forest land. Expanding IBAMA’s existing radar capabilities that allow visuals through cloud coverage and INPE’s improvements to the DETER system will make conservation efforts more feasible.

Other initiatives concerning the use of innovative security technologies include the following programs carried out by the Ministry of Defense: Amazônia SAR, Connected Amazon, and the Jungle War Instruction Center. The Amazônia SAR was developed to complement the work performed by the INPE—rather than optical satellites, the program installed space-based radar that can monitor deforestation during rainy seasons.¹⁷⁸ The second program, Connected Amazon, is currently being implemented with the objective to provide isolated communities with access to high-speed internet that could support projects on telemedicine and e-learning.¹⁷⁹ Finally, the Jungle War Instruction Center provides training on how to conduct military operations in the jungle.¹⁸⁰

Recently, President Bolsonaro created (i.e., reactivated) the Amazon Council, which will be responsible for coordinating “diverse actions within each ministry focused on the protection, defense and sustainable development of the Amazon.”¹⁸¹ This represents a significant opportunity to improve security in the region. The council, which since 1995 has been attached to the Ministry of Environment, will now be led by Brazil’s vice president, General Hamilton Mourão, and 14 heads of ministries.¹⁸² It will not include the representation of any minority group, nor the participation of state governors and environmental agencies such as IBAMA and FUNAI.¹⁸³ According to General Mourão, the council will, however, continue to consult state governors.¹⁸⁴

¹⁷³ “DETER,” Coordenação-geral de Observação da Terra – INPE, <http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/deter>.

¹⁷⁴ “TerraBrasilis,” Divisão de Processamento de Imagens – INPE, <http://terraBrasilis.dpi.inpe.br/en/home-page/>.

¹⁷⁵ “About the Satellite,” INPE, http://www.inpe.br/amazonia1/en/about_satellite/.

¹⁷⁶ Ryan Woo, “China-Brazil Satellite Launch into Space to Monitor Amazon Rainforest,” Reuters, December 20, 2019, <https://www.reuters.com/article/us-china-space-satellite/china-brazil-satellite-launched-into-space-to-monitor-amazon-rainforest-idUSKBN1Y00JO>.

¹⁷⁷ Juliano Assunção, Clarissa Gandour, and Romero Rocha, *DETERring Deforestation in the Amazon: Environmental Monitoring and Law Enforcement* (Rio de Janeiro: CPI, 2017), https://climatepolicyinitiative.org/wp-content/uploads/2013/05/DETERring-Deforestation-in-the-Brazilian-Amazon-Environmental-Monitoring-and-Law-Enforcement-Technical-Paper_Feb2017.pdf.

¹⁷⁸ Péricles Cardim, “Projeto Amazônia SAR: desenvolvimento operacional e primeiros resultados na identificação do desmatamento com imagens de Radar Orbital,” CENSIPAM-Ministério da Defesa, <http://www.sipam.gov.br/projeto-amazonia-sar>.

¹⁷⁹ “TOA – Forças armadas utilizam tecnologia a serviço da segurança, na Amazônia,” Defesanet, August 28, 2015, <http://www.defesanet.com.br/toa/noticia/20177/TOA---Forcas-armadas-utilizam-tecnologia-a-servico-da-seguranca-na-Amazonia/>.

¹⁸⁰ Ibid.

¹⁸¹ Eduardo Simões, “Brazil to Create ‘Amazon Council’ to Protect and Develop the Rainforest,” Reuters, January 21, 2020, <https://www.reuters.com/article/us-brazil-environment/brazil-to-create-amazon-council-to-protect-and-develop-the-rainforest-idUSKBN1ZK237>; and “Conselho da Amazônia e Força Nacional Ambiental: o que são?” *Politize*, April 3, 2020, <https://www.politize.com.br/conselho-da-amazonia-e-forca-nacional-ambiental/>.

¹⁸² Ibid.

¹⁸³ Rubens Valente, “Mourão forma Conselho da Amazônia com 19 militares e sem Ibama e Funai,” UOL, April 18, 2020, <https://noticias.uol.com.br/colunas/rubens-valente/2020/04/18/conselho-amazonia-mourao.htm>.

¹⁸⁴ “Conselho da Amazônia e Força Nacional Ambiental: o que são?” *Politize*.

Moreover, Operation Green Brazil was initiated in 2019 to combat fires and environmental crimes in the Amazon.¹⁸⁵ In one month, Brazilian authorities seized 28 vehicles, detained 63 people, and applied a total of 112 criminal charges associated with illegal mining, deforestation, and seizure of timber cut. In 2020, the government authorized punctual action against loggers in the state of Rondônia (*Operação Inimigos da Tora*) and the deployment of 3,800 military personnel for the second phase of Operation Green Brazil.¹⁸⁶

Devising Security Partnerships with Communities

Better enforcement and accountability will require a larger financial commitment to the responsible government agencies, including IBAMA and FUNAI. Increased staffing and resources will be necessary to ensure that these agencies can levy fines and distribute land titles in accordance with the law. In addition, closer government coordination with local communities and indigenous groups could make anti-deforestation monitoring and enforcement efforts easier. The government should consider initiating community partnerships with local indigenous ethnic groups to monitor illegal activities and understand the land better. Community policing could prove successful and involve different local stakeholders and national government agency employees. As history has shown, indigenous peoples are knowledgeable about the land and often practice sustainable farming and burning techniques that should be used instead of more harmful forms of land management.

Some examples of these partnerships include the Forest Guardians in the Amazon state of Maranhão, which is composed of 17 indigenous groups that work with IBAMA, the federal police, and the military police to identify areas of criminal activities, including illegal logging, wildlife trafficking, and drug trafficking.¹⁸⁷ Equipped with drones, GPS devices, trucks, shotguns, and bows and arrows, the Forest Guardians started to monitor illegal activities beginning in 2010 as a response to the lack of public initiatives to combat crimes and protect indigenous territories.

In 2014, the Dutch NGO Forest Forces carried out a similar initiative in the Amazon, a pilot project to implement community-based forest crime prevention.¹⁸⁸ Several Amazonian communities were equipped with waterproof GPS cameras to identify and report criminal activities to environmental agencies and the police. The NGO also provided power banks and portable solar chargers to communities without access to electricity and mobile phone networks. The objective of the project was to test whether evidence collected by the communities would reach the Brazilian forest law enforcement system. In three years, the project showed some positive outcomes; however, they were limited to communities that maintained a strong level of organization and leadership. According to Tim van Solinge, who was responsible for the implementation of the project, the work performed by GPS-equipped communities complements the use of satellites because it can identify small-scale deforestation and is not affected by rainy seasons.

Despite some advancements, initiatives to empower indigenous communities and support their role in preventing and reporting environmental crimes in the Amazon are still hampered by major challenges associated with the lack of resources necessary to distribute technological devices to indigenous groups,

¹⁸⁵ Mariana Tokarnia, “Operação Verde Brasil: multas na Amazônia somam R\$36 milhões,” Agência Brasil, September 19, 2019, <https://agenciabrasil.ebc.com.br/politica/noticia/2019-09/operacao-verde-brasil-multas-aplicadas-na-amazonia-somam-r36-milhoes>.

¹⁸⁶ G1 Rondônia, “PF deflagra operação ‘Inimigos da Tora’ para combater extração de madeira em terras da União,” G1, May 11, 2020, <https://g1.globo.com/ro/rondonia/noticia/2020/05/11/pf-deflagra-operacao-inimigos-da-tora-e-tenta-combater-extracao-de-madeira-em-terra-da-uniao.ghtml>; and “Brasil deflagra Operação Verde Brasil 2,” Defesanet, May 11, 2020, <http://www.defesanet.com.br/vb/noticia/36734/Brasil-deflagra-Operacao-Verde-Brasil-2/>.

¹⁸⁷ Ciro Barros, “No Maranhão, cada guardião da floresta é um Paulino Guajajara,” Pública, November 12, 2019, <https://apublica.org/2019/11/no-maranhao-cada-guardiao-da-floresta-e-um-paulino-guajajara/>; and “Máfias do Ipê: Como a violência e a impunidade impulsionam o desmatamento na Amazônia Brasileira,” Human Rights Watch, September 17, 2019, <https://www.hrw.org/pt/report/2019/09/17/333519>.

¹⁸⁸ Tim Boekhout van Solinge, “GPS-supported, Community-based Forest Crime Prevention in the Brazilian Amazon,” *Illegal Wildlife Trade*, November 22, 2018, <https://www.illegalwildlifetrade.net/2018/11/22/gps-supported-community-based-forest-crime-prevention-in-the-brazilian-amazon/>.

the absence of a legal framework that supports the evidence collected, and the weak protection provided to environmental leaders.¹⁸⁹ Confrontations with indigenous groups are initiated mostly by settlers, loggers, miners, and criminal groups.¹⁹⁰ Consequently, indigenous peoples' major concerns are related to the capacity and commitment of the Brazilian police and other authorities in guaranteeing their protection. Increased budgetary resources are needed to improve the ability of environmental agencies to supervise protected areas.

Increased International Cooperation on Security

In terms of international cooperation on security in the Amazon, the nine Amazon Basin countries should use convening platforms such as the Amazon Cooperation Treaty Organization (ACTO) and the Leticia Pact to share best practices for fighting crime within and outside their borders.¹⁹¹ The United States also has a role to play in providing training and equipment. For example, in November 2017, the United States provided security training to Brazil, Colombia, and Peru. The focus of Operation AmazonLog17 was to prepare domestic armed forces to conduct humanitarian assistance operations in the Pan-Amazon.¹⁹² The activities were based in the Brazilian city of Tabatinga in the state of Amazonas, located in the tri-border region between Peru, Colombia, and Brazil.

In 2019, world leaders at the G7 summit voiced their support for Brazil's efforts to combat deforestation and forest fires in the Amazon Basin and also offered financial and technical assistance.¹⁹³ President Trump said, "if the United States can help with the Amazon Basin fires, we stand ready to assist."¹⁹⁴ Since then, the U.S. military has been supporting the Amazon Basin through joint military exercises and provision of equipment as a sign of closer U.S.-Brazil defense ties.¹⁹⁵ U.S. troops have joined ranks with troops from Brazil, Colombia, and Peru who have set up temporary military bases in their tri-border region. The United States also provides a number of aircraft to Brazil, including several Hercules C-130 military planes to help put out the massive forest fires and transport military personnel and equipment.¹⁹⁶

Infrastructure Supporting a Sustainable Development Model for the Amazon

Increasing surveillance and deploying more police and military in the region is necessary, but these actions on their own will not solve the underlying conditions that enable these insecure situations to thrive in the basin. Insecurity in the Amazon must be approached as a multidimensional problem, one that goes hand in hand with strengthening governance, respecting the rule of law, increasing job opportunities and meaningful economic activity, and providing communities with basic public services. In many cases, people engage in informal or even illicit activities because there are no genuine economic alternatives. In

¹⁸⁹ Vanessa Romo, "Tecnología para cazar delitos: monitores indígenas combaten ilegalidade," Mongabay Latam, November 4, 2019, <https://es.mongabay.com/2019/11/tecnologia-para-cazar-delitos-monitores-indigenas-combaten-ilegalidad/>.

¹⁹⁰ Tiago Miotto, "Pelo menos seis terras indígenas sofrem com invasões e ameaças de invasão no início de 2019," Conselho Indigenista Missionário, January 23, 2019, <https://cimi.org.br/2019/01/pelo-menos-seis-terras-indigenas-sofrem-com-invasoes-e-ameacas-no-inicio-de-2019/>.

¹⁹¹ Ministry of Foreign Affairs, "Amazon Cooperation Treaty Organization – ACTO," Government of Brazil, <http://www.itamaraty.gov.br/en/politica-externa/integracao-regional/6351-amazon-cooperation-treaty-organization-acto>; and Luis Jaime Acosta, "Amazon Countries Sign Forest Pact, Promising to Coordinate Disaster Response," Reuters, September 6, 2019, <https://www.reuters.com/article/us-brazil-environment-amazon-summit/amazon-countries-sign-forest-pact-promising-to-coordinate-disaster-response-idUSKCN1VR2B1>.

¹⁹² Felipe Betim, "EUA participam de exercício militar na Amazônia a convite do Brasil," *El País*, November 10, 2017, https://brasil.elpais.com/brasil/2017/11/09/politica/1510250965_868739.html.

¹⁹³ Merrit Kennedy, "G-7 Leaders Pledge Money to Help Fight Amazon Rainforest Blazes, Macron Says," NPR, August 26, 2019, <https://www.npr.org/2019/08/26/754255863/g-7-leaders-near-deal-to-help-amazon-nations-fight-rainforest-blazes-macron-says>.

¹⁹⁴ Ibid.

¹⁹⁵ Pablo Garcia, "U.S. Military Joins Brazil Army Exercises in Amazon," Reuters, November 8, 2017, <https://www.reuters.com/article/us-brazil-usa-military/u-s-military-joins-brazil-army-exercises-in-amazon-idUSKBN1D8347>.

¹⁹⁶ "Brazilian C-130 Hercules Planes to Douse Amazon Fire," *Defense World*, August 26, 2019, https://www.defenseworld.net/news/25352/Brazilian_C_130_Hercules_Planes_To_Douse_Amazon_Fire#.Xt16DC-z2u5.

this regard, infrastructure projects need to be embedded in a sustainable development vision for the region.

Economic incentives can serve to leverage the Amazon's resources through a "standing forest economy" so that the value of the living forest surpasses the benefit of deforestation.¹⁹⁷ This can be achieved by harnessing the power of the bioeconomy and environmental services (i.e., using science and technology to harness the resources of the forest in a sustainable manner) that benefit local communities and ensure environmental sustainability through pharmaceuticals, food production, and other areas.¹⁹⁸ Companies and the Brazilian public sector should work in partnership together, while the latter should explore the profitability of the bioeconomy.

Today, there are few cases in which the biodiversity of the Amazon is utilized in a way that channels profits back to conserve the forest and provides socioeconomic benefits to local communities. The private sector has a large role to play in creating momentum for sustainable products, while consumers can advocate for goods that do not originate from deforested lands. Several companies already work in partnership with local inhabitants in the Amazon and provide essential jobs harvesting crops in a non-exploitative way. Therefore, a more sustainable, bioeconomy-focused economic model will ultimately preserve the vitality of the Amazon Basin while also benefiting local communities.

For example, the production of the açai berry already generates more than \$1 billion per year to the Amazon economy while supporting the preservation of the environment and generating socioeconomic benefits to local communities.¹⁹⁹ According to Carlos Nobre, açai's contribution to local economies could be even greater if modern technology were incorporated into the value chain. The implementation of Agroforestry Systems (SAF), for example, could make the production of açai 10 times more profitable than beef production.²⁰⁰

Another example is cosmetics. Since 2000, Natura, the largest Brazilian cosmetics company, has been operating in the Amazon with the mission to contribute to the economic, social, and environmental development of the region. The objective of Natura's Amazônia Viva program is to have 30 percent of its inputs come from local sources by the end of this year.²⁰¹ So far, the program has benefited 4,636 Pan-Amazonian families and generated \$260 million (R\$1.5 billion) in economic activity alone. In food and beverages, Coca-Cola's factory, located in Manaus, sources half of its guarana berry inputs from family farms in 12 Amazonian municipalities.²⁰² The company also invests in initiatives to provide potable water to the population (Water + Access Program) and technical support to implement agroforestry systems in family farms (Programa Olhos na Floresta). In the state of Pará, the company Alcoa has invested more than \$1.6 million (R\$9.5 million) in public health infrastructure, sanitation, education, social assistance, and security.²⁰³ By 2017, the company had generated more than \$26.5 million (R\$152 million) in economic activity alone in the region of Juruti, in western Pará. Organizations such as the Amazon Environmental

¹⁹⁷ Ismael Nobre and Carlos A. Nobre, "The Amazonia Third Way Initiative: The Role of Technology to Unveil the Potential of a Novel Tropical Biodiversity-Based Economy," IntechOpen, November 5, 2018, <https://www.intechopen.com/books/land-use-assessing-the-past-envisioning-the-future/the-amazonia-third-way-initiative-the-role-of-technology-to-unveil-the-potential-of-a-novel-tropical>.

¹⁹⁸ Frank Rijsberman, "This is What You Need to Know about the Bioeconomy," World Economic Forum, April 26, 2018, <https://www.weforum.org/agenda/2018/04/can-a-nature-based-economy-help-us-drive-green-growth>,

¹⁹⁹ Stockholm Resilience Centre TV, "Carlos Nobre Talking about the Amazonia Third Way," YouTube video, 32:20, posted by February 16, 2019, 32:30, <https://www.youtube.com/watch?v=WwgtRdTjJE0>.

²⁰⁰ Nobre and Nobre, "The Amazonia Third Way Initiative"; and Eliane Fonseca, "Carlos Nobre apresenta o conceito da Terceira Via/Amazônia 4.0 em palestra na Unicamp," Unicamp, September 27, 2019, <https://www.unicamp.br/unicamp/noticias/2019/09/27/carlos-nobre-apresenta-o-conceito-da-terceira-viaamazonia-40-em-palestra-na>.

²⁰¹ Kempson Cabral, "Empresas e desenvolvimento sustentável na Amazônia," Conselho Empresarial Brasileiro para o Desenvolvimento Sustentável, August 29, 2019, https://cebds.org/empresas-desenvolvimento-sustentavel-amazonia/#.Xt1_tS-z2u5.

²⁰² Ibid.

²⁰³ Ibid.

Research Institute (IPAM) and the Sustainable Amazon Foundation (FAS) work with communities on sustainable models of production and to strengthen value chains such as fish and forest products and cut intermediary costs (Box 6 and 7).

Box 6: Amazon Environmental Research Institute (IPAM)

Since 1995, IPAM has been playing a significant role in driving the sustainable economic development of the Amazon.²⁰⁴ The purpose of the organization is to “consolidate the Amazonian tropical development model by 2035, by producing knowledge, implementing local initiatives and directing public policies, in a way that influences economic development, social equality, and environmental preservation.”

From 2012 to 2016, IPAM’s Sustainable Settlements Project (PAS) helped more than 2,700 families in three agrarian reform settlements with the provision of technical assistance and investments to advance the use of sustainable production methods.²⁰⁵ Some of these families were also included in a recompensation system for environmental services. The project’s activities were focused on five areas: assisting with the environmental regularization of the settlements, recognizing the economic value of the forest, increasing productivity in open areas of the forest (e.g., implementing agroforestry systems), adding value to the supply chain, and strengthening settlements’ management capacity. Within the fourth area, the project supported communities to market their products by addressing key issues related to the level of adequacy of sanitary facilities and supply chain management. In four years, affected producers increased their income by 66 percent and the level of deforestation in the three areas decreased by 79 percent.

In Mato Grosso, the organization also established a program that helps companies eliminate deforestation from their supply chains.²⁰⁶ The program follows a jurisdictional approach that classifies municipalities according to their commitment to sustainable production, encouraging cooperation between the private sector, local governments, communities, and producers. Another IPAM initiative is the Tanguro Project, which since 2004 has been carrying out several studies with controlled fires in the Amazon Basin to develop innovative techniques for the recovery of degraded areas and outline a sustainable agricultural production model for the region.²⁰⁷ Another IPAM initiative is the Tanguro Project, which since 2004 has been carrying out several studies with controlled fires in the Amazon rainforest Basin to develop innovative techniques for the recovery of degraded areas and outline sustainable agricultural model for the region.

²⁰⁴ “Our Purpose,” IPAM, <https://ipam.org.br/about-ipam/>.

²⁰⁵ IPAM, FVPP, and INCRA, “O Desafio da Produção Familiar de Baixo Carbono,” *InfoPAS* 10 (April 2017), <http://www.fundoamazonia.gov.br/export/sites/default/pt/.galleries/documentos/acervo-projetos-cartilhas-outros/IPAM-boletimPAS10.pdf>.

²⁰⁶ “A New Look – Pathways to Sustainable Productions Landscapes in Mato Grosso,” IPAM, May 6, 2019, <https://ipam.org.br/bibliotecas/a-new-look-pathways-to-sustainable-productions-landscapes-in-mato-grosso/>.

²⁰⁷ “Tanguro Project,” IPAM, https://ipam.org.br/wp-content/uploads/2018/04/Teaser-Tanguro_ENG.pdf; and IPAM, “Tanguro em Pauta,” *Boletim Informativo IPAM* 2 (September 2016), <https://ipam.org.br/wp-content/uploads/2017/08/Tanguro-em-Pauta-Edição02.pdf>.

Box 7: Sustainable Amazon Foundation (FAS)

Created in 2008 in partnership between the state of Amazonas and Bradesco Bank, FAS is a nongovernmental organization that implements programs to empower local communities and support the development of sustainable supply chains in the Amazon.²⁰⁸ Today, the organization is also supported by Coca-Cola Brazil, Fundo Amazônia, and Samsung.

One of the organization's main programs, the *Bolsa Floresta*, is a public policy introduced in 2007 to compensate families that are engaged in environmental services.²⁰⁹ Families that are rewarded with the Bolsa Floresta can participate in workshops that will define which types of investments local communities need to market their products and scale their production in a sustainable way. The investment plans focus on generating income, empowering communities, and providing community infrastructure. When the investments are delivered, FAS also offers training, technical assistance, and performance monitoring. In the municipality of Fonte Boa (Amazonas), the once-threatened production of Pirarucu is today one of the most profitable activities in the region due to the methods of sustainable fishing introduced by FAS.²¹⁰ Over the last 10 years, the organization has invested more than R\$2 million (\$3.7 million) in infrastructure improvement and other income-generating programs that benefited 2,000 families and 178 communities of the Mamirauá Sustainable Development Reserve.

At the Sustainable Development Reserve of Uacari, the creation of the Community Based Enterprise Bauana was supported by the FAS Sustainable Business Incubator program and several organizations from the public and private sectors.²¹¹ Since its creation, the production of Andiroba oil has tripled, and a number of families have benefited from the initiative. Recently, the project has also supported the creation of the company Menino dos Oleos, which is managed by three young men who are now selling their own brand of Andiroba oil products.

One such model for sustainable development in the Amazon, proposed by Carlos Nobre, centers on the production of biodiverse products using modern technology and traditional knowledge to create a socially inclusive and equitable green economy.²¹² His Creative Amazon Labs located throughout the Amazon plan to provide local communities with the ability to exploit the resources available in the region by combining modern technology with traditional knowledge. For example, some of these labs could teach the local community to genetically sequence plants and animals with blockchain registers to safeguard intellectual property.²¹³ It is estimated that by the second half of 2020, three communities in the state of Pará will receive the first creative labs.²¹⁴ The first labs will focus on the production of cupuaçu and cacao. Following the first phase of this model's development, which includes supply chain mapping, the next phase corresponds to the construction of the labs and the incorporation of modern technology. Moreover, a

²⁰⁸ "Quem Somos," Fundação Amazonas Sustentável, <https://fas-amazonas.org/sobreafas/>.

²⁰⁹ "Programa Floresta em Pé," Fundação Amazonas Sustentável, <https://fas-amazonas.org/pfp/#texto>.

²¹⁰ "Manejo do Pirarucu é fortalecido com entrega de empreendimentos de pesca em Fonte Boa," Fundação Amazonas Sustentável, <https://fas-amazonas.org/manejo-do-pirarucu-e-fortalecido-com-entrega-de-empreendimentos-de-pesca-em-fonte-boa/>.

²¹¹ "Programa Floresta em Pé," Fundação Amazonas Sustentável.

²¹² Stockholm Resilience Centre TV, "Carlos Nobre Talking about the Amazonia Third Way."

²¹³ Fonseca, "Carlos Nobre apresenta o conceito da Terceira Via/Amazônia 4.0 em palestra na Unicamp."

²¹⁴ Sibélia Zanon, "Indústria 4.0 chega a Amazônia: projeto quer salvar a floresta levando tecnologia de ponta," Mongabay, February 13, 2020, <https://brasil.mongabay.com/2020/02/industria-4-0-chega-a-amazonia-projeto-quer-salvar-a-floresta-levando-tecnologia-de-ponta/>.

program will be created to empower the local community, including a project called the Rainforest Business School.²¹⁵

Another model is the construction of local industrial parks and sustainable use of the region's biodiversity potential to create a decentralized economy in the state of Amazonas (as proposed by the nonprofit Instituto Escolhas).²¹⁶ A 2019 Instituto Escolhas study focuses on opportunities for a new economy specifically in Manaus, where the biggest challenges are associated with the social vulnerability of the region and the weaknesses of the Manaus Free Trade Zone. There are several opportunities to bolster the regional economies within the Amazon, including developing a digital transformation economy, ecotourism, and fish farming. For each opportunity, the study identifies five critical "success factors": infrastructure, human resources, legislation and regulation, research and development, and marketing. If the ideas presented are implemented, it is estimated that more than 218,000 jobs would be created over 10 years and that the GDP of Amazonas would increase by 17 percent.

At the same time, improving the productivity of existing activities such as agribusiness (e.g., beef and soy production) is an essential component of sustainable development. In Brazil, deforested areas fail to reach their full potential because they are mostly used for unproductive activities such as cattle raising. Today, approximately 70 percent of the country's uncovered area is used for cattle raising, and the other 30 percent is used for agriculture and urban infrastructure.²¹⁷ To expand Brazilian agricultural production and generate more economic growth while reducing deforestation, it is necessary to change this scenario and move agricultural production to grazing areas with the use of intensive techniques.

Four CPI studies show that it is possible to increase agricultural productivity while protecting the environment.²¹⁸ The studies highlight recent changes that contributed to the country's economic growth and reduced deforestation. The first study identified that after the introduction of adapted soybeans in the Brazilian Cerrado, grazing areas started to be used for agriculture, resulting in more agricultural production and less deforestation. Similarly, a second study demonstrated that in Mato Grosso do Sul, when grazing areas began to be used to grow cane sugar, the economy of the region accelerated, with 6,300 fewer hectares deforested after three years. The third study identified a positive relationship between the electrification of rural areas, agricultural productivity, and the expansion of covered areas. Lastly, CPI found that an increase in the cost of raising cattle encouraged several farmers of the Tapajós Basin to invest in other activities and substitute their pastures with crops that require less land, reducing deforestation for cattle grazing.

IPAM has also carried out studies that exemplify the economic potential of substituting cattle raising with intensive farming practices.²¹⁹ Between 2006 and 2010, soy production in the state of Mato Grosso increased by more than 30 percent while deforestation decreased by the same amount. According to the studies, two factors contributed to this scenario: (1) an increase in productivity and (2) a change in the use of the land, given that 91 percent of the lands used to grow soy were already deforested. Low deforestation levels in the same period also coincided with the implementation of several federal initiatives to combat environmental degradation, including the "soy moratorium" and the Plan to Prevent and Control Deforestation in the Legal Amazon (PPCDAM).

²¹⁵ Ibid.

²¹⁶ Instituto Escolhas, *A New Economy for the Amazonas: Manaus Free Trade Zone and Bioeconomy* (São Paulo: Instituto Escolhas, 2019), <http://www.escolhas.org/wp-content/uploads/2020/01/PRESENTATION-A-New-Economy-for-the-Amazon-Manaus-Free-Zone-and-Bioeconomics.pdf>.

²¹⁷ Juliano Assunção, "Melhorar a produtividade agrícola brasileira é um passo importante para a mitigação das mudanças climáticas," CPI, May 2017, <https://climatepolicyinitiative.org/publication/melhorar-produtividade-agricola-brasileira-e-um-passo-importante-para-mitigacao-das-mudancas-climaticas/>.

²¹⁸ Ibid.

²¹⁹ Elton Alisson, "Redução do desmatamento com aumento da produção agrícola," Agência FAPESP, January 16, 2012, <http://agencia.fapesp.br/reducao-do-desmatamento-com-aumento-da-producao-agricola/15033/>.

Lastly, to protect the country's natural resources and increase agricultural productivity, it is essential to establish a relationship between public policies and market mechanisms, with an alliance between the agricultural and environmental sectors.²²⁰ Brazil's Forest Code, for instance, presents itself as an opportunity to accelerate the modernization of the country's agricultural sector and its competitiveness in the international market. By restricting the area used for agricultural production, the code not only stimulates productivity but also places the country in a better position for environmental and trade negotiations.

Mining is a major economic activity in Brazil that supports millions of local residents. The Brazilian mining sector produces nearly 5 percent of the country's total GDP, with a great part of this production coming from the Amazon region.²²¹ However, when not performed sustainably, mining activities can also have severe impacts on the environment. This is especially true in the case of artisanal and small-scale mining (ASM), which makes limited use of technologies and is generally not regulated by the state.²²² It is estimated that ASM alone is responsible for approximately 71 percent of all mercury emissions in the Pan-Amazon.²²³

According to a USAID study, if modern guidelines and mitigation measures are applied to ASM, there is a unique opportunity to positively impact the sector, creating more sustainable communities and livelihoods.²²⁴ The study considers the importance of implementing community diagnostic assessments in order to identify specific local characteristics that could be impacted by mining activities. Community involvement is necessary not only in the planning stage but throughout the project life cycle, including in the post-closure stage (i.e., legacy issues). Other project interventions include the provision of technical support, production of environmental and health impact assessments, implementation of mitigation measures, capacity building, and the identification of alternative uses for land after the site closure.

Mining projects should take into consideration general environmental aspects (e.g., the characteristics of local soils, water and air quality, weather patterns, and geology) and socioeconomic and political factors (e.g., community health status, gender and labor issues, and land tenure).²²⁵ With reference to the first aspect, mitigation strategies may include the implementation of soil cover and conservation methods, programs to educate miners on environmental impacts and sustainable practices, provision of adequate infrastructure (e.g., WASH and roads), and technical assistance on pit construction or closure. Within the second aspect, it is important to promote alternative processing or production methods that do not use contaminants, provide health education, enforce labor protection, and monitor labor violations. Moreover, the report emphasizes the importance of formalizing miners and mining associations and increasing access to micro-financing loans in order to allow investment in sustainable technologies. These alternative economic opportunities for the Amazon's inhabitants could allow for more sustainable and profitable resource extraction and should change the equation over illegal activities that oftentimes exacerbate forest destruction. Prioritizing both profitable and legal economic activities in the Amazon would be part of the effort to provide security to the region.

²²⁰ Assunção, "Melhorar a produtividade agrícola brasileira é um passo importante para a mitigação das mudanças climáticas."

²²¹ "Qual a importância da mineração para a economia do país?," Vale, July 17, 2017,

<http://www.vale.com/brasil/pt/aboutvale/news/paginas/qual-a-importancia-da-mineracao-para-a-economia-do-pais.aspx>. More than 60 percent of Brazil's production of tin, aluminum, manganese, and copper comes from the Amazon region. Source: Agência Nacional de Mineração, *Anuário Mineral Brasileiro: Principais Substâncias Metálicas* (Brasília, DF: 2018), http://www.anm.gov.br/dnpm/publicacoes/serie-estatisticas-e-economia-mineral/anuario-mineral/anuario-mineral-brasileiro/amb_2018.pdf.

²²² Fikri, Koster, and de Wit, *Healthy Rivers, Healthy People*.

²²³ Ibid.

²²⁴ USAID, *Sector Environmental Guideline: Artisanal and Small-Scale Mining* (Washington, DC: USAID, 2017), https://www.usaid.gov/sites/default/files/documents/1860/SectorEnvironmentalGuidelines_Mining_2017.pdf.

²²⁵ Ibid.

In terms of infrastructure to support a more sustainable economy, drones could be used to transport products within the Amazon jungle—unmanned aerial vehicles (UAVs) could facilitate the transportation of processed products to ports and airports and from there to international markets.²²⁶ In the case of primary commodities, railways, waterways, and highways would still have to be considered. With reference to product perishability, the use of lyophilization techniques are proposed; examples include freeze-dried fruit powder that still retains a significant amount of nutritional value. The Amazon 4.0 project also considers the use of solar energy in Amazon communities and the operation of sensor-equipped devices that allow remote repairs and revisions.²²⁷ Carlos Nobre emphasizes the importance of keeping people connected and recognizes some advancements in this area. He mentions the existence of the Brazilian geostationary telecommunications satellite and government plans to install fiber-optic cables along Amazon rivers. These initiatives would provide isolated communities with high-speed internet connections and support the implementation of distance training programs as well as the use of virtual reality training techniques.

The shift in the economic paradigm of the basin will take time to develop to achieve the necessary scale and will require increased investments in quality infrastructure and science and technology—an “MIT for the Amazon” according to Denis Minev, the former State Secretary for Planning and Economic Development of Amazonas.²²⁸ Budgets for important research institutions such as the Instituto Nacional de Pesquisas da Amazônia (INPA) and government agencies such as Secretaria de Desenvolvimento, Ciência, Tecnologia e Inovação (SEDECTI) in the state of Amazonas will need to be strengthened to help create this alternative economy for the Amazon. For example, INPA’s average annual budget is currently a meager \$7.3 million (R\$35 million).²²⁹ At the same time, these efforts need to be complemented by continued interventions to improve productivity of traditional food sectors such as cattle grazing and soy in addition to a massive education campaign to educate global consumers about responsible and sustainable consumption. Infrastructure that supports this more sustainable vision of the Amazon will include a mix of new technologies, transport, and renewable energy production. Brazil has the knowledge to balance environmental, security, and economic concerns in the Amazon. The country has a significant opportunity to develop the region in a more sustainable way and enable infrastructure to play a positive role in that process.

²²⁶ Ismael Nobre and Carlos Nobre, “‘Amazon 4.0’ Project: Defining a Third Way for the Amazon,” Medium – Fundação FHC, September 25, 2019, <https://medium.com/fundação-fhc/amazon-4-0-project-defining-a-third-path-for-the-amazon-f0412305f066>.

²²⁷ Ibid.

²²⁸ “WEBCAST – Where Deforestation and Disease Collide: Sustainability and COVID-19 in the Brazilian Amazon,” Wilson Center, May 14, 2020, <https://www.wilsoncenter.org/event/webcast-where-deforestation-and-disease-collide>.

²²⁹ Evanildo da Silveira, “Crise dos mais antigos centros de pesquisa da Amazônia ameaça proteção da floresta,” BBC, November 17, 2019, <https://www.bbc.com/portuguese/brasil-50396127>.

Annex A: Select Infrastructure Projects in the Brazilian Amazon

Roads

- **Belém-Brasília Highway:** The construction of the Belém-Brasília Highway was initiated in 1958, during the term of President Juscelino Kubitschek, approximately two years after the decision to build Brasília, the capital of Brazil.²³⁰ The project was seen as a way to integrate the future capital with other parts of the country in a 2,772 km vertical line crossing the states of Goiás, Tocantins, Maranhão, and Pará. Completed in 1960 and paved in 1974, it was the first road that connected the Amazônia Legal to Brazil's Central-West region.²³¹ Since its completion, the Belém-Brasília Highway has contributed to the expansion of agricultural settlements, cities, and industries across a previously disconnected region.
- **Manaus-Porto Velho Highway (BR-319):** The BR-319 was completed in 1976 and is approximately 900 km long.²³² The highway, which connects Manaus, Amazonas, to Porto Velho, Rondônia, was one of the first roads to cut through the Amazon Basin. The Brazilian military government opened the highway in 1973, but it had to be closed in 1988 due to maintenance issues caused by overweight vehicles and high average precipitation rates combined with the lack of resources allocated to infrastructure projects during the economic hardship of the 1970s.²³³ Recently, the government announced plans to rehabilitate the road.²³⁴
- **Cuiabá-Santarém Highway:** Built in the 1970s, the Cuiabá-Santarém Highway is part of the BR-163 (Porto Alegre-Pará). Often called the Soybean Corridor, it is a 1,780 km road that cuts through the states of Mato Grosso and Pará.²³⁵ It connects agribusiness areas of the Brazilian Center-West region to the ports of Pará, especially the port of Miritituba (Tarajós River). The project to pave the road was completed at the beginning of 2020, more than 40 years after the paving began.²³⁶ This road is controversial for its failure to include environmental and social initiatives that take into

²³⁰ "Belém-Brasília Une País de Norte a Sul," Memorial da Democracia, <http://memorialdademocracia.com.br/card/belem-brasilia-rodovia-de-integracao>.

²³¹ Michelle Louise Sousa and Rafael Araújo Pacheco, "A influência da rodovia Belém-Brasília no processo de desenvolvimento das cidades do centro-norte de Goiás," *Revista Geoaraguaia* 3, no. 2 (2013): 246-262, <https://dialnet.unirioja.es/servlet/articulo?codigo=4521648>.

²³² Fabiano Maisonnave and Lalo de Almeida, "BR-319: Estrada que liga Manaus a resto do país ameaça abrir uma Alemanha na mata," *Folha de São Paulo*, September 4, 2018, <https://temas.folha.uol.com.br/projeto-amazonia/br-319/estrada-que-liga-manaus-a-resto-do-pais-ameaca-abrir-uma-alemanha-na-mata.shtml>.

²³³ Ibid.; and Thiago Oliveira Neto and Ricardo José Batista Nogueira, "BR-319: Os quarenta anos de uma rodovia na Amazônia," *Revista Franco-Brasileira de Geografia* 28 (October 2016), <https://journals.openedition.org/confins/11270#authors> <https://journals.openedition.org/confins/11270>.

²³⁴ André Richter, "Bolsonaro diz que rodovia Porto Velho Manaus será recuperada," Agência Brasil, December 25, 2019, <https://agenciabrasil.ebc.com.br/politica/noticia/2019-12/bolsonaro-diz-que-rodovia-porto-velho-manaus-sera-recuperada>.

²³⁵ "Grandes Obras – Rodovia BR-163: Relatório Completo," Radar Brasil – FIESP, <http://radarbrasil.fiesp.com.br/rodovia-br-163-relatorio-completo>.

²³⁶ Lucas Rodrigues, "Entrega da BR-163 é um passo enorme para a competitividade de MT", afirma governador," Government of Mato Grosso, February 17, 2020, <http://www.mt.gov.br/-/13767414--entrega-da-br-163-e-um-passo-enorme-para-a-competitividade-de-mt-afirma-governador>.

consideration the likelihood of paving projects speeding up deforestation and stimulating the migration of illegal loggers to other areas along the highway.²³⁷

- **Trans-Amazon Highway (BR-230):** The Trans-Amazon Highway was devised to settle 10 million impoverished families by the 1980s in the Amazon Basin.²³⁸ Due to a series of factors, the project was cancelled in 1974. At the time of cancellation, 20,000 families that had been relocated to the area were left without government support. The highway was built on unstable Amazon Basin ground that easily flooded and collapsed during the rainy season, making construction difficult and the road impassible for six months of the year. People who did move to the area could neither ship out their agricultural products nor bring in the supplies they needed. Adding to their hardships, many lacked financial knowledge and took out unsustainable loans, leaving them with debts they could not repay even if the road were open.²³⁹ Moreover, portions of the highway led to what is called the “fishbone pattern,” where tendrils of destruction emanate from the road in a pattern that looks like a desiccated fish.²⁴⁰ The road made vast tracts of land accessible for illegal loggers, miners, and slash-and-burn farmers. This led to widespread deforestation, mercury poisoning, and erosion. In January 2019, the Brazilian government announced its plan to privatize the Trans-Amazon Highway and attract more investments to pave it.²⁴¹
- **Marechal Rondon Highway:** Marechal Rondon Highway connects São Paulo to Mâncio Lima in the northwestern Brazil state of Acre. The section of the highway that cuts through the Amazon is 1,454 km long; it connects the city of Cuiabá (Mato Grosso) to Porto Velho (Acre).²⁴² Despite the promise of economic development, this highway was controversial due to the environmental damage it caused and the failure to protect indigenous communities from displacement. It was originally built in the 1960s and paved using World Bank financing in the 1980s.²⁴³ Withering criticism of the project’s effects—including logging of virgin rainforests covering an area larger than the Netherlands and malaria rates exceeding one in four inhabitants—led to the creation of the World Bank’s environmental department. That said, the World Bank loan spurred tremendous economic development in the area, as prior to paving, the BR-364 was impassable for six months of the year.
- **Interoceanic Highway (or Trans-oceanic Highway):** In December 2004, Presidents Alejandro Toledo of Peru and Luiz Inácio Lula de Silva of Brazil agreed to construct the 2,600 km Interoceanic or Trans-oceanic Highway that would connect Brazil’s Atlantic coast to Peru’s Pacific ports.²⁴⁴ Its main purpose was to combine Brazil’s economic strength with Lima and other strategic ports that lie along

²³⁷ See for example, Philip Fearnside, “Brazil’s Cuiabá-Santarém (BR-163) Highway: The Environmental Cost of Paving a Soybean Corridor Through the Amazon,” *Environmental Management* 39, no. 5 (June 2007), doi:10.1007/s00267-006-0149-2 ; and WWF Network, *Brazil: Assessing the Sustainability Impacts of Paving Highway BR-163: A Literature Review and a Summary of Best Practices Related to Soy Production* (Morges, Switzerland: 2006) https://wwfeu.awsassets.panda.org/downloads/wwfbrazil04_08_06.pdf.

²³⁸ Kaushik Patowary, “The Trans-Amazonian Highway: An Ecological Disaster,” *Amusing Planet*, 2014, <https://www.amusingplanet.com/2014/11/the-trans-amazonian-highway-ecological.html>.

²³⁹ “The Trans-Amazonian Highway,” *Mongabay*, <https://rainforests.mongabay.com/08highway.htm>.

²⁴⁰ Eugenio Arima et al., “Loggers and Forest Fragmentation: Behavioral Models of Road Building in the Amazon Basin,” *Annals of the Association of American Geographers* 95 (2005): 525-541, https://msu.edu/~rwalker/pubs/Arima_et_al2005.pdf.

²⁴¹ Jake Spring, “UPDATE 3-Brazil seeks to privatize, pave Trans-Amazonian Highway,” *Reuters*, January 22, 2019, <https://www.reuters.com/article/brazil-infrastructure/update-1-brazil-seeks-to-privatize-pave-trans-amazonian-highway-idUSL1N1ZM1G2>.

²⁴² WWF, *Brazil: Assessing the Sustainability Impacts of Paving Highway BR-163*.

²⁴³ Tyler Bridges, “The Rain Forest’s Road to Ruin?,” *Washington Post*, July 24, 1988, <https://www.washingtonpost.com/archive/business/1988/07/24/the-rain-forests-road-to-ruin/d97a28fb-0a40-4b90-ab06-7b23a2d482c3/>.

²⁴⁴ Sam Goodman, “The Role of NGOs in Mitigating the Impact of the Interoceanic Highway,” American University, <https://www.american.edu/sis/gep/upload/sam-goodman-srp-final-draft-4.pdf>; and Ker Than, “Bugs Help Measure Impact of New Transoceanic Highway on Amazon,” *National Geographic*, May 18, 2012, <https://www.nationalgeographic.com/news/2012/5/120518-leaf-packs-transoceanic-highway-amazon-water-quality/#close>.

the Pacific coast of Peru, such as Ilo, Matarani, and San Juan de Marcona.²⁴⁵ From its inception in 2006 to its completion in July 2011, the cost of the project nearly tripled from \$658 million to almost \$2 billion, much of which was financed by the Brazilian Development Bank (BNDES), the Development Bank of Latin America (CAF), and the Peruvian government.²⁴⁶

Dams

- **São Luiz do Tapajós:** The project to build the second-largest Brazilian hydroelectric dam was canceled in 2016 after FUNAI approved a study to demarcate the territory of the indigenous Mundurucu group.²⁴⁷ The project would have flooded the Mundurucu village and displaced people and villages.²⁴⁸ In addition, according to IBAMA, the project was canceled because its environmental impact study had several flaws. This was one of the several dams proposed for the Tapajós region. Eletrobras, the Brazilian power generation company that was leading the project, has not eliminated the possibility that it will open a new licensing process and implement the project in the next few years.
- **Tucuruí:** The construction of the Tucuruí hydroelectric dam was concluded in 1984, during the period of Brazilian military governance.²⁴⁹ It is located in the state of Pará and has an installed capacity of more than 8,000 MW, which supplies part of the states of Pará and Maranhão, some states of the Northeast region, and all of the states of the South and Southeast regions of Brazil.²⁵⁰ It is estimated that the dam cost \$7.5 billion and displaced more than 23,000 people.²⁵¹
- **Santo Antônio and Jirau:** The Santo Antônio and Jirau hydroelectric dams are part of Madeira River Hydroelectric Complex initiative.²⁵² The dams are located in the Amazon state of Rondônia and were fully completed by 2016 with the installation of the last turbines.²⁵³ It is estimated that the Jirau Dam alone generates 3.7 percent of the energy produced in Brazil. Studies show that the construction of the dams has changed the level of the water and the flooding and drought periods of the river.²⁵⁴ Moreover, the barrages constructed along the Madeira river have been blocking the migration of fishes, affecting both the Brazilian and the Bolivian sides of the border.

²⁴⁵ “Southern Interoceanic Highway (Peru-Brazil),” Bank Information Center, <https://web.archive.org/web/20110905054540/http://www.bicusa.org/en/Project.10312.aspx>.

²⁴⁶ Ibid.; and Bart Crezee, “Interoceanic Highway Incites Deforestation in Peru, Threatens More to Come,” Mongabay Environmental News, November 1, 2017, <https://news.mongabay.com/2017/11/interoceanic-highway-incites-deforestation-in-peru-threatens-more-to-come/>.

²⁴⁷ Karla Lima, “‘Enterramento de São Luiz do Tapajós nos dá esperança’, diz procurador,” *G1*, August 8, 2016, <http://g1.globo.com/pa/santarem-regiao/noticia/2016/08/enterramento-de-sao-luiz-do-tapajos-nos-da-esperanca-diz-procurador.html>; and “Eletrobras ainda vê saída para São Luiz do Tapajós,” FGV Energia, <https://fgvenergia.fgv.br/noticias/eletrobras-ainda-ve-saida-para-sao-luiz-do-tapajos>.

²⁴⁸ Ibid.

²⁴⁹ Lúcio Flávio Pinto, “De Tucuruí a Belo Monte: a história avança mesmo?,” *Boletim do Museu Paraense Emílio Goeldi. Ciências Humanas* 7, no. 3 (September/December 2012): 777-782, <https://www.scielo.br/pdf/bgoeldi/v7n3/a10v7n3.pdf>.

²⁵⁰ Victória Mendes, “As mulheres que tiveram a vida inundada pela hidrelétrica de Tucuruí,” Planeta.DOC, <https://www.planetadoc.com/as-mulheres-que-tiveram-a-vida-inundada-pela-hidreletrica-de-tucuru/>.

²⁵¹ Ibid.

²⁵² Daniel Amorim, “Estudo aponta impactos econômicos e ambientais das hidrelétricas do Madeira,” *A Crítica*, August 8, 2019, <https://www.acritica.com/channels/governo/news/estudo-aponta-impactos-sociais-economicos-e-ambientais-das-hidreletricas-do-madeira>.

²⁵³ Giseli Buscariollo, “3ª maior hidrelétrica do Brasil, Jirau é inaugurada oficialmente em Rondônia,” *G1*, December 16, 2016, <http://g1.globo.com/ro/rondonia/noticia/2016/12/3-maior-hidreletrica-do-brasil-jirau-e-inaugurada-oficialmente-em-rondonia.html>.

²⁵⁴ Amorim, “Estudo aponta impactos econômicos e ambientais das hidrelétricas do Madeira.”

- **Belo Monte:** The construction of the Belo Monte hydropower plant was completed in November 2019, after the installation of its last turbine.²⁵⁵ Located in the state of Pará in the northern Brazilian Amazon region, it is one of the world's largest hydropower plants by generating capacity. Composed of 18 turbines, 24 generating units, and 33 barrages built along the Xingu River, it is estimated that the Belo Monte complex has a maximum output of 11,233 MW.²⁵⁶

Railways

- **Ferrogrão:** Ferrogrão is a proposed 1,142 km project to link the Center-West of Brazil, a major grain-producing region, with the northern ports of the Amazon.²⁵⁷ This project would vastly expedite moving grains to the market because heavy rainfall makes the present road impassible for much of the year.²⁵⁸ As of yet, the government has not approved anything, but companies from around the world, including China, have signaled their interest in investing in the project.²⁵⁹ Environmental groups have signaled their concern that the project would cause great environmental harm and would particularly impact indigenous communities.²⁶⁰
- **Carajás (EFC):** The construction of the Carajás railway was completed in 1985.²⁶¹ This railway is 892 km long and connects the world's largest open-cast iron ore mine—the Carajás mine, in the Southeast region of Pará—to the northern port of Ponta Madeira in Maranhão. It is estimated that it transports 120 million tons of cargo and 350,000 passengers per year. A 575-km expansion of the railway was completed by the company Vale in 2018, despite intense criticism concerning deforestation, noise, and water pollution issues as well as innumerable protests against the lack of pedestrian bridges over the tracks of the railway.²⁶²
- **North-South (FNS):** The initial project of the FNS is composed of three railway sections that form a vertical line crossing the Brazilian territory from north to south.²⁶³ The “northern section” is the one located in the Amazon region. It is a 720 km stretch that begins in the city of Açailândia in Maranhão and ends in Porto Nacional, Tocantins. In addition to the initial project, which is almost completed, now the government plans to add 477 km to the northern section of the railway. According to the project, the railway would end at the city of Barcarena, in the state of Pará, where the port complex of Vila do Conde is located.

²⁵⁵ Pedro Rafael Vilela, “Belo Monte liga última turbina e inicia operação completa,” Agência Brasil, November 27, 2019, <https://agenciabrasil.ebc.com.br/politica/noticia/2019-11/belo-monte-liga-ultima-turbina-e-inicia-operacao-completa>.

²⁵⁶ Adriano Pires, “Usina de Belo Monte, o Brasil profundo, escreve Adriano Pires,” Poder 360, November 26, 2019, <https://www.poder360.com.br/opiniaoeconomia/usina-de-belo-monte-o-brasil-profundo-escreve-adriano-pires/>.

²⁵⁷ Anthony Boodle and Isabel Versiani, “Brazil Delays Two Big Rail Projects until Third Quarter 2020,” Reuters, December 13, 2019, <https://www.reuters.com/article/us-brazil-infrastructure/brazil-delays-two-big-rail-projects-until-third-quarter-2020-idUSKBN1YH27Z>; and Sam Cowie, “Brazil Indigenous Group Mobilises against Planned Soy Railway,” Al Jazeera, February 21, 2019, <https://www.aljazeera.com/news/2019/02/brazil-indigenous-group-mobilises-planned-soy-railway-190221220100362.html>.

²⁵⁸ Sue Branford and Maurício Torres, “Ferrogrão Grain Railway Threatens Amazon Indigenous Groups, Forest,” Mongabay Environmental News, December 4, 2017, <https://news.mongabay.com/2017/12/ferrograo-grain-railway-threatens-amazon-indigenous-groups-forest/>.

²⁵⁹ “Ferrovia Sinop-Miritituba está na mira de investimentos dos Chineses,” *Mato Grosso Econômico*, May 15, 2019, <https://www.matogrossoeconomico.com.br/politica/ferrovia-sinop-miritituba-esta-na-mira-de-investimentos-dos-chineses/21800>.

²⁶⁰ Branford and Torres, “Ferrogrão Grain Railway Threatens Amazon Indigenous Groups, Forest.”

²⁶¹ “Estrada de Ferro Carajás: o caminho onde passa a nossa riqueza,” Vale, <http://www.vale.com/brasil/PT/initiatives/innovation/carajas-railway/Paginas/default.aspx>.

²⁶² Ibid.; Cristiane Faustino e Fabrina Furtado, *Mineração e Violações de Direitos: O Projeto Ferro Carajás S11D, da Vale S.A.* (Açailândia: DHESCA Brasil, 2013), http://www.global.org.br/wp-content/uploads/2016/03/plataforma-dhesca_carajas.pdf; and “Vale conclui obra de expansão da Estrada de Ferro Carajás e amplia projetos sociais no Maranhão,” Vale, August 17, 2018, <http://www.vale.com/brasil/PT/aboutvale/news/Paginas/expansao-estrada-carajas-projetos-sociais-maranhao.aspx>.

²⁶³ “Faltam 3.000 km para que a ferrovia Norte-Sul ligue extremos do país,” Canal Rural, January 30, 2019, <https://www.canalrural.com.br/conteudo-patrocinado-campanha/faltam-3-000-km-para-que-a-ferrovia-norte-sul-ligue-extremos-do-pais/>.

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