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A Green, Inclusive, and Sustainable Development Framework for the Amazon Region

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Barbara Avila Aravena
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Inter-American Development Bank
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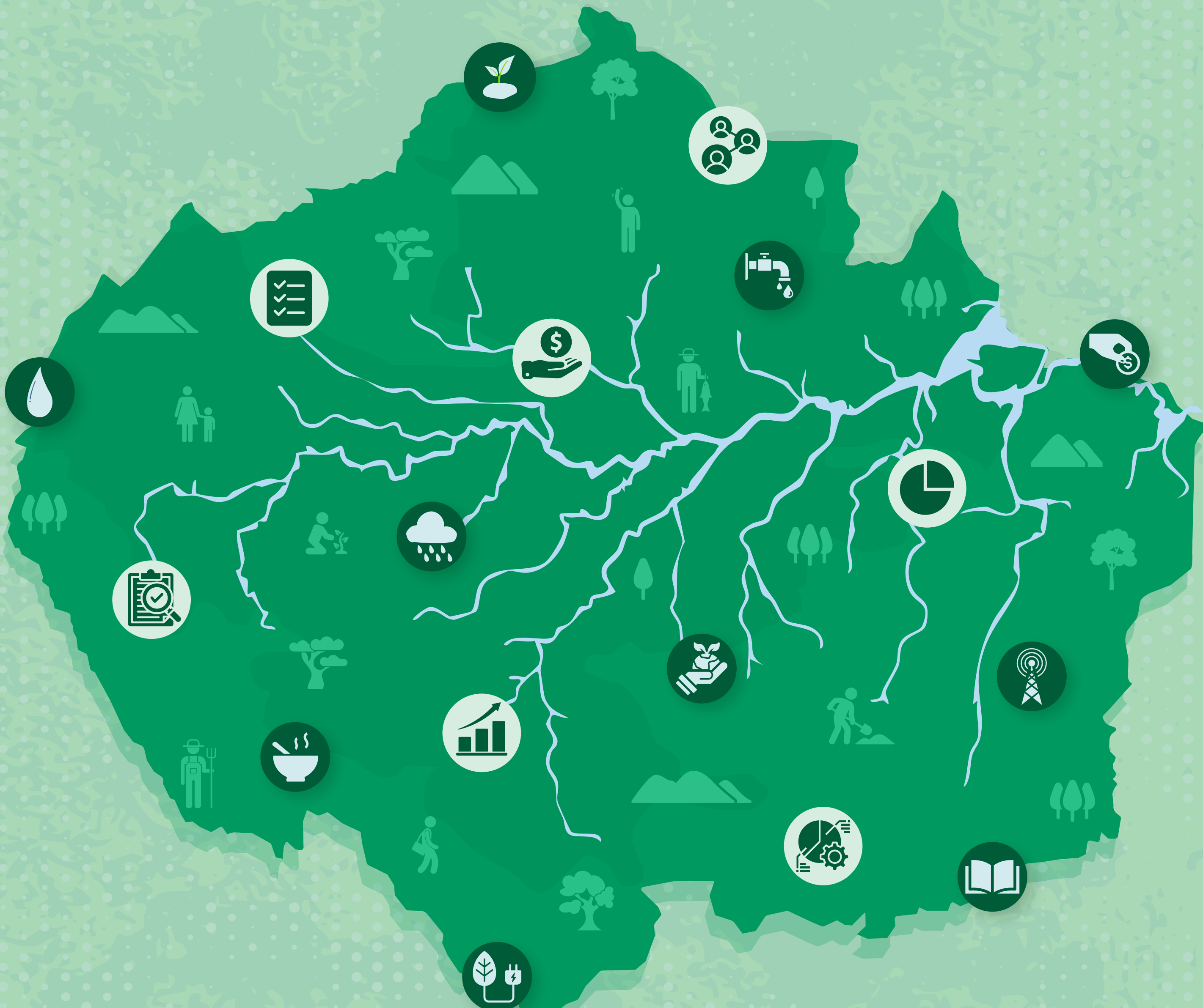

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IDB

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Acronyms

ACU	Amazon Coordination Unit
IATI	International Aid Transparency Initiative
IBGE	Brazilian Institute of Geography and Statistics
IDB	Inter-American Development Bank
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
SDG	Sustainable Development Goals

01 Introduction

The Amazon Region is one of the globe's most environmentally rich, culturally diverse, and vital landscapes in the world, reflecting South America's diverse ecosystems and inhabitants. The region spans nearly half of the South American continent, encompassing eight countries and one department. It presents tremendous socio-environmental complexity, with great potential for the continent and the world. However, the region historically has experienced degradation of its natural capital, its population registers high levels of poverty and exclusion, and economic activities have limited contributions to growth (IDB, 2021; Ávila Aravena et al., 2024). The Inter-American Development Bank (IDB) recognizes the significance of this region—as stated in IDBImpact+ and the Amazonia Forever Regional Coordination Program[6]—and highlights the institution's commitment to understanding the region's interconnected challenges and opportunities, as well as to promoting a territorial approach to both analytical projects and operations in the region (IDB, 2021). However, data limitations make this approach challenging. Many of these countries, and especially Amazonian regions within these countries, do not conduct systematic and consistent data collection that allow for more-accurate diagnostics and evidence-based policymaking (Ávila Aravena et al., 2024).

This study seeks to contribute to the overarching dialogue and work in the region on the part of both IDB and other development partners. In this analysis, the Amazon Region is defined as the geographical intersection of the Amazon with Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela.[7]

The purpose of this study is to generate a comparable database of georeferenced development gaps in the Amazon Region,[8] a crucial input for dialogue and strategic thinking. It does not, however, replace qualitative nor field analyses that provide much-needed on the ground verification for developing specific interventions. Specifically, this study (1) develops an analytical framework to identify the different factors that are necessary to promote green, inclusive, and sustainable development in the Amazon Region, a framework that is based on a thorough document review and discussions with IDB specialists;[9] (2) constructs a unique, region-wide database for a georeferenced gap analysis; (3) presents the results of 20 sector-gap analyses and 3 multisector analyses using these data; and (4) applies the database to analyze four key challenges relevant to the Amazon Region. These issues are: environmental degradation, potential for green businesses, routes of regional integration, and transboundary conditions and opportunities for coordination.

[6] https://www.iadb.org/en/home/idbimpact; https://www.iadb.org/en/who-we-are/topics/amazonia
[7] For the purpose of this study, the definition of Amazon Region set in the Red Amazónica de Información Socioambiental Georeferencíada (RAISG) is used (https://www.raisg.org/en/), comprising territories in Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela. For more details see Annex 6.2.
[8] Georeferenced data refers to information that is linked to specific geographic locations using coordinates, allowing for spatial analysis and mapping.
[9] Green, inclusive, and sustainable development is based on the principle of sustainably utilizing biological resources, knowledge, science, technology, and innovation to support productive economies, resilience, and the well-being of the population. See Annex 6.3 for more information.

This document is structured in five sections. Following this introduction, Section 2 presents the analytical framework developed, as well as the methodology and data used to create the regional georeferenced database and the gap analyses. Section 3 provides a summary of the findings of the gap and multigap analyses. Section 4 presents the application of the database to four thematically relevant policy questions, providing insights into related issues and identifying potential geographical areas and populations that could benefit from targeted interventions, and Section 5 concludes.

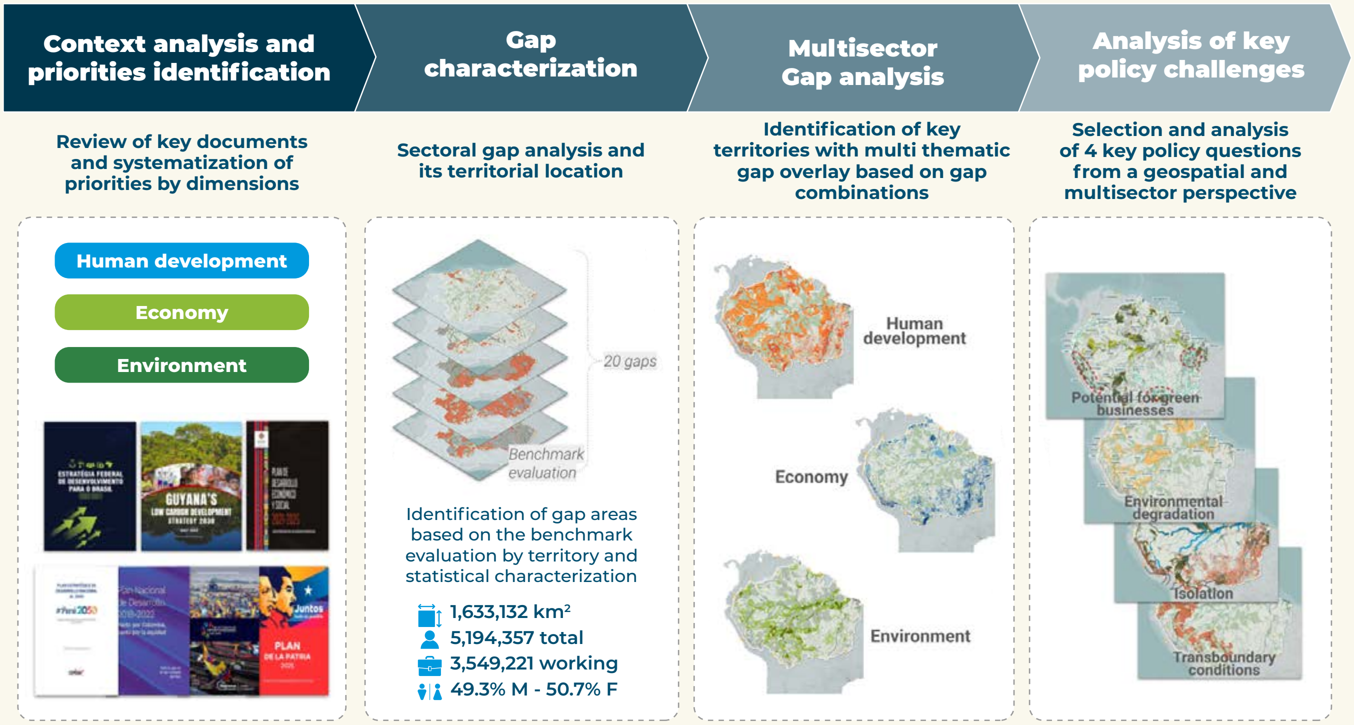
02 Data and Methodological Framework

2.1. Methodology

This study develops a unique, regional-scale georeferenced database of indicators, using over 80 sources of data, and applies it to a development gap analysis of the Amazon Region. The study seeks to address the data challenges presented in Section 1 by building a georeferenced database for the region. It is thus quantitative in nature, yet it also relied on a wide document review and extensive consultations with IDB specialists during its elaboration. Four key phases of work were carried out (**Figure 1**). First, an analytical framework was developed to structure and organize existing challenges and identify regional development priorities, based on a context analysis through a thorough literature review and consultations with IDB specialists. Second, data collection and systematization processes were conducted using over 80 sources of publicly available information, satellite databases, and crowd-sourced data.[10] The resulting database made it possible to select 20 sectoral gaps and benchmarks and in turn to perform the gap analysis.[11] Third, the sectoral gap analyses were combined to create multisector gaps. More than 200 spatial analyses were used to develop Phases 2 and 3. Finally, the data framework was used to analyze four key policy questions for the region.

[10] A detailed discussion of the methods used is presented in Annexes 6.6 and 6.8.
[11] A detailed discussion of the methods used is presented in Annex 6.6.

Figure 1. General description of the phases conducted for the development of the study



Source: Developed by the authors.

The development gap assessment of this study builds on existing analyses and methodologies. This study draws on previous work conducted by the IDB in countries such as Haiti, Honduras, and Nicaragua (Giles Álvarez et al., 2021). Additionally, similar techniques have been used in academic studies such as DeGuzman et al. (2018), who conduct a geospatial analysis to determine access gaps, and BenYishay and Parks (2017), who use geospatial impact evaluation to understand development interventions by combining georeferenced intervention data with remote-sensing outcome data. Among the numerous case studies using these techniques to evaluate development outcomes are Mulvenon et al. (2006), who focus on education and Manole et al. (2011), who investigate development gaps in Romania. Other institutions are also developing geospatial methodologies for regional planning. For example, in 2024, the Comisión Económica para América Latina y el Caribe (CEPAL; Economic Commission for Latin America and the Caribbean) published a study on sociodemographic inequality gaps in the Amazon Region, integrating spatial data to analyze socioeconomic inequalities and environmental vulnerabilities (CEPAL/OCTA, 2024).

2.1.1 Context analysis and priorities identification

An analysis of regional priorities was conducted by means of a three-step process. The first step began with a thorough document review of 41 national, regional, and international documents. These included planning documents, regional reports, national development strategies, IDB country development challenges documents, and IDB country strategies for each of the eight countries. This resulted in a list of preliminary priorities for development in the region. The second step consisted of selecting a more concise list of regional development priorities by means of three selection criteria: (1) the priority had to align with at least one sustainable development goal (SDG), (2) it had to align with the overall objective of the study (promoting green, sustainable, and inclusive development), and (3) it had to align with the IDB's operational potential in the region and with the five pillars of the Amazonia Forever program. For this third step, various meetings with IDB specialists were conducted for validation. By means of this process, 22 regional priorities were selected (**Figure 2**), which can be grouped into 3 broad dimensions: human development, the economy, and the environment (**Figure 3**).

Figure 2. Documents researched, selection criteria, and the 22 selected regional priorities

Country Development Challenges

Country Strategies

Amazonía Forever

Regional Projects and documents

National Planning Instruments

Criteria used in document prioritization:

1. Focused on the development of green and sustainable economic activities
2. Addresses human capital development
3. Priorities aligned with regional development
4. Priorities captured by the IDB Group that
5. fit operational criteria as set in the Amazon Forever program

Dimensions	#	Regional Priorities
Human Development	P1	Improve access to clean water across the whole territory.
	P2	Improve reliability, accessibility, and sourcing of electricity to connect all regions and meet sustainability targets.
	P3	Promote investments in electrical systems and renewable energy to ensure access.
	P4	Enhance access to improved sanitation services in all communities.
	P5	Improve basic services to all communities.
	P6	Improve healthcare access, outcomes, and regional disparities.
	P7	Improve access to and outcomes of education, reducing regional disparities.
	P8	Promote work training and education curricula aligned with labor market needs.
	P9	Improve intra- and interstate connectivity and climate resilience of transport infrastructure.
	P10	Expand digital and telecommunications infrastructure through investment and partnerships.
	P11	Promote equitable access to energy infrastructure to support underserved areas.
Economy	P12	Optimize agricultural practices to increase productivity
	P13	Involve innovative and climate-friendly methods to improve the agricultural sector.
	P14	Increase productivity and competitiveness in bioeconomic sectors.
	P15	Leverage natural capital to create alternative sustainable livelihoods that protect biodiversity.
	P16	Reduce environmental vulnerability by adopting a resilience lens in development.
	P17	Promote investments in climate resilience of transport and energy infrastructure.
	P18	Promote social inclusion and economic opportunities in territories with high presence of indigenous population
Environment	P19	Increase institutional capacity to respond to environmental challenges in territories with high presence of indigenous population.
	P20	Protect biological diversity and ecosystem services through sustainable practices.
	P21	Promote water resource management in communities.
	P22	Strengthen sustainable management of conservation areas.

Source: Figure developed by the authors.
Note: Although the geographical scope of different regional priorities can vary, unless otherwise stated the geographical scope is national (including urban and rural areas).

2.1.2 Sectoral gap characterization

The list of regional priorities was used to inform the selection of georeferenced development gaps. The final list of sectors chosen for the gap analysis was based on the regional priorities and the availability of comparable georeferenced data across the eight countries.[12] **Table 1** presents the full list of selected development gaps and benchmarks. Further detail of the indicators used can be found in Section 3. In this study, a development gap is defined as an area or population group that experiences a measurable disparity in terms of an adequate level of access of a service or outcome in a sector. Living in an area with a gap can therefore signify (1) limited access to services or infrastructure based on time-of-travel standards, (2) a suboptimal outcome based on performance results, or (3) deficiencies in the application of policies in a specific territory. An adequate level of access or outcome is determined by a benchmark.[13] Each benchmark was applied uniformly across eligible territories for each of the indicators selected.[14] Gaps in this study are therefore binary in nature: the gap either exists or does not exist. It is important to mention that the study does not measure severity or other aspects; it simply determines the presence or absence of a gap. This highlights the opportunity for future efforts where severity measures can be included to improve focalization.

Table 1. Development gaps and selected benchmarks for the analysis

Sectoral Gap	Gap Description	Benchmark	Benchmark Source
Limited Access to Drinking Water	Administrative units with, on average, less than 43% of households with piped water in the home or yard	< 43.0%	WHO/UNICEF (2020)[15]
Limited Access to Electricity in Urban Areas	Urban administrative units with less than 96.4% of households, on average, served by electricity from the grid	< 96.4%	World Bank (2020)
Limited Access to Electricity in Rural Areas	Rural administrative units with less than 81.3% of households, on average, served by electricity from the grid	< 81.3%	World Bank (2020)
Limited Access to Sanitation Services	Administrative areas with an average rate of household access to sanitation (sewer and septic) under 9%	< 9.0%	WHO/UNICEF (2020)[16]
Limited Geographic Access to Health Centers in Urban Areas	Urban territories farther than 30 minutes by car from health centers	> 30 min	MAP (2019); Mathon et al. (2018)
Limited Geographic Access to Health Centers in Rural Areas	Rural territories farther than 120 minutes by car from health centers	> 120 min	MAP (2019); Mathon et al. (2018)
Limited Geographic Access to Primary and Secondary Education in Urban Areas	Urban territories farther than 20 minutes by car from primary and secondary schools	> 20 min	Ding and Feng (2022)

[12] In addition, the final selection of gaps for analysis was reviewed with IDB specialists through various consultation stages during the study's development, with the results being validated with the Amazon Coordination Unit, knowledge coordinators, sectoral specialists and Regional Economic Advisors for the Caribbean, Andean and Brazil regions. For this study, the gaps were not normalized, given the different characteristics of the initial indicators, methods utilized, and type of data; for more details se Annex 6.1.
[13] Due to the unique characteristics of the territory under study and the significant disparities among countries, benchmarks were selected on a case-by-case basis, based on a comprehensive literature review and validated with IDB specialists. It is important to acknowledge that the gap results remain sensitive to the chosen benchmarks.
[14] The use of eligible territories yields a gap result that excludes areas where a gap would not be relevant such as infrastructure access within unpopulated areas or agricultural analyses beyond agricultural lands. See Annex 6.5 for more information about eligible territories.
[15] The benchmark is based on WHO/UNICEF's 2020 Joint Monitoring Programme for Water Supply, Sanitation and Hygiene rate of piped water for landlocked developing countries. This rate was used as the benchmark due to the landlocked conditions of most of the Amazon Region. The rate of 43% is lower than the average LAC piped water rate because it draws on data from countries around the world.
[16] The benchmark is based on the WHO/UNICEF's 2020 Joint Monitoring Programme for Water Supply, Sanitation and Hygiene rate of sewer services for landlocked developing countries. This rate was used as the benchmark due to the landlocked conditions in the majority of the Amazon Region.

Sectoral Gap	Gap Description	Benchmark	Benchmark Source
Limited Geographic Access to Primary and Secondary Education in Rural Areas	Rural territories farther than 30 minutes by car from primary and secondary schools	> 30 min	Ding and Feng (2022)
Limited Access to Primary Roads	Populated areas farther than 45 minutes by car from a primary road	> 45 min	Mathon et al. (2018)
Limited Access to Secondary Roads	Populated areas farther than 45 minutes by car from a secondary road	> 45 min	Mathon et al. (2018)
Limited Geographic Access to Digital Connectivity	Populated areas that are more than 45 minutes by car from a cell tower or at least 2 km from a cell tower in urban areas or 5 km in rural areas	> 45 min > 5 km / 2 km	Unwired Labs (2020); Simmons (2024)
Limited Geographic Access to Electric Substation	Populated areas at least 4.5 km from an electric substation in urban areas and 20 km away in rural areas	Urban: 4.5 km Rural: 20 km	Kavuma et al. (2021); Csanyi (2017)
Limited Efficiency of Agricultural Lands[17]	Agricultural lands with less than USD 29,240/km2 contribution to the agricultural GDP in the Andean region (Bolivia, Colombia, Ecuador, Peru, and Venezuela), or less than USD 14,779/km^2 of contribution to the agricultural GDP in Brazil, Guyana, and Suriname	CAN: < USD 29,240/km^2 BR, GY & SR: < USD 14,779/km^2	Regional benchmarks: Andean; BR, GY & SR (lowest two quintiles)
Limited Green and Sustainable Activities	Administrative units with fewer than 1 private firm engaged in green and sustainable economic activities and more than 1,840 people of working age	< 1 firm in >1,840 people of working age	Regional benchmark (lowest two quintiles)
Limited Aid Investment in Climate Resilience and Adaptation	Areas with high climate change risk factors without public investments in resilience and adaptation	0 Investments	Regional benchmark (lowest two quintiles)
Indigenous Territories with Limited Investments in Climate Resiliency and Green and Sustainable Activities	Indigenous territories without public investment in climate resilience or green and sustainable activities	0 Investments	Regional benchmark (lowest two quintiles)
Indigenous Territories Exposed to Climate Hazards	Indigenous territories with high climate change risk factors	Index of high climate risk	Regional benchmark (highest two quintiles)
Potential Areas for the Protection of Biodiversity	Areas with species richness above the 95th percentile globally that are unprotected or disturbed by land use change	> 95th global percentile 10% deforested	BiodiversityMapping (2021a, 2021b, 2021c); Flores et al. (2024)
Potential Areas for Sustainable Management of Water Supply	High environmental water supply areas that are unprotected or highly disturbed by land use change	> 80th global percentile 10% deforested	Regional benchmark Flores et al. (2024)
Potential Areas for Protection of Ecosystem Services	Globally critical ecosystem service provision areas that are unprotected or highly disturbed by land use change	> 75th global percentile 10% deforested	Chaplin-Kramer et al.(2022) Flores et al. (2024)

Source: Developed by the authors.
Note: The geographical scope of different binding priorities can vary. Unless otherwise stated, the geographical scope is national (including urban and rural areas).

[17] Due to contrast in the average agricultural productivity between the Andean Region and the region formed by Brazil, Guyana, and Suriname, 2 separate benchmarks were established to tailor analysis to more localized conditions.

The study considers the large diversity of territories and populations that characterize the region. Aspects relating to population density as well as natural, economic, administrative and cultural factors are considered to inform the territorial analysis. This territorial diversity shapes the perspective with which the gaps are calculated, in light of the fact that access to services, productive processes, and inclusion factors are not homogeneous across the region and can therefore not be the same in urban and rural territories, in more densely and less densely forested areas, etc. Given this context, protected areas have been removed from human development and economic gap analyses in order to focalize evaluations and findings around areas more likely to be populated with an eye to human development intervention.[18] In addition, for visualization purposes, population points are added in some of the maps to represent the average number of inhabitants of an administrative unit with extensive gap coverage. These population points are divided into 3 brackets: 10,000 to 50,000, 50,000 to 100,000, and over 100,000.

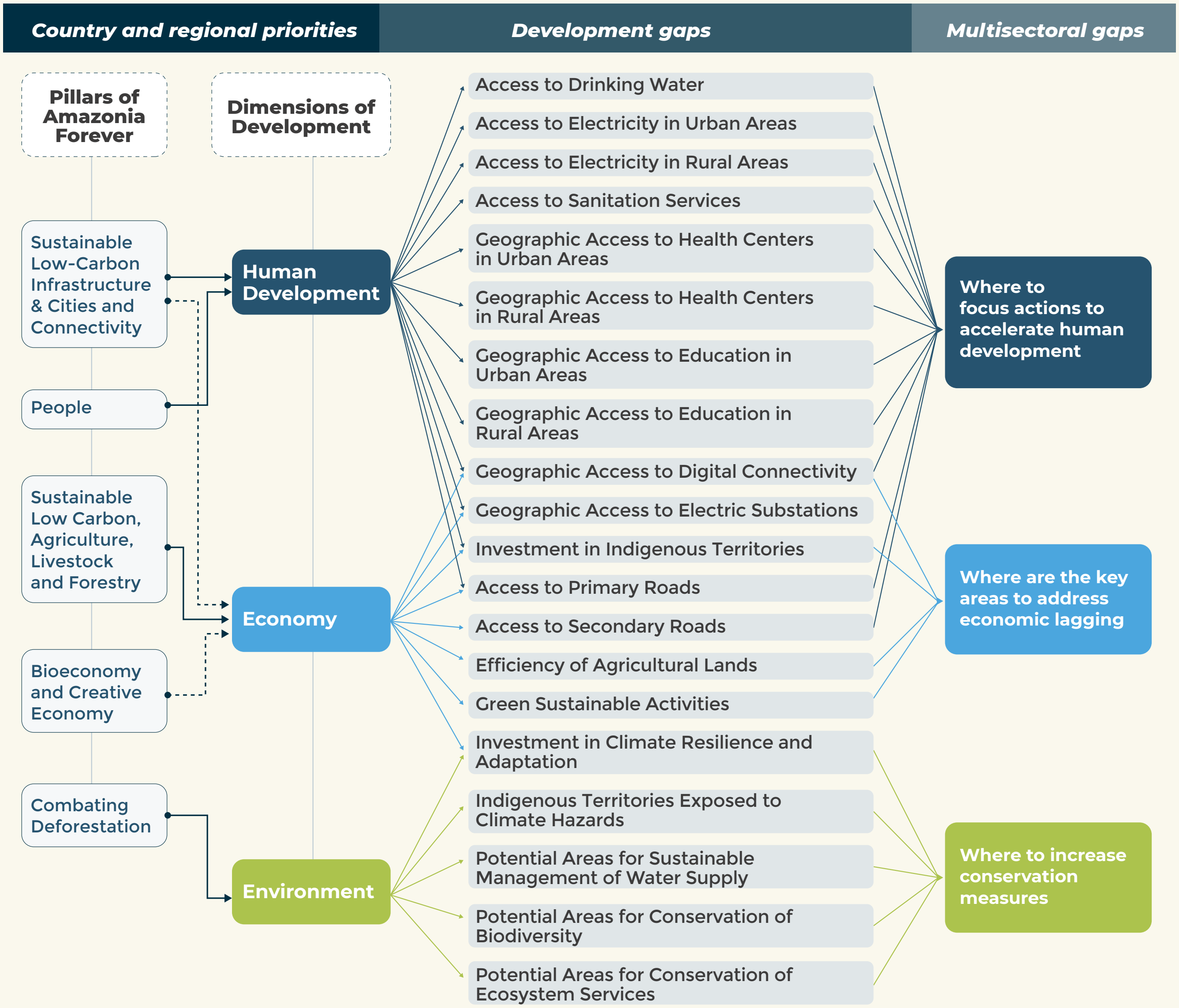
Consistency in indicators and base years across different databases is a priority. Different types of indicators were used for this study, including census and household survey information, satellite imagery, raster-based and geospatial vector data. Development gaps using census or household data are measured as the average value for the administrative unit.[19] Whereas gaps based on satellite imagery or raster-based data, are much more granular in nature. In addition, the use of different sources of data to create a region-wide measure, in some cases, requires the selection of indicators that are as similar as possible, but could vary slightly in definition across countries. For example, in the case of access to sanitation services, some countries might measure access to a sanitation grid and other countries might also include access to septic tanks. To address this challenge, censuses were reviewed and compared across countries to identify the most common and comparable indicator. However, some discrepancies may still remain (for more details please refer to Annex 6.8). In addition, 2021 was selected as the baseline year for all gaps and a standardization process was conducted, when required, indicator by indicator (for more details please refer to Annex 6.8).[20]

2.1.3 Multisector gap analysis

By combining different sectoral gaps, multisector gaps were then constructed. The challenges in the Amazon Region are complex and multifaceted in nature (IDB, 2021). Development challenges do not tend to happen in isolation. They often combine challenges across sectors. Thus, in order to start building a more complex gap analysis that could reflect some of these overlaps and relations, a multisector gap analysis was conducted. A series of geospatial analyses were performed by combining equally weighted gaps into three thematic groups: human development, the economy, and the environment (**Figure 3**). The concentration of overlapping gaps identified three multisector gaps, highlighting specific territories with low, medium, and high concentrations of gaps.

[18] Given the size of the study area, regional scale, and scope of the study and data availability, detailed insights of specific locations could be misleading and therefore would require further quantitative and qualitative analyses to draw conclusions at that level of granularity.
[19] The authors acknowledge that there could be variations in results within an administrative unit, yet given the nature of these data, an average value per administrative unit is used.
[20] A baseline year is the standard point in time from where the calculations, exercises, and analysis of the gaps were made. Consult Annex 6.8 for more details.

Figure 3. Framework of the study's interrelations



Source: Developed by the authors.
Note: The geographical scope of different binding priorities can vary. Unless otherwise stated, the geographical scope is national (including urban and rural areas).

For the human development multisector gap, the analysis was framed by the question of "Where in the region could actions be focused to address the most lagging areas and accelerate human development?" This multisector gap consists of eight human development sectoral gaps: limited access to potable water, limited access to electricity in urban and rural territories, limited access to sanitation services, limited access to health centers in urban and rural territories, limited access to education centers in urban and rural territories, limited access to primary roads, limited access to secondary roads, and limited digital connectivity. The measurements of these gaps were overlaid and analyzed in three brackets: if the overlap resulted in between one and three gaps in the same location, this region was characterized as having "low gap concentration"; an overlap of four to five gaps in a single location was termed "medium gap concentration"; and an overlap of six to eight gaps was termed "high gap concentration."

In the case of the economic production multisector gap, the framing question to answer was "Where are the key areas in the region that could be prioritized to address lagging conditions in economic well-being?" This multisector gap analysis consists of five gaps: limited access to secondary roads, limited digital connectivity, limited agricultural efficiency, limited green and sustainable activities, and limited investment in indigenous territories. The analysis also incorporated two additional layers of information, non-biodiverse areas and areas without green and sustainable development potential, to supplement the intersection of the five gaps.[21] Areas that had an overlapping of one to three gaps were characterized as having "low gap concentration"; areas with four overlapping gaps were characterized as having "medium gap concentration"; and areas with five to seven overlapping gaps were considered as having "high gap concentration."

The environmental conservation multisector gap was framed by the question "Which areas would benefit from increased conservation measures?" Four sector gaps are considered in this multisector gap analysis: limited investment in climate resilience and adaptation, areas for protection of biodiversity, areas for management of water supply, and areas for protection of ecosystem services. In addition, two supplemental information layers considered relevant to addressing the main environmental challenges confronted by the Amazon Region are applied: forest at risk of disturbance and deforestation.[22] Areas with one or two overlapping gaps are considered as having "low gap concentration"; areas with three to four overlapping gaps are considered as having "medium gap concentration"; and areas with five to six gaps are considered as having "high gap concentration."

2.1.4 Analysis of key policy questions

The gap and multisector gap analyses results were used as inputs to analyze key regional thematic areas with a territorial and data-driven approach. The four key challenges for the region analyzed include (1) environmental degradation, (2) potential for green businesses, (3) routes of regional integration, and (4) transboundary conditions and opportunities for coordination. The scope and richness of the database allow for a deep and sophisticated analysis, providing insights related to the combined factors that have an effect on these issues on the one hand; and to the affected geographical locations on the other. For example, for the analysis on environmental degradation, indicators on the ecosystem value of different regions, the deforestation rate, and the presence of protected areas are combined to provide a regional picture of the extent of deforestation and the potential effectiveness of environmental protection. For each of these key thematic areas, key policy questions were formulated, and relevant statistics were analyzed, accompanying the cartography and results of the section. Each of the percentages presented in Sections 3 and 4 were calculated based on the total study area.

[21] For the purposes of this study, regions with green and sustainable development potential are those with a high provision and usage of natural assets or environmental conditions to support sustainable use. We elaborate on this topic in greater detail in Annex 6.2. Areas without green and sustainable development potential are the inverse territories.
[22] "Forest at Risk of Disturbance" represents current tree cover that is near deforested areas, making it vulnerable. Deforestation corresponds to tree cover that has been destroyed.

03 A Gap Analysis for the Amazon Region: Results

The findings of the gap analysis highlight critical challenges and opportunities in the Amazon Region. The gap analysis is organized in terms of the three dimensions outlined at the beginning of Section 2: human development, economy, and environment. By leveraging geospatial data and analyzing key indicators, the findings emphasize the importance of a territorial approach and integrated actions to ensure that economic and social advancements align with environmental conservation and long-term resilience, in line with IDB (2021). This section presents an initial diagnosis for each of the gap analyses.[23] For each of the gaps, the corresponding benchmark with its source, a cartographic representation of the gap area, highlights of some of the gap locations, and relevant statistics are included.[24]

3.1 Human Development Gaps[25]

Despite being home to more than 48 million people (Worldpop, 2020), the majority of the Amazon Region's territory is rural in nature, with the highest-density urban centers located most frequently around the border of the region's territory. The dispersed settlement pattern has created conditions of isolation and low population densities, which have led to challenges in the efficient provision of basic services, such as health care, education, and infrastructure. This remoteness often results in communities' having limited access to opportunities, exacerbating issues such as poverty and low contribution to economic growth. The cultural diversity of the region further requires tailored approaches that respect both environmental conservation and populations' rights. This unique set of challenges requires innovative strategies and significant investment to improve living conditions and promote sustainable development.

The human development dimension includes analyses of gaps in access to drinking water, electricity, sanitation services, health centers and education facilities. These challenges affect the population's well-being, quality of life and their opportunities for participation in the labor market. Of the 48 million people in the Amazon Region, an estimated 12.8 million are school-age children, 54 percent of whom live in areas that have at least one gap in human development conditions. This makes them vulnerable to health-related challenges and compromises their educational and income opportunities later in life.[26] Further, although Amazon Region is home to roughly 29.9 million working-age people, their full potential can only be realized when their basic needs are met. Targeted investments to enhance service provision across the region can help to improve well-being, open up new opportunities, and realize the region's potential.

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[23] Field validation of results is not within the scope of this study, so that focalization and fieldwork are advised to validate conditions on the scale of potential policies and interventions. All locations highlighted in this study are, therefore, approximations and subject to local validation.

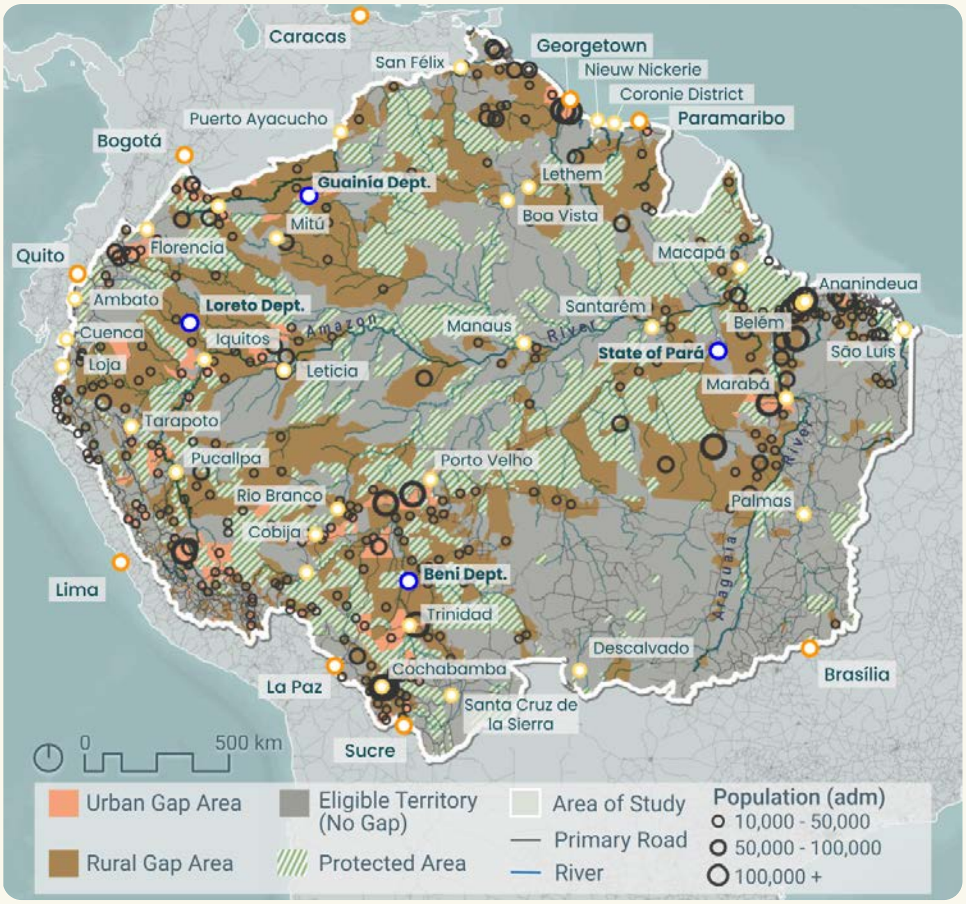
[24] Statistics that describe a gap as a percentage of an area refer to the whole area of the region of study.

[25] Census-based gaps (water, electricity, and sanitation) are calculated at the administrative level, so that all populations living within an administrative unit with service access rates below the gap benchmark are considered gap populations. Protected areas have been removed from human development gap results to focalize evaluations and findings around areas are more likely to be populated and as such could benefit from human development interventions. The study is limited to the availability of open-source information.

[26] The figure of 54 percent is based on the human development multigap results, which include gaps in access to drinking water, electricity, sanitation services, health centers, education facilities, primary and secondary roads, and digital connectivity.

1. Limited access to drinking water

Administrative units with on average less than 43 percent of households with piped drinking water in the home or yard – WHO & UNICEF (2021)[27]



Even though the Amazon Region holds one-fifth of global freshwater (UNESCO, 2023), access to improved sources of water is limited, increasing the risk of health issues, particularly among the most vulnerable populations. The gap is predominantly present in rural areas, with key concentrations in the departments of Beni, Bolivia; Guainía, Colombia; and Loreto, Peru; as well as in Brazil's state of Pará.

- **Up to 11.2 million** people (22.9 percent of the population) live in administrative areas with an access to drinking water below the benchmark.[28]
- About **34.2 percent** of the territory presents low access to drinking water.
- This benchmark shows that **695 out of 2,503** administrative areas (27 percent) have rates of household drinking water service below the conservative 43 percent benchmark, defined according to the census information of each country.

[27] The benchmark is based on the WHO/UNICEF's 2020 Joint Monitoring Programme for Water Supply, Sanitation and Hygiene rate of piped water for landlocked developing countries. This rate was used as the benchmark due to the landlocked conditions in the majority of the Amazon Region. The rate of 43 percent is lower than the average LAC piped water rate because it draws on data from countries around the world. Other more-strict benchmarks could be used to measure access to piped water above 92 percent for Latin America and the Caribbean (WHO & UNICEF, 2020).

[28] Orange indicates urban territories and brown rural territories.

2. Limited access to electricity in urban areas

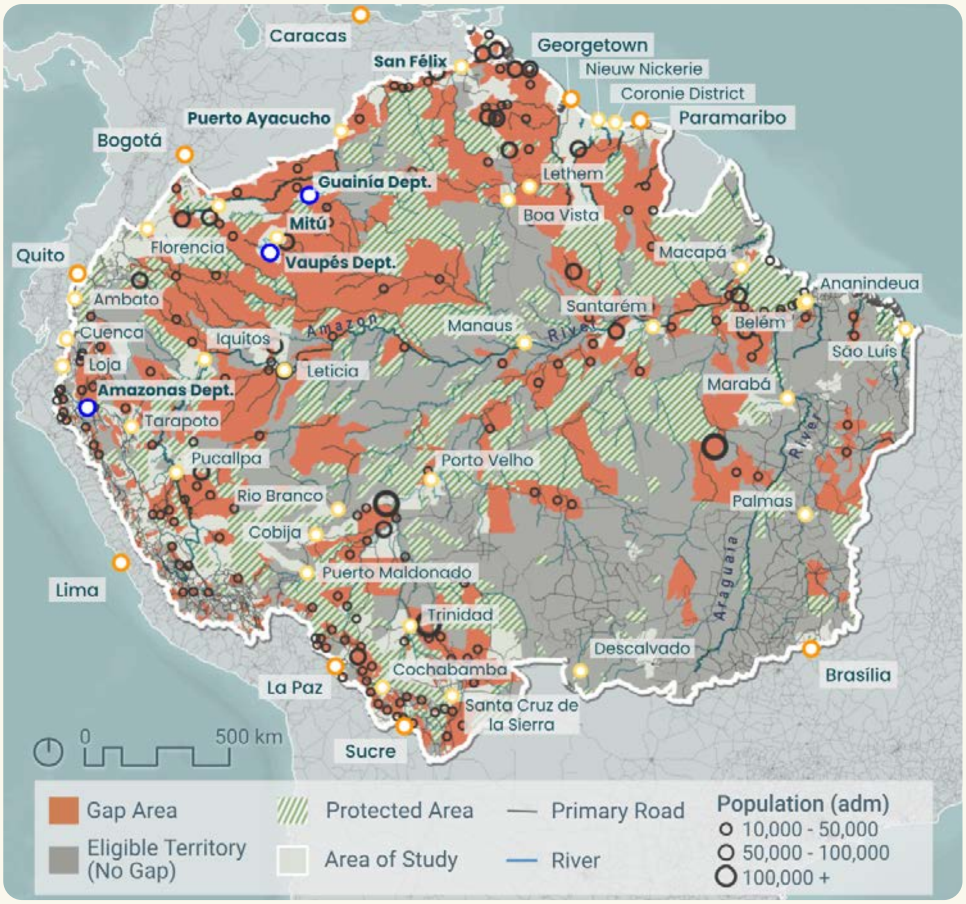
Urban administrative units with less than 96.4 percent of households, on average, served by electricity from the grid – World Bank (2020)

Despite the generally high rates of electricity access in the Amazon Region's urban areas, there are locations with intermittent service, which affects the daily lives of the unserved population. Key areas of gap concentration are found in Venezuela's Northern Bolívar state, Peru's department of Cusco, Colombia's departments of Caquetá and Putumayo, and Bolivia's department of Cochabamba.

- **Up to 6.3 million** people (13 percent of the population) live in areas that could benefit from addressing this gap.
- **Up to 1.6 million** school-age children live in urban territories with limited electricity access.
- According to census information, **6 percent** of the territory has an urban electricity access gap; the administrative areas in this portion of the territory have an average household rate of service of electricity from the grid below 96.4 percent.

3. Limited access to electricity in rural areas

Rural administrative units with less than 81.3 percent of households, on average, served by electricity from the grid – World Bank (2020)

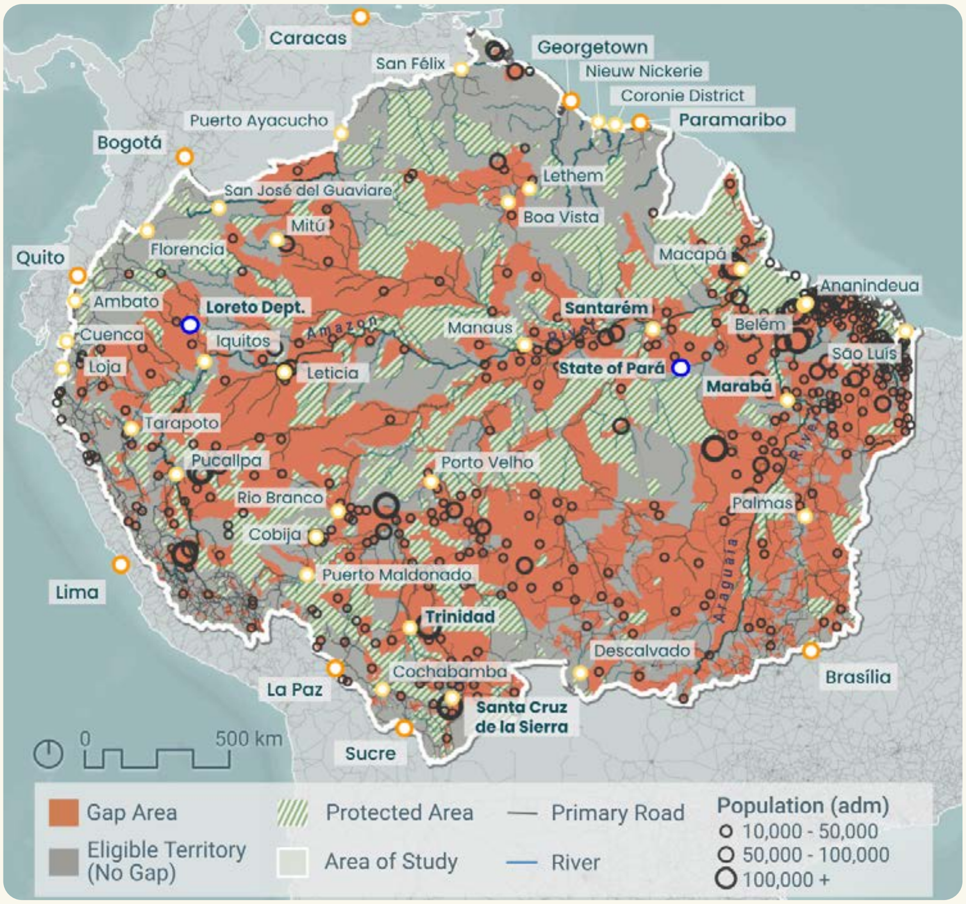


Lacking access to electricity can reduce community opportunities, especially in isolated rural settlements. This has been a challenge for decades in the rural areas of the Amazon Region: the vast extension of the territory and a lack of connectivity structures make it difficult to produce and distribute electricity in a conventional way. Gap concentrations exist in Peru's Amazonas department, Venezuela's Northern Amazonian boundary between Puerto Ayacucho and San Félix, and near Mitú, Colombia in the departments of Vaupés and Guainía.

- **Up to 4.3 million** people (8.9 percent) live in rural areas that could benefit from managing this gap.
- **Up to 1.3 million** school-age children live in rural administrative areas with limited electricity access.
- According to census information, about **28.6 percent** of the territory has a rural gap in access to electricity; the administrative areas in this portion of the territory have a household average rate of access to the electricity grid below 81.3 percent.

4. Limited access to sanitation services

Administrative areas with an average rate of household access to sanitation (sewer and septic) under 9 percent – WHO & UNICEF (2020)[29]



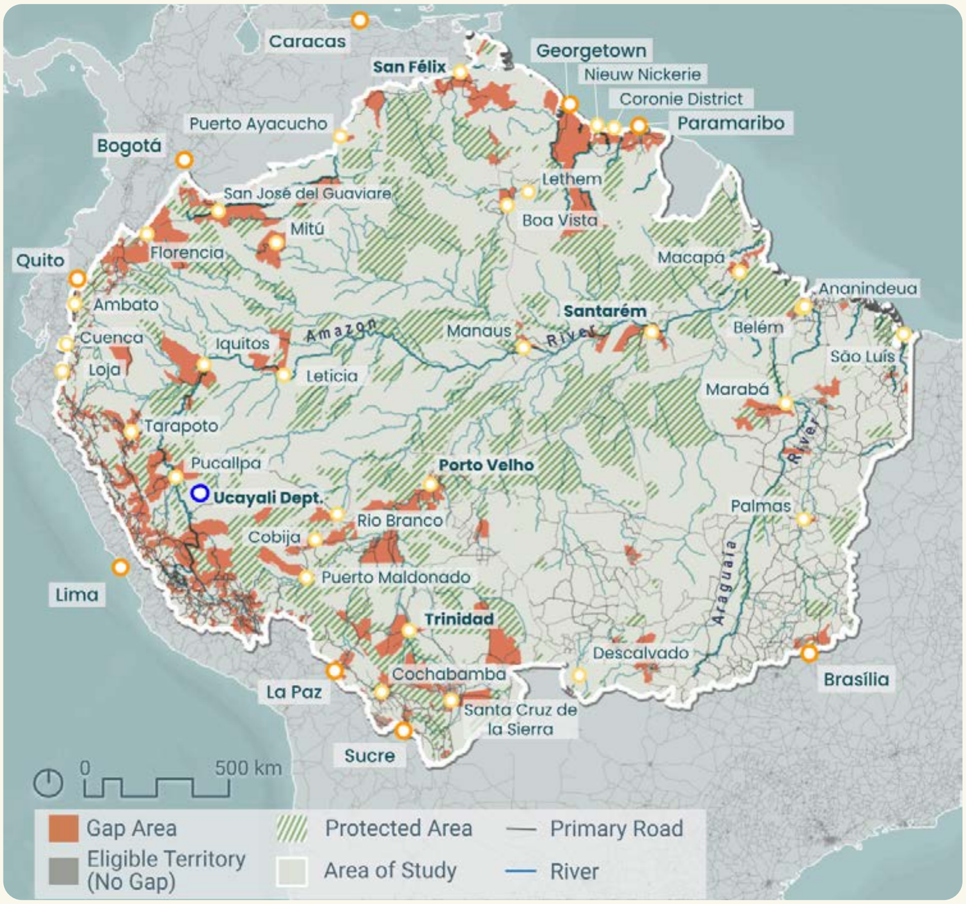
The situation of the sewer network in the Amazon Region is highly variable, as it depends on the location and population density. In general, access to sewage and waste disposal services is limited, especially in rural areas. The gap analysis reveals lagging conditions in the Bolivian departments of Beni near Trinidad and Santa Cruz near Santa Cruz de la Sierra, Peru's department of Loreto, and Brazil's Pará state, especially around Santarém and Marabá

- **Up to 11.5 million** people (23.6 percent) of the region's population live in administrative areas that could benefit from addressing this gap.
- **Up to 5.8 million** women and **3.3 million** school-age children live in administrative areas with limited sanitation services.
- According to the countries' census information, **45 percent** of the territory has a gap in access to sanitation services; the administrative areas in this portion of the territory have a household rate of sanitation services below 9 percent.

[29] The benchmark is based on the WHO & UNICEF's 2020 Joint Monitoring Programme for Water Supply, Sanitation and Hygiene rate of sewer for landlocked developing countries. This rate was used as the benchmark due to the landlocked conditions in the majority of the Amazon Region.

5. Limited geographic access to health centers in urban areas

Urban territories farther than 30 minutes by car from health centers – MAP (2019); Mathon et al. (2018)



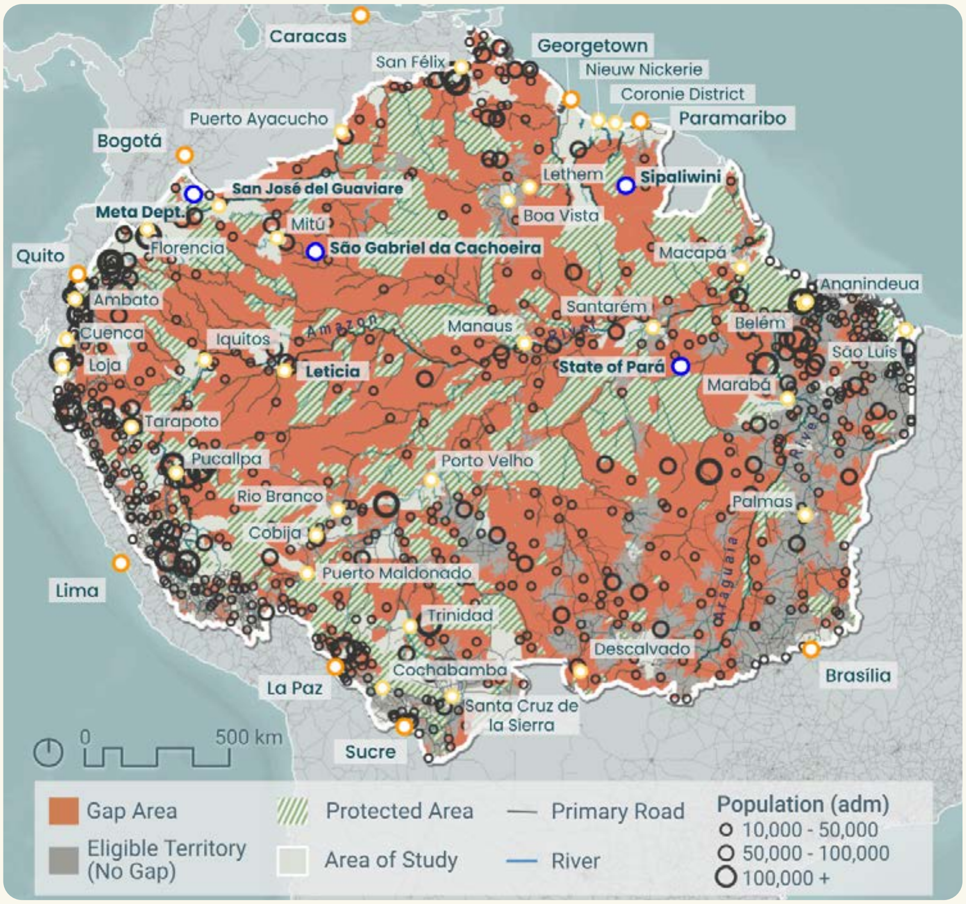
Health centers are more prevalent in urban areas than in rural areas, but limitations to access are still present.[30] This can create barriers to treatment and exacerbate health inequities and risks. Gap concentrations are found around the urban centers of Trinidad, Bolivia; Santarém and Porto Velho, Brazil; San Félix, Venezuela; and the Peruvian department of Ucayali.

- Approximately **3.4 million** people (7.1 percent of the population) live in areas that could benefit from managing this gap.
- Around **885,000** (6.9 percent) of school-age children live in areas with a gap, reducing resilience to childhood mortality risks.
- About **8.8 percent** of the Amazon Region's urban areas are more than 30 minutes away from any health center.

[30] Access to health centers depends not only on the existence of health centers, but also on the presence of adequate transportation infrastructure to connect people with centers and the human capital capacity to staff medical facilities.

6. Limited geographic access to health centers in rural areas

Rural territories farther than 120 minutes by car from health centers – MAP (2019); Mathon et al. (2018)[31]



The low presence of health centers and long travel times to healthcare in dispersed, rural areas can have negative effects on health outcomes.[32] Some of the key gap concentrations can be found in Peru near the border with Colombia, in Suriname's Sipaliwini communities, and north of San José del Guaviare in Colombia's Meta department, as well as in Brazil's state of Pará and the borderlands municipality São Gabriel da Cachoeira.

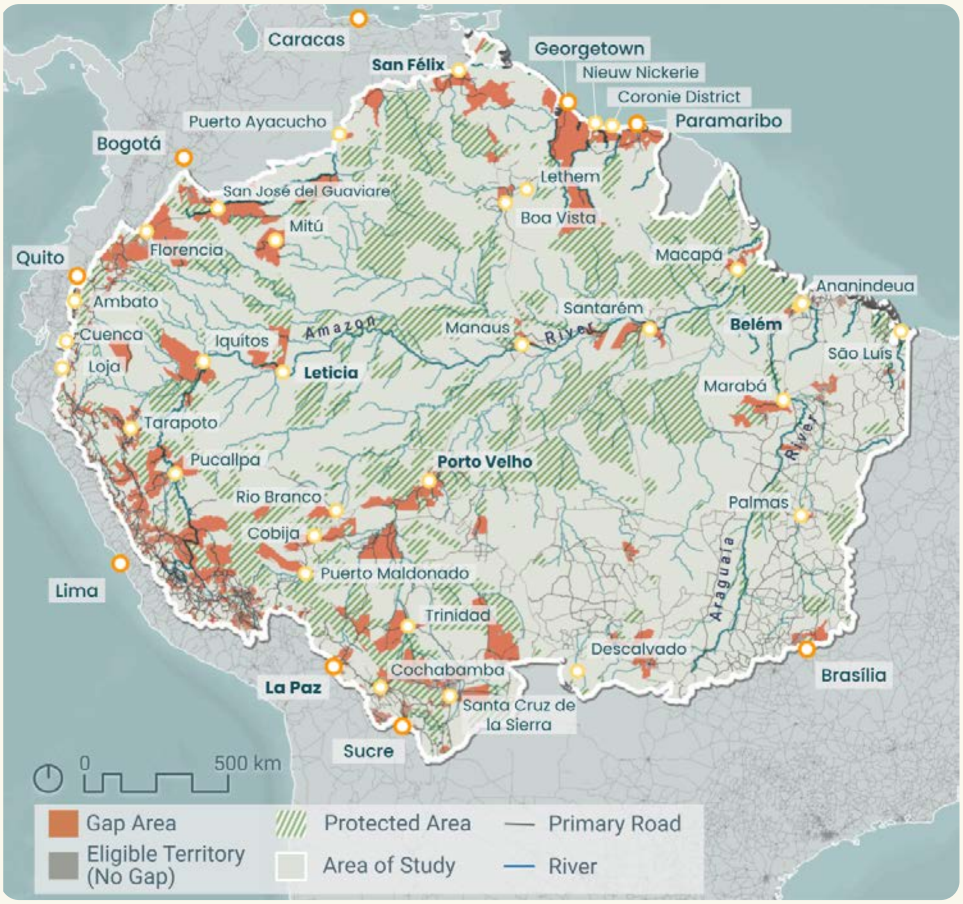
- Approximately **4.3 million** people (8.8 percent) live in areas that could benefit from addressing this gap.
- Nearly **1.2 million** (9.7 percent) of school-age children live in areas affected by the gap, reducing resilience to childhood mortality risks.
- Nearly **51.9 percent** of the Amazon Region is classified as rural areas that are more than 120 minutes away from a health center.

[31] This is twice the recommended time of the so-called Golden hour standard recommended by the WHO. More information is available at https://www.who.int/about/accountability/results/who-results-report-2022-mtr/rapid-reaction-aiming-for-the-golden-hour-of-health-emergency-response#:~:text=In%20emergency%20clinical%20care%2C%20health,good%20outcome%20for%20the%20patient.

[32] Access to health centers depends not only on the existence of health centers, but also on the presence of adequate transportation infrastructure to connect people with centers and the human capital capacity to staff medical facilities. For the purpose of this study, and given data limitations, only geographic access to medical centers is measured.

7. Limited geographic access to education in urban areas

Urban territories farther than 20 minutes by car from primary and secondary schools – Ding & Feng (2022)



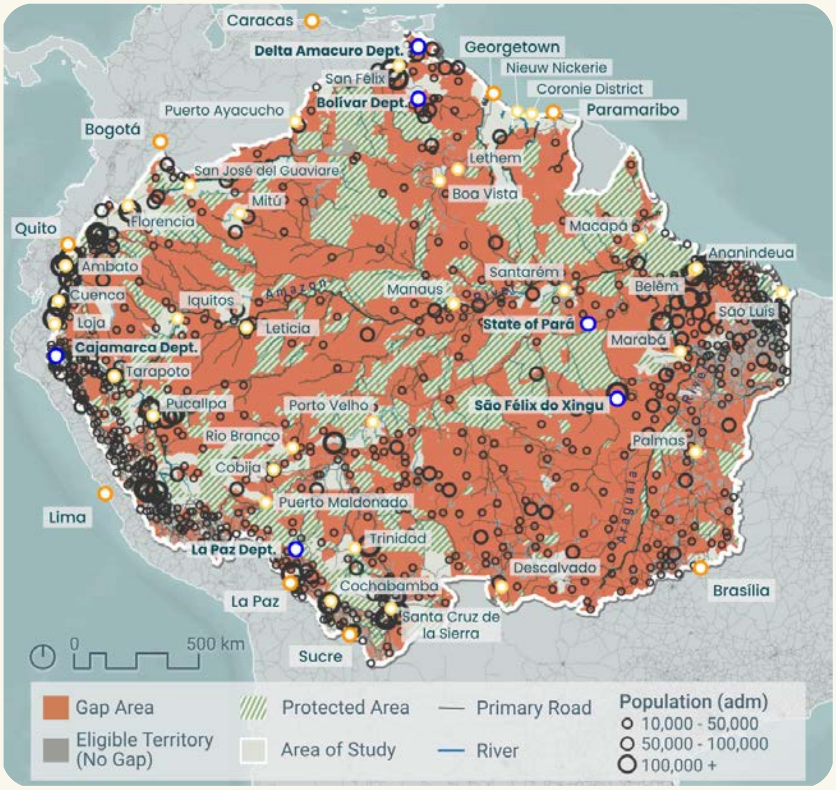
Gaps of access to education in urban areas of the Amazon Region are due to several factors, including lack of schools or limited transportation connectivity,[33] resulting in a lack of opportunities for children and youth. Key gap concentrations are located around La Paz, Bolivia; near Brazil's Porto Velho and Belém; and San Félix, Venezuela.

- Nearly **622,000** (4.9 percent) of school-age children live in areas affected by the gap.
- Approximately **8.4 percent** of the Amazon Region's area has educational gaps in urban territories.
- In the Amazon Region, the primary school-age population lives, on average, 5.9 km from the nearest primary school (Giambruno et al., 2024).

[33] For the purpose of this study, only geographic access to schools is considered, due to data limitations. However, access to school can also be hindered by other factors, such as availability of resources and quality of the education system, as well as availability and training of teachers. More information is available in Giambruno et al. (2024).

8. Limited geographic access to education in rural areas

Rural territories farther than 30 minutes by car from primary and secondary schools – Ding & Feng (2022)



Rural areas in the Amazon Region face substantial gaps in access to primary and secondary education.[34] Some communities representing high gap concentrations are found in La Paz department of Bolivia, Brazil's state of Pará in municipalities south of the Amazon River such as São Félix do Xingu, Peru's Cajamarca department along the Andean crest, and Venezuela's states of Delta Amacuro and Bolívar.

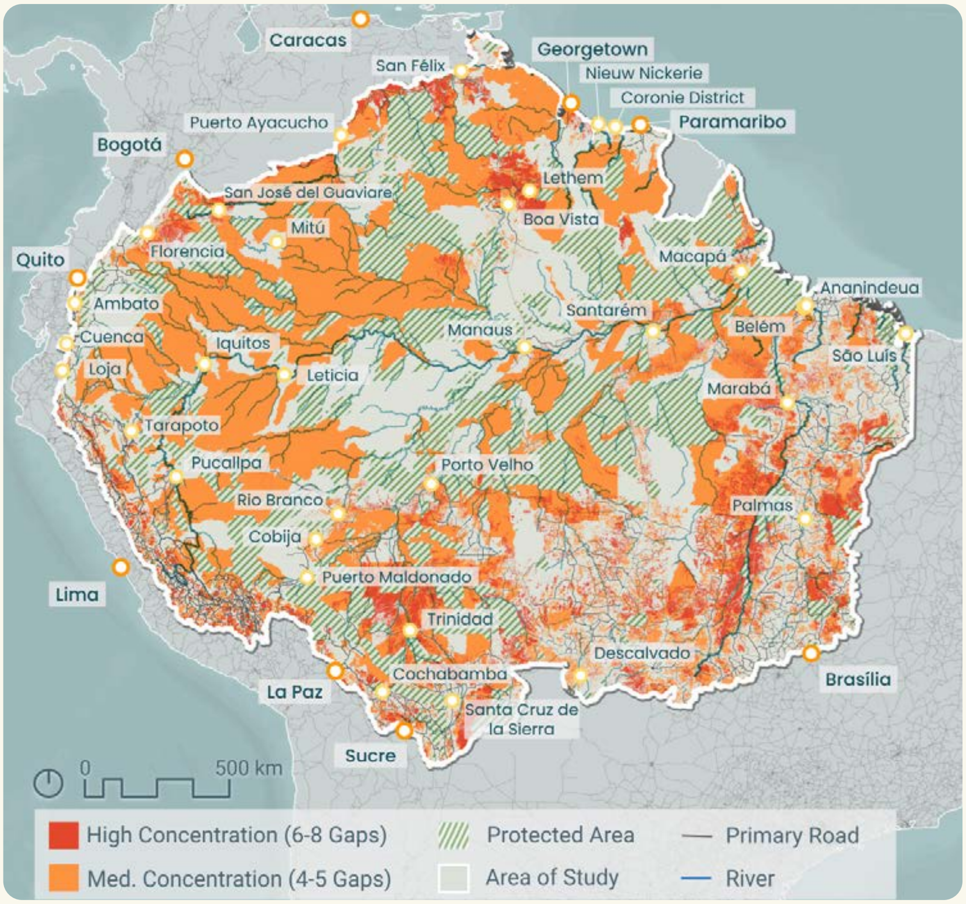
- Nearly **1.9 million** (14.7 percent) of school-age children live in areas characterized by this gap.
- About **60.7 percent** of the region's area has education gaps in rural territories, being further than 30 minutes by car from a school.
- Although digital learning options could help alleviate gaps in physical access, 80 percent of schools in the rural Amazon Region do not have digital devices available to students (Giambruno et al. 2024).

Starting to understand the extent of individual development gaps is a crucial step in guiding sector-specific actions. However, evaluating combinations of gaps provides insights into much more complex processes and relations between indicators, highlighting areas where multisectoral actions could relieve the challenges of compounding gaps. Below a multisector gap analysis for human development is presented. This considers access to drinking water, electricity, sanitation, health,

[34] Access to education is not only dependent on the existence of schools, but also on the presence of adequate transportation infrastructure to connect students with schools and the human capital capacity to staff educational facilities.

education, primary and secondary roads, and digital connectivity. This integrated approach provides a deeper understanding of how these sectors could interconnect and influence each other, offering an initial reflection on the importance of coordinated strategies that could significantly enhance overall human development outcomes.

Multisector Gap Analysis – Human Development[35]



The resulting multisector gap evaluation of human development conditions highlights 23 key areas of high gap concentration (areas with 6 or more concurrent human development gaps). These areas are especially present around the Andean crest, the western bank of the Araguaia River, Trinidad in the south, and around Boa Vista. Nearly 6 million people across 3.4 million km^2 live within areas facing a high concentration of gaps, leading to significant challenges to their well-being.

- Up to **23.9 million people** live in areas with at least one human development gap. Nearly 6 million people live in areas with 6 or more concurrent gaps.
- Up to **1.8 million school-age children** live in high-gap areas, impacting their well-being and development opportunities.
- Up to **3.9 million working-age people** live in high-gap areas, affecting their well-being and economic potential.

[35] The gap inputs are drinking water, electricity, sanitation, health, education, primary and secondary roads, and digital connectivity.

3.2 Economic Gaps

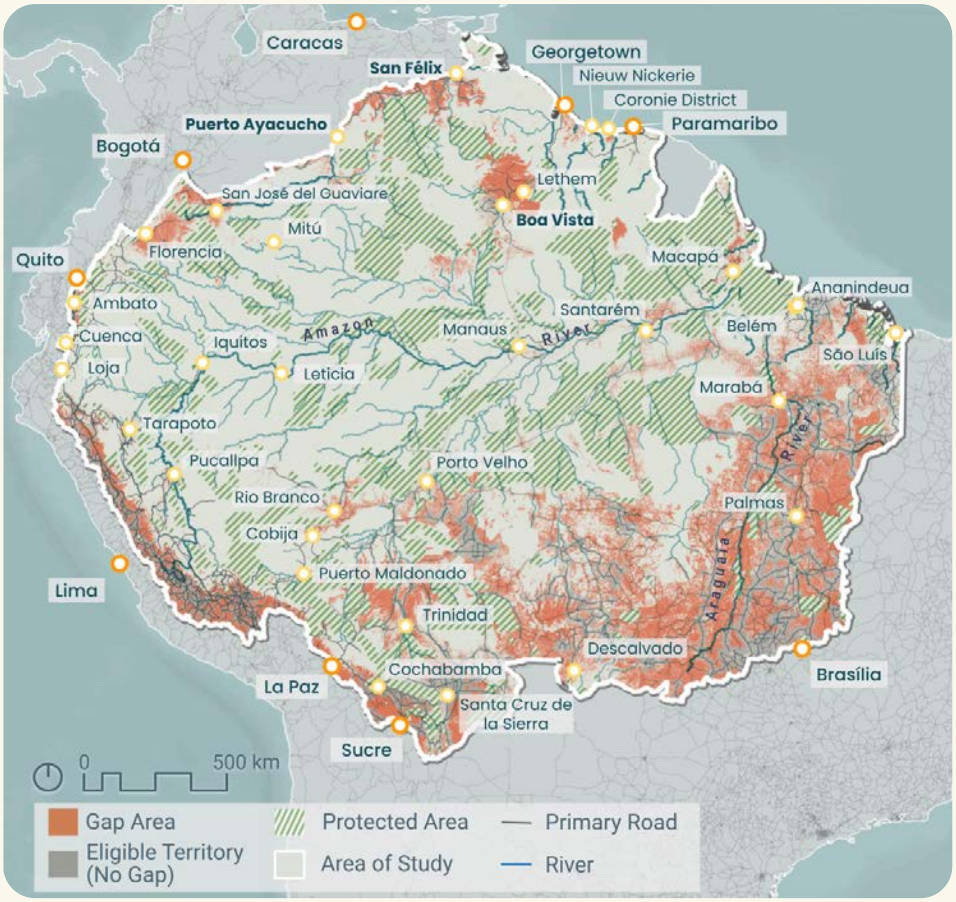
The Amazon Region is one of the most resource-rich regions in the world, but its economy is constrained by limitations in connectivity, investments, unsustainable practices, and extractivist activities. The gap analysis of economic enabling conditions reveals areas lagging in terms of sustainable economic development. With dense forests, vast agricultural land acreage, and immense carbon storage capacity, the region has the resources to support a strong and sustainable economy. The region's primary activities—agriculture, logging, and mining—must be aligned with sustainable practices to ensure long-term environmental health, social well-being, and economic resilience. Without this commitment to sustainability, these key economic sectors risk depleting natural resources and will likely continue to underperform rather than realize their full economic potential. Moreover, within the Amazon Region limited connective infrastructure restricts the mobility of people, resources, and goods between communities, markets, and economic opportunities, thereby reducing efficiency and economic activity.[36]

Due to the unique environmental characteristics of the Amazon Region described in previous sections, the region has potential to develop new types of economic activities following a green, inclusive, and sustainable model. Harnessing this potential will require alignment between the sustainable use and management of natural resources (ensuring that economic activities do not compromise the rich biodiversity and ecological balance of the region). It will also require supporting infrastructure, and promoting targeted investments in human capital, aligned with environmental and conservation goals. The gap analysis relating to economic conditions thus includes analyses of gaps in access to roads, digital connectivity, and electric substations, as well as gaps in agricultural efficiency, green business operations, investment in climate resilience, and investment in indigenous territories.

[36] The Amazon Region's transportation system relies heavily on the fluvial network as an alternative to roads. Connectivity analyses in this study, however, are limited to road infrastructure due to regional data constraints.

9. Limited access to primary roads[37]

Populated areas farther than 45 minutes by car from a primary road – Mathon et al. (2018)



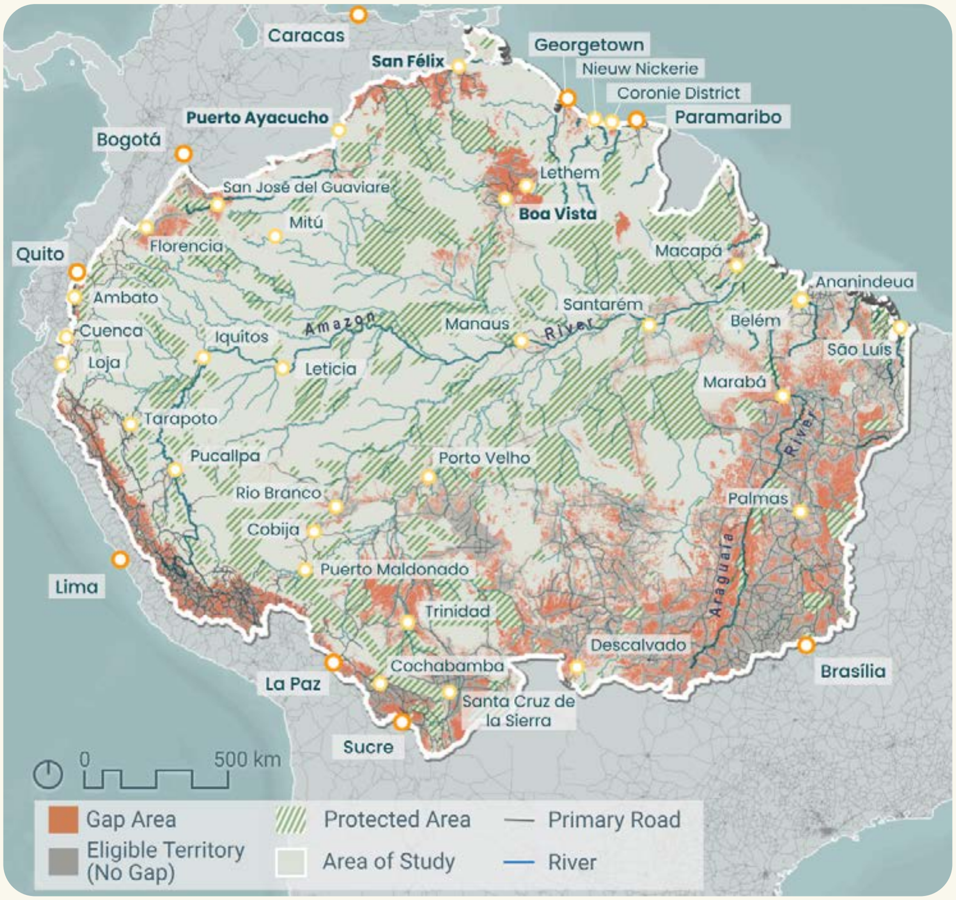
Deficiencies in the road network are responsible for the lack of connectivity of the most isolated territories to markets, financial resources, basic services, and labor markets, greatly affecting the region's productive capacity and opportunities. However, it is essential to consider that without adequate planning, expansion could pose a threat to the region's natural capital. Key locations of gaps are in the Southern Bolivian Amazon north of Sucre; north of Boa Vista in Brazil; Brazil's Eastern Amazon, especially east of the Araguaia River; Peru's Andean Crest; and Venezuela's Northern Amazonian boundary between Puerto Ayacucho and San Félix.[38]

- Around **7.1 million** people (14.7 percent of the region's population) live in areas that could benefit from remedying this gap.
- More than **4.7 million** people of working age live in areas affected by this gap.
- About **14.3 percent** of the Amazon Region's area is further than 45 minutes from major roads.

[37] This gap measures access to roads and does not consider quality. If quality were considered, the gap would likely be larger.
[38] The gap territory is primarily located around the outer edges of the Amazon Region due to the extent of the territory considered eligible for this analysis. The core of the Amazon Region is primarily dense forest land cover, which is not suitable for the expansion of road infrastructure. See Annex 6.5 for more information about eligible territories.

10. Limited access to secondary roads[39]

Populated areas farther than 45 minutes by car from a secondary road – Mathon et al. (2018)



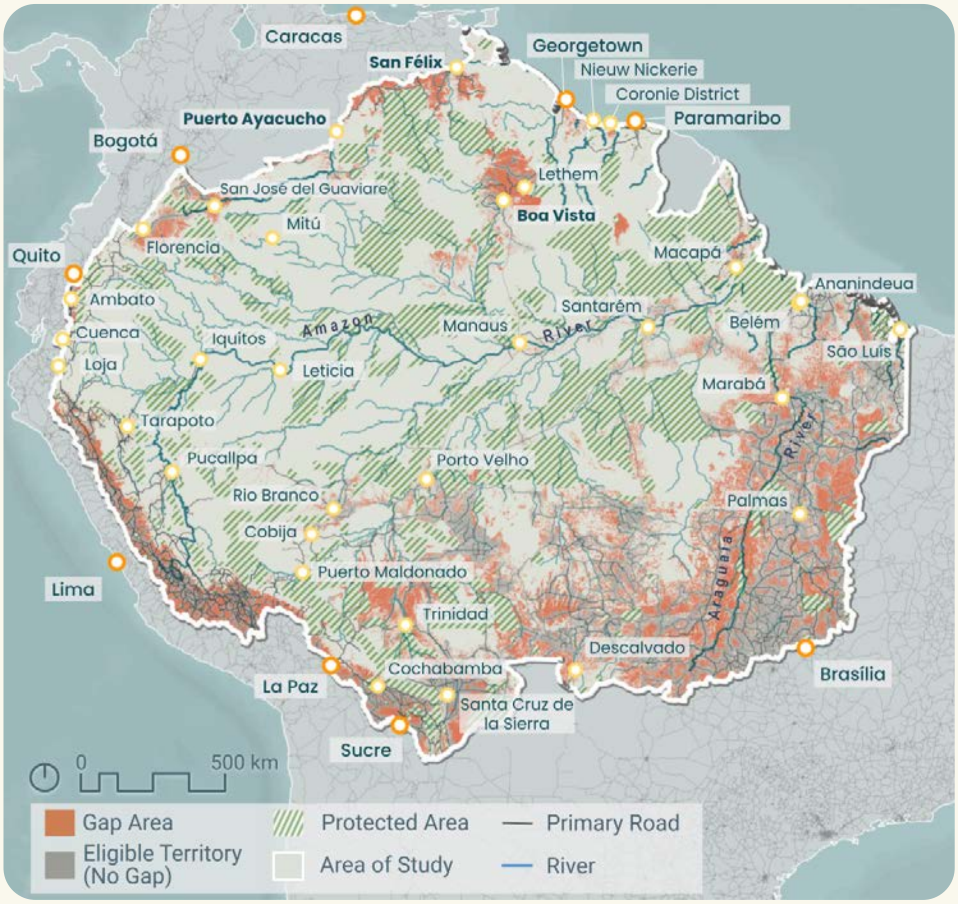
Secondary roads play a key role in shaping the connectivity of the region. The general patterns in this gap follow those of primary road access, though the gap area is smaller due to a more expansive secondary road network. Key locations of gaps are in the Southern Bolivian Amazon north of Sucre, north of Boa Vista in Brazil, the western bank of the Araguaia River in Brazil, the Eastern edge of the Brazilian Amazon, Peru's Andean Crest, and Venezuela's Northern Amazonian boundary between Puerto Ayacucho and San Félix.[40]

- Around **4.7 million** people (9.7 percent) live in areas that could benefit from remedying this gap.
- Nearly **1.4 million** people in the gap are of school age and 3 million are of working age.
- Approximately **10.4 percent** of the Amazon Region's area is further than 45 minutes from a secondary road.

[39] This gap measures access to roads and does not consider quality. If quality were considered, the gap would likely be larger.
[40] The gap territory is primarily located around the outer edges of the Amazon Region due to the extent of the territory considered eligible for this analysis. The core of the Amazon Region is primarily dense forest land cover, which is not suitable for the expansion of road infrastructure. See Annex 6.5 for more information about eligible territories.

11. Limited geographic access to digital connectivity

Populated areas that are more than 45 minutes by car from a cell tower or at least 2 km from a cell tower in urban areas or 5 km in rural areas – OpenCellID (2020); Simmons (2024)



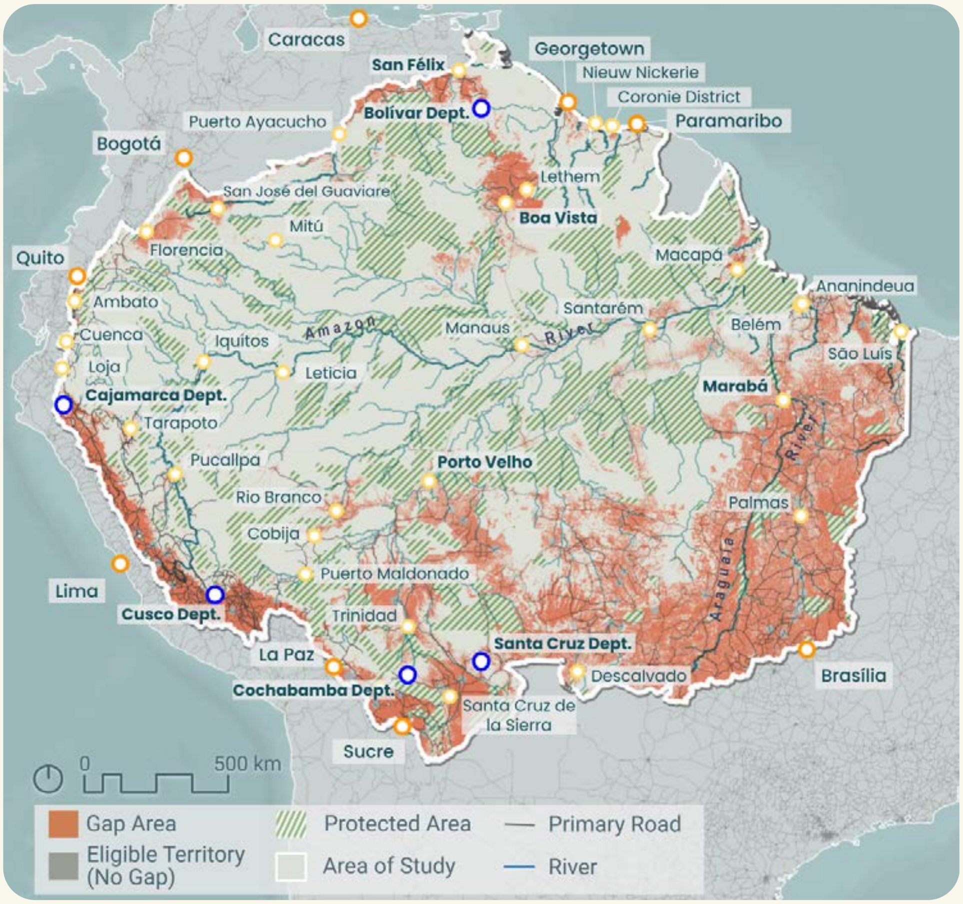
Digital connectivity is a vital tool for promoting the sustainable development of a region, especially in an area with such a high level of disaggregation as the Amazon Region. The expansion of other decentralized delivery methods of digital connection could improve the connectivity of populations in this gap.[41] Key locations of gaps in access to digital connectivity are north of La Paz, Bolivia; between Cochabamba and Sucre, Bolivia; north of Boa Vista in Brazil; Brazil's Eastern Amazon, especially east of the Araguaia River; Peru's Junin department and the Andean Crest; and Venezuela's Northern Amazonian boundary between Puerto Ayacucho and San Félix.[42]

- Around **2.5 million** people (about 5.3 percent of the Amazon Region's population) live in areas that could benefit from remedying this gap.
- More than **2.3 million** people of working age and school age live within this gap.
- About **12 percent** of the Amazon Region's area has limited digital connectivity, being over 45 minutes or further than a 2–5 km radius from a cell tower.

[41] Due to data limitations, information such as Starlink accessibility cannot be incorporated into the existing gap estimations. It should also be noted that there exist extremely localized nuances to digital access, including not only geographical isolation, but also socioeconomic and cultural factors.
[42] Due to data limitations, information such as Starlink accessibility cannot be incorporated into the existing gap estimations. It should also be noted that there exist extremely localized nuances to digital access, including not only geographical isolation, but also socioeconomic and cultural factors.

12. Limited geographic access to electric substations[43]

Populated areas at least 4.5 km from an electric substation in urban areas and 20 km away in rural areas – Kavuma et al. (2021); Csanyi (2017)



Access to electrical substations can be a key element in ensuring a reliable power supply for homes and businesses, improving infrastructure, building a more dynamic economy, and promoting sustainable development. Analyzing proximity to an electric substation also provides insights into how this dimension can affect energy distribution and reliability.[44] Gap concentrations are found in Bolivia's Cochabamba and Santa Cruz departments, Peru's Cajamarca and Cusco departments, and Venezuela's Bolívar state south of San Félix, as well as the areas around Porto Velho, Boa Vista, and Marabá in Brazil.

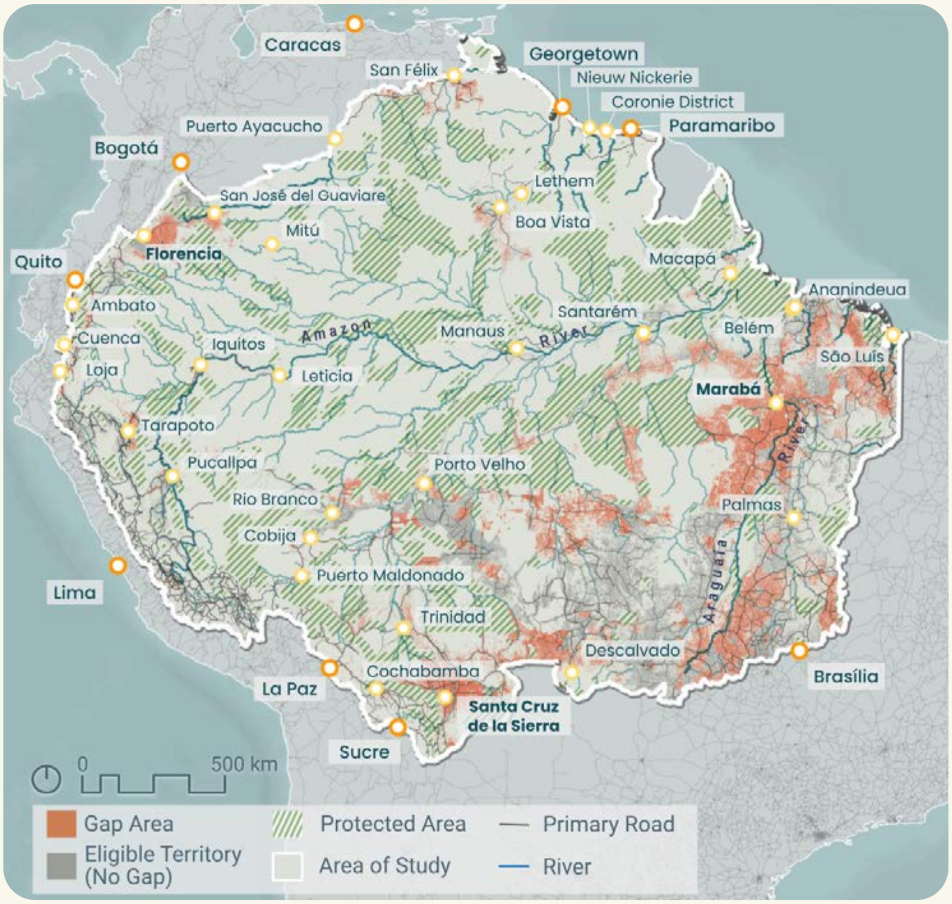
- Around **25.9 million** people (nearly 53.2 percent of the Amazon Region's population) could benefit from remedying this gap.
- More than **17.2 million** working-age people live in areas affected by this gap.
- Approximately **20.2 percent** of the Amazon Region's area has limited geographical access to electrical substations, being further than 4.5 km in urban territories or 20 km in rural territories from a substation.

[43] Due to data limitations, the quality of the network cannot be measured in this gap. Including this measure would likely make the gap larger.

[44] Substations can support reliable electricity supply by minimizing transmission losses. Long distances from substations result in voltage drops and inefficiencies, particularly in the Amazon, where the terrain and climate amplify the challenges.

13. Limited efficiency of agricultural lands

Agricultural lands with less than USD 29,240/km² (CAN region) or USD 14,779/km² (Brazil, Guyana, Suriname) of contribution to the agricultural GDP – Regional benchmark (lowest two quintiles)[45]



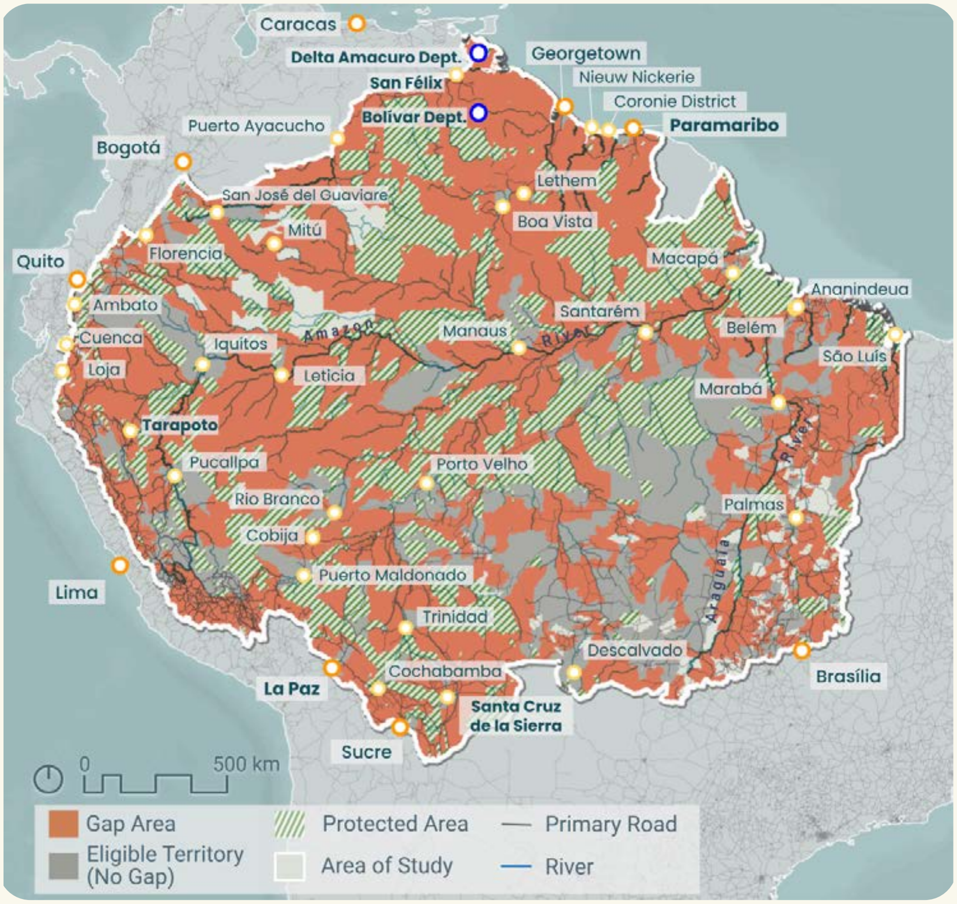
Enhancing agricultural efficiency presents an opportunity to improve food security and promote sustainable agriculture. Steps in this direction include addressing the needs of growing rural populations, optimizing migratory patterns, leveraging modern technology, and expanding farmers' access to information and best practices. Key gap concentrations are located around Florencia, Colombia; Santa Cruz de la Sierra, Bolivia; and along the Araguaia River near Marabá, Brazil.

- Around **7.1 percent** of the study area has low agricultural efficiency, meaning that the agricultural lands contribute less than USD 14,779/km² to the agricultural GDP.
- Approximately **3.3 million** people (6.9 percent) live in areas that could benefit from the remedying of this gap.
- **841 out of 2503** (33.5 percent) administrative areas are characterized by efficiency gaps, but some of these areas have more extensive agricultural territories than others.

[45] According to FAO (2017), land productivity is typically measured by physical yields such as kg per hectare or monetary units such as gross income or revenue generated by the land. Based on the data limitations of the region and aiming to maximize comparability across countries, agricultural GDP at the administrative level was used to represent monetary yields from the land. The measure can be represented as follows: Agricultural efficiency = Agricultural GDP (USD) at administrative level / Agricultural land area (km2) within the administrative unit.

14. Limited green and sustainable activities

Administrative units with fewer than 1 private firm engaged in green and sustainable economic activities and more than 1840 people of working age – Regional benchmark (lowest two quintiles)

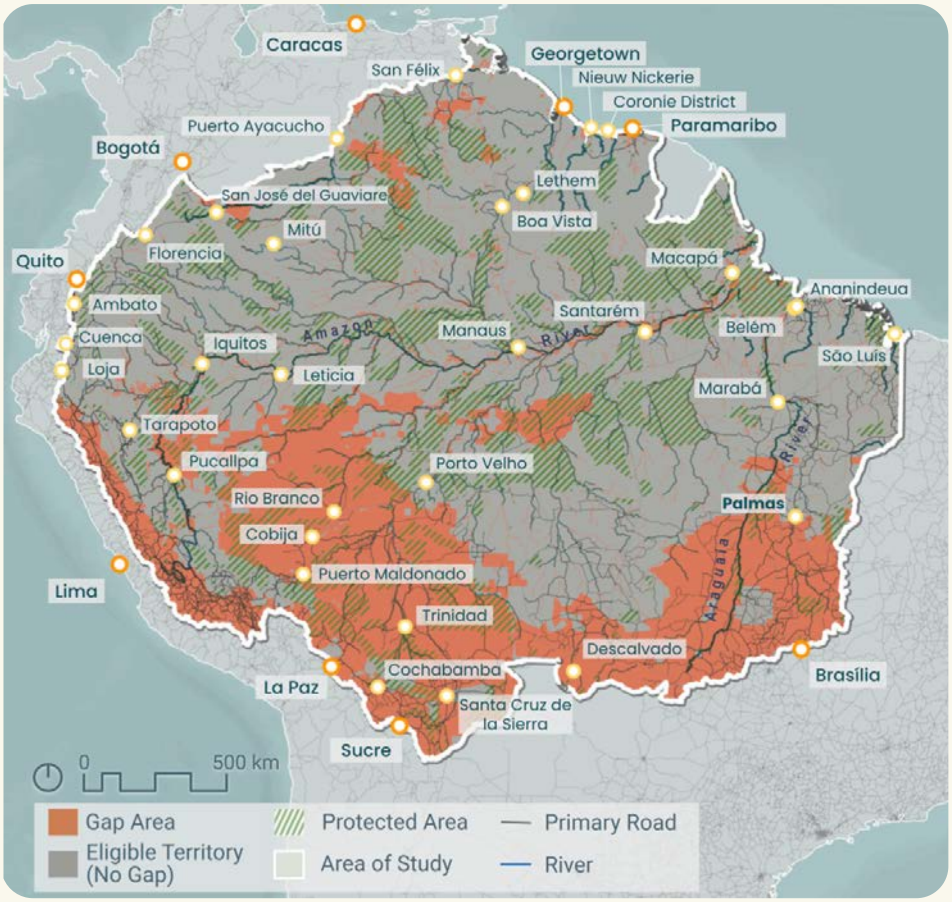


With regard to boosting the development of green and sustainable activities, public and private agents must work in alignment with the natural environment in order to enable conservation while providing economic benefits to the population. Key gap areas include La Paz and Santa Cruz de la Sierra, Bolivia; around Tarapoto, Peru, and the Andean crest; Paramaribo, Suriname; and near San Félix in Venezuela's Delta Amacuro and Bolívar states.

- More than **6.5 million** people (13.3 percent) live in areas that could benefit from the remedying of this gap.
- **916 out of 2503** administrative areas present a gap.
- Approximately **54.1 percent** of the Amazon Region are administrative areas with fewer than 1 firm engaged in green and sustainable economic activities but more than 1,840 people of working age; the presence of human capital presents an opportunity to develop these initiatives.

15. Limited aid investment in climate resilience and adaptation[46]

Areas with high climate change risk factors without public investments in resilience and adaptation – Regional benchmark (lowest two quintiles)



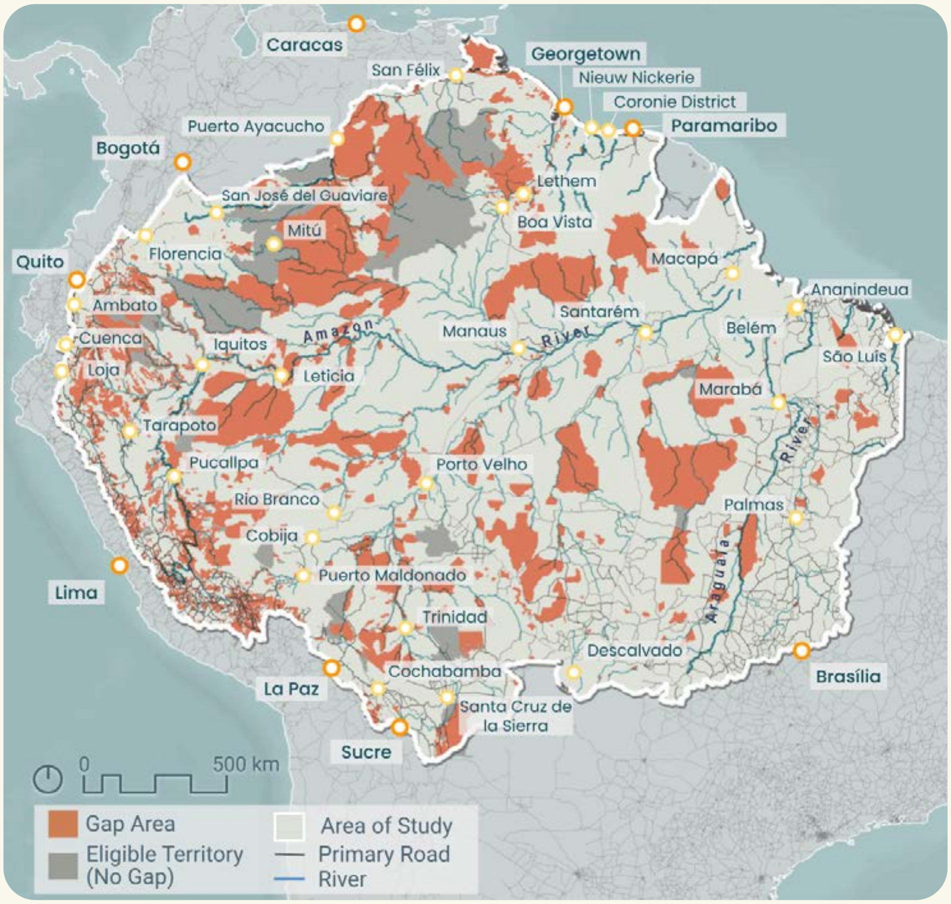
The Amazon Region currently faces numerous environmental threats that will be exacerbated by climate change. These include riverine flooding, extreme temperatures, variations in precipitation and wildfires. Donor organizations are important supporters of climate resilience and adaptation investments. Investments in sustainable agriculture and environment and disaster management should have a cross-sectoral impact to build the resilience of communities engaged in climate-sensitive activities such as agriculture, forestry, and livestock. Gap areas frequently occur along major rivers and are concentrated in the Southern Amazon Region, south of Palmas, Brazil; Peru's Andean Crest; the borderlands between southeastern Peru and Brazil; and notably much of the Bolivian Amazon.

- Nearly **42.4 percent** of the territory is not receiving aid in the form of investment in climate resilience.
- **20.6 million** people (33.5 percent of the region's population) live in areas that could benefit from remedying this gap.

[46] This is based on investment data from the International Aid Transparency Initiative (IATI; https://iatistandard.org/en/), which includes public and private investment. See Annex 6.9 for a full list of the sectors included.

16. Indigenous territories with limited investments in climate resilience or sustainable activities

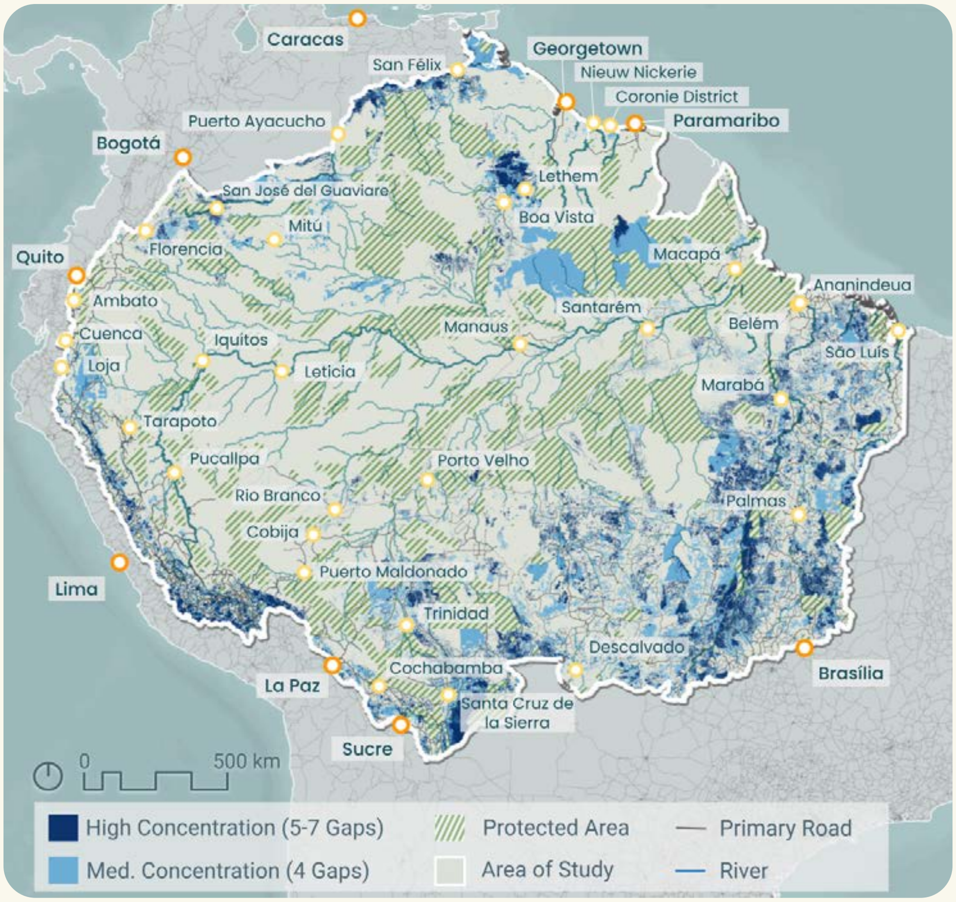
Indigenous territories without public investment in climate resilience or green and sustainable activities – Regional benchmark (lowest two quintiles)



Indigenous communities are important stewards of the land, playing a vital role in conservation of the environment through their harnessing of their ancestral knowledge and culture to help address many of the challenges discussed in this study. However, low investments related to climate resilience or green, inclusive, and sustainable economic activities limit the mitigation of the rising risks that these communities face. Some of the indigenous territories that are more vulnerable to this gap are the Warao and Muaina territories close to the coast of Venezuela, Trombetas/Mapuera close to the Mapuera River in the north of Brazil, and the Isoso territories in the south of Bolivia.

- About **3 million** people (6.2 percent of the region's population) live in areas that could benefit from remedying this gap.
- **1.9 million** km^2 of the indigenous territories are not seeing investments in climate resilience or sustainable activities.

Multisectoral Gap Analysis – Economic Well-being[47]



The economic well-being multisectoral gap identifies 16 key areas of high gap concentration that are marked by 5 or more of the 7 input gaps. The multisectoral gap evaluation of economic well-being overlays areas with limited access to secondary roads, limited digital connectivity, limited agricultural efficiency, limited green and sustainable activities, and limited investments in indigenous territories, as well as areas lacking a high degree of provision of sustainable ecosystem services or biodiversity to reflect the resources involved in green and sustainable economies (for more details, see Annex 6.7). These areas are concentrated north of Boa Vista, along the Andean crest, south of Santa Cruz de la Sierra, and in the eastern portion of the study area. Over 661,000 people live in areas facing 5 or more lagging factors and nearly 1.6 million people are estimated to live in areas that face 4 lagging factors.

- Around **40.2 million people** are estimated to live in areas that have at least one economic well-being gap. Nearly **661,000 people** face 5 or more concurrent gaps.
- Nearly **428,000 working-age people** live in high-gap areas, affecting their well-being and economic potential.
- Close to **327,000 women** live in high-gap areas, highlighting an opportunity to target women in the effort to improve the standard of living in the region.

[47] The gap inputs are digital connectivity, secondary roads, indigenous investment, agricultural efficiency, green and sustainable activities, nonbiodiverse areas, and areas outside of green and sustainable development potential (see Section 4.3).

3.3 Environmental Gaps

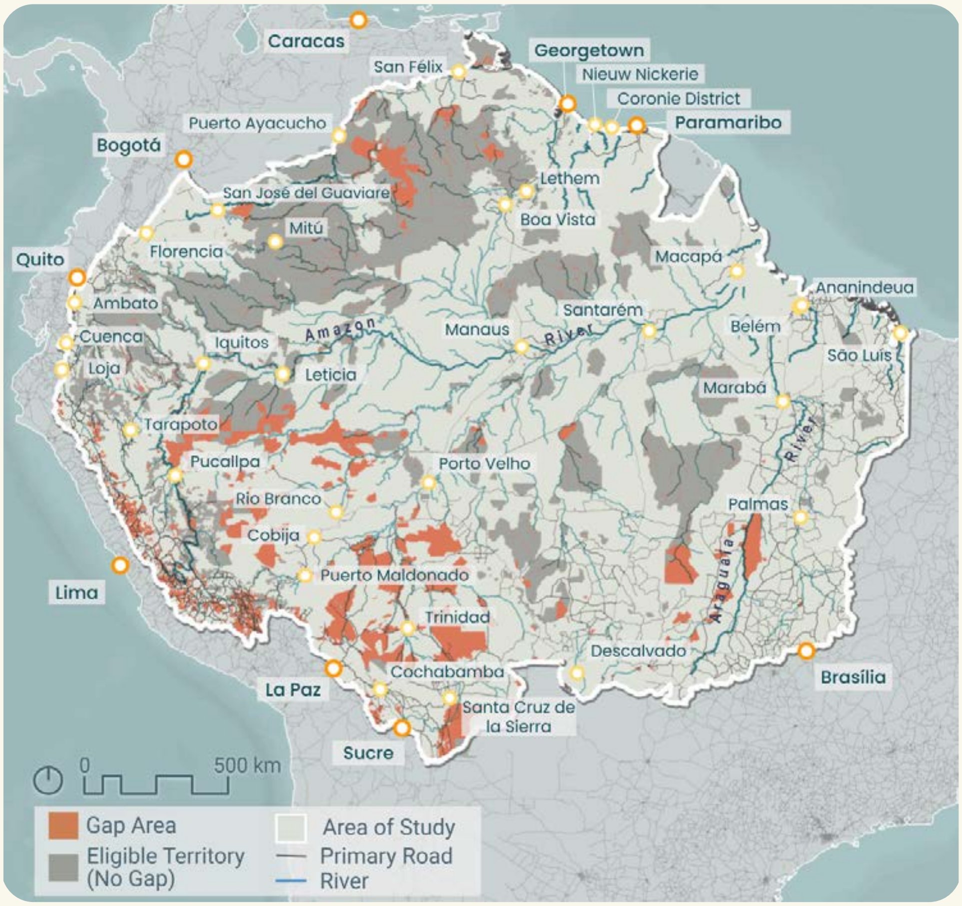
The Amazon Region is a diverse and complex environmental system. The region has complex and diverse ecosystems, ranging from high crests and glaciers in the east to a broad expanse of rain forest and a network of rivers in the center and west. The dense forest and vast river network support the global oxygen and moisture cycles, sequester vast amounts of carbon dioxide from the atmosphere, sustain rich biodiversity, and regulate global weather patterns. However, environmental degradation via deforestation, mining, and other exploitative practices is eroding the natural capital of the Amazon Region, thereby threatening the well-being of its communities, its future resources, and global environmental stability.

The Amazon Region offers distinct opportunities for targeted interventions to tackle climate change due to its unparalleled ecological significance. This region serves as a critical carbon sink and houses an immense diversity of species, making it a pivotal area in the global fight against climate change. However, the areas within the Amazon Region that are most susceptible to climate change are often those already experiencing significant ecological disturbance (for example, in the form of decreased forest cover and biodiversity due to forest fires, illegal activities, building without appropriate safeguards etc) and thus diminished resilience in the face of changing climatic conditions.

The evaluation of environmental conditions reveals areas of opportunity for strategic conservation and resilience measures. Conservation of the Amazon Region's resources does not require an all-or-nothing approach; 24.5 percent of the Amazon Region is already protected by a spectrum of management designations, from strict preservation to sustainable use. Additionally, 28.7 percent of the region consists of indigenous territories, which can also provide additional protection (Baragwagnath & Bayi, 2020). A better understanding of the spatial distribution of areas that face a higher risk and areas that are already protected will help focus preservation efforts on those areas that need it most. This dimension thus includes analyses of gaps in indigenous territories exposed to climate hazards, potential areas for conservation of biodiversity, potential areas for sustainable management of water supply, and potential areas for conservation of ecosystem services.

17. Indigenous territories exposed to climate hazards

Indigenous territories with high climate change risk factors – Regional benchmark (lowest two quintiles)



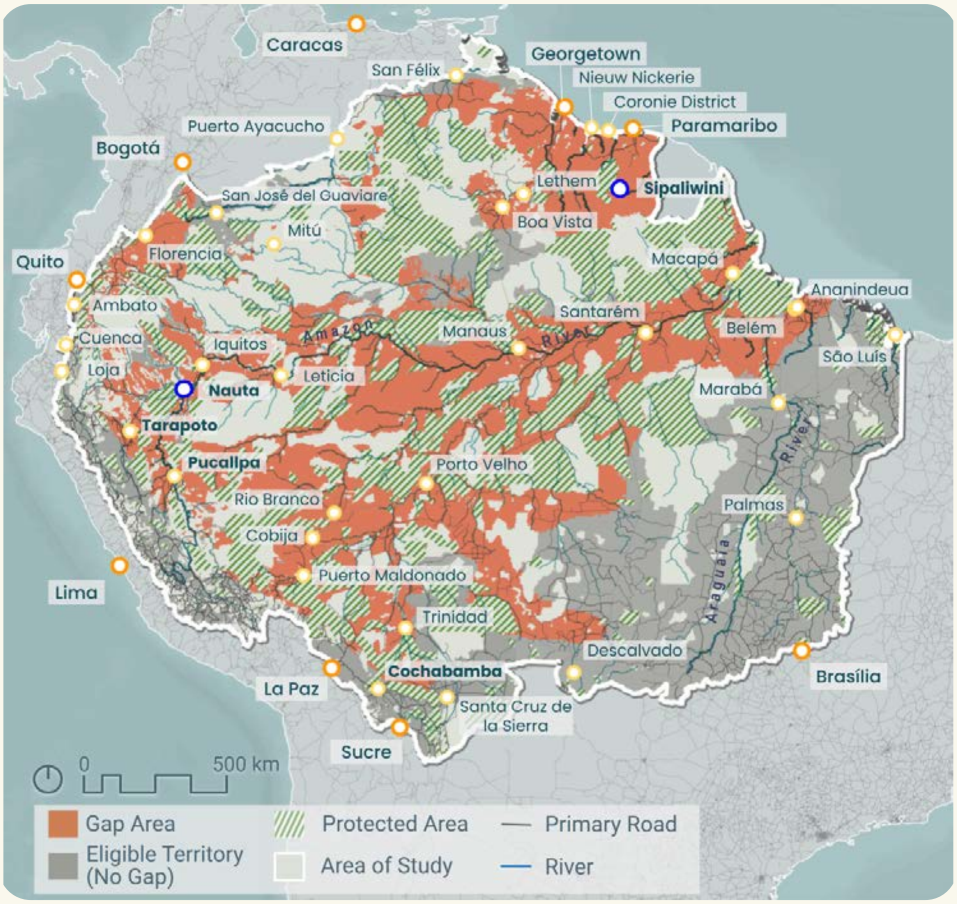
Deforestation rates in the Amazon Region are two to three times lower in indigenous territories than in nonindigenous territories (Baragwagnath & Bayi, 2020; Webb et al., 2020). Therefore, protected areas and recognition of indigenous territories are two important mechanisms for protecting the Amazon Region and reducing deforestation. Some of the indigenous territories more vulnerable to climate hazards are the Ye'kwana-Sanema de Medio Alto Ventuari in Venezuela, the Araguaia territories around the Brazilian national park with the same name, the Deni and Kanamado territories in the west of Brazil, along the river north of the Núcleo del Parque Yasuní and T. Tagaeri - Taromenane in Ecuador, the territories surrounding Cerro de Pasco in Peru, and the Guarayo territories in Bolivia, among many others.[48]

- **27.7 percent** of indigenous territories have a high exposure to climate hazards, including riverine flooding, extreme temperatures, increased variability in precipitation, and increased wildfires.
- Approximately **4.8 percent** of the region's population could benefit from remedying this gap.

[48] All gap locations are approximations based on a regional-level desktop review and analysis. All gaps are subject to validation via fieldwork, especially hyperlocal conditions such as climate hazards.

18. Potential areas for protection of biodiversity

Areas with species richness above the 95th percentile globally that are unprotected or disturbed by land use change – BiodiversityMapping (2021a, 2021b, 2021c); Flores et al. (2024)[49]



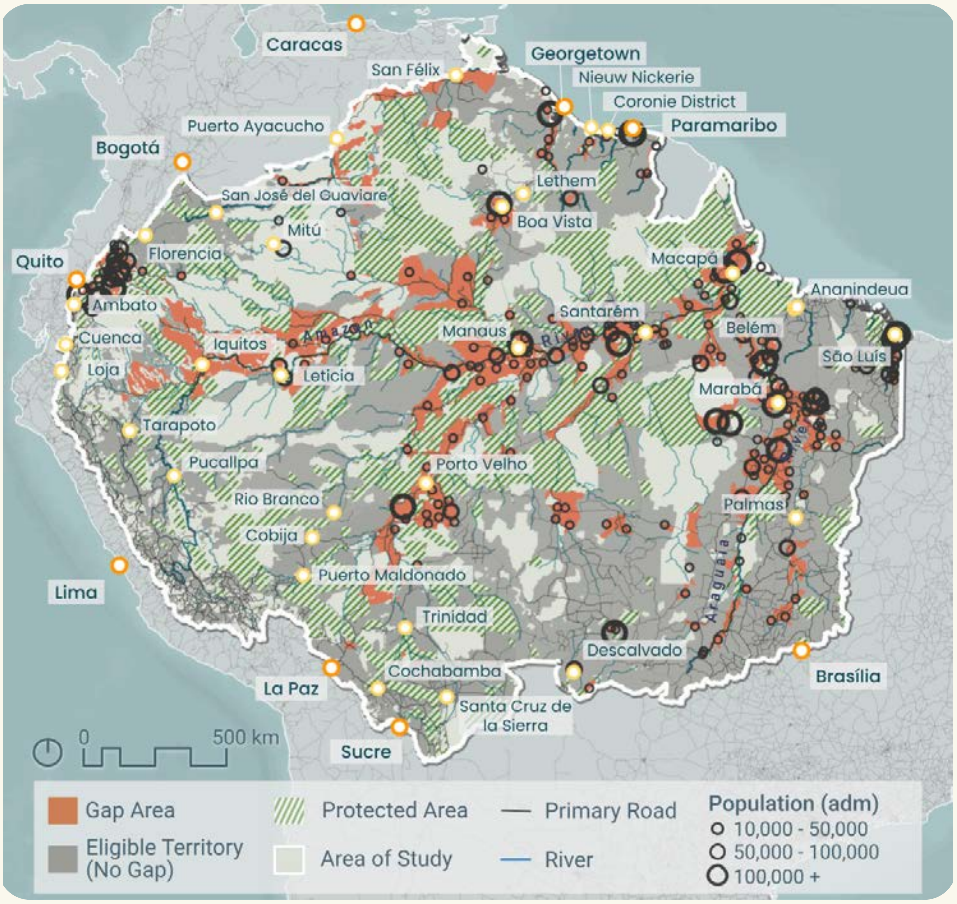
Although the region already has 24.5 percent of its area protected by a spectrum of instruments, there are still areas with high biodiversity that could be considered for the expansion of protection efforts. Some of the more biodiverse territories that are currently unprotected or facing some kind of disturbance are located around Sipaliwini in Suriname and along the Amazon River from Nauta in Peru and crossing Brazil into the Mid-Atlantic Ridge. Other affected areas are located close to Beni and north of Cochabamba in Bolivia and to Pucallpa and Tarapoto in Peru.

- An estimated **63.8 percent** of the region is characterized as being home to globally important biodiversity (see Annex 6.6 for details).
- Around **27.1 percent** of the study area has low protection of areas with high biodiversity.
- Approximately **17.1 million** people live in areas facing this gap.

[49] The 95th percentile was identified for the entire territory with respect to total global biodiversity, excluding protected areas, indigenous territories, and administrative areas with greater than 10 percent deforestation.

19. Potential areas for sustainable management of water supply

High environmental water supply areas that are unprotected or highly disturbed by land use change – Regional benchmark; Flores et al. (2024)

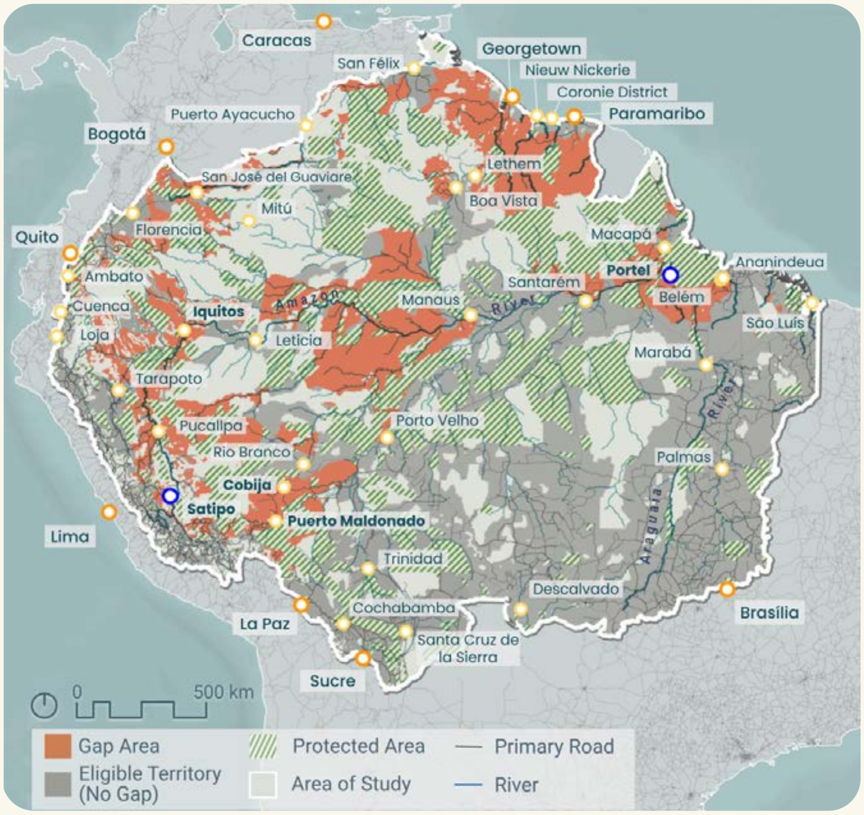


Water supply and quality is especially important to the Amazon Region, supporting ecological processes, serving as transport corridors for fluvial connectivity, enabling agricultural production, and remaining clean so as to provide drinking water. The main watersheds of the Amazon, Araguaia, and Negro Rivers are most important for these considerations. Yet headwaters such as the Putumayo and Napo Rivers in the Sucumbios province of Ecuador and the Guaviare River in Colombia are also crucial, because any degradation upstream affects downstream areas as well.

- **24.7 percent** of the region is characterized by a high water supply, and over **988,000** km^2 are vulnerable to degradation.
- Around **10.1 million** people live in areas with potential for sustainable management of water supply, but an even greater number are affected due to downstream flow of disturbance effects.

20. Potential areas for protection of ecosystem services

Globally critical ecosystem service provision areas that are unprotected or highly disturbed by land use change – Chaplin-Kramer et al. (2022); Flores et al. (2024)



Ecosystem services, including carbon sequestration and moisture recycling, provide vital environmental functions with secondary benefits to the global population. Ecosystem services are typically highest where the environment has been least disturbed. Such areas present a valuable opportunity to maintain support systems. Specifically, the key areas of ecosystem services are located in the west and north of the Amazon Region: some of them can be found in Melgaço, Bagre, and Portel, and the area between the Coari, Yurua, and Amazon Rivers in Brazil; around the Anzu River and in the Morona-Santiago province in Ecuador, in Iquitos and Satipo in Peru; and in the northern part of Bolivia from Puerto Maldonado to Cobija.

- **36.0 percent** of the region's acreage provides high ecosystem services, and over **1.3 million** km^2 are vulnerable to degradation.
- Around **5.4 million** people live in the gap area, but the loss of regional and global service provision affects populations on a global scale.

The layering of gaps in the environmental dimension reveals areas of opportunity for improved resource management and conservation, as well as areas vulnerable to further degradation. Given the complex balance between environmental, social, and economic needs, these maps could help identify where environmental policies and actionable interventions may have the greatest impact. This prioritization is crucial across such a vast territory, especially where the gaps in the conservation of different natural resources may be spread across different parts of the study area. The conservation multisectoral gap overlays potential areas for biodiversity protection, water supply management, and ecosystem services protection, while also highlighting regions with limited investment in climate resilience and adaptation from the economic dimension. Additionally, it identifies forests within 5.5 km of roads or agricultural territories and administrative areas that have lost more than 10 percent of their forest cover in the last 20 years.[50] These factors indicate increased vulnerability to deforestation, because impacts tend to occur first near areas that have already been disturbed.

Multisectoral Gap Analysis – Environmental Conservation[51]

The environmental conservation multisector gap analysis identifies nine key areas of high gap concentration, facing five or six conditions, where environmental resources are high and imminently vulnerable. These areas are concentrated south of Boa Vista in Brazil, along the main stem of the Amazon River and near the mouth of the Araguia River, and in the vicinity of Cobija, Bolivia, and Rio Branco, Brazil.

Conserving environmentally rich areas is important for regional and global cycles, as well as protecting community health and long-term economic resource provision.

- **6.6 million** km^2 of the region's area has at least one conservation gap. Nearly **243,000** km2 face high concentration of gaps (five or six concurrent gaps).
- **Over 39 million** people live in conservation gap areas, highlighting the integration of communities in environmentally rich areas and the need for innovative, multiuse management solutions.
- **Over 760,000** people live in the most vulnerable areas (five to six gaps) and that population is only expected to grow.

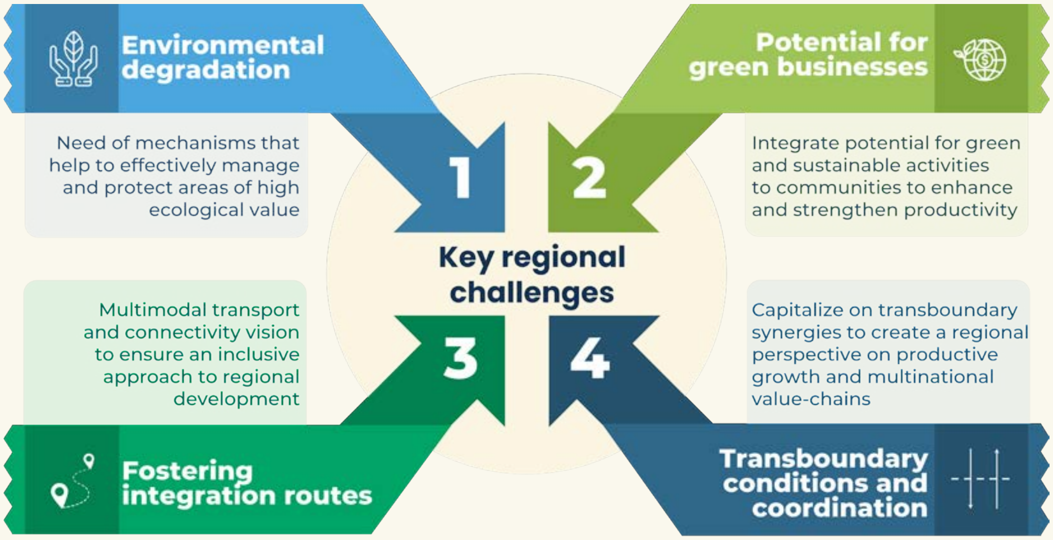
[50] Research shows that 10 percent is the "safe" threshold; below this point ecological systems begin to collapse (Flores et al., 2024).
[51] Gap Inputs: Biodiversity, water supply, ecosystem services, investments in climate resilience, deforested municipalities, forest within 5.5 km of roads and/or agriculture.

04 The Application of the Gap Analysis to Key Policy Questions

A territorial-based approach allows for a deeper understanding of the Amazon Region's diverse landscapes, cultures, and socioeconomic conditions, facilitating more-effective and context-specific policy interventions. By focusing on the unique characteristics and needs of different areas within the region, policy makers can better understand issues such as increasing deforestation, limited private-sector development consistent with green and sustainable principles, inadequate infrastructure and insufficient cross-country cooperation for diagnostics and policy actions, and the provision of inputs for evidence-based policy actions. Program design will benefit from this analysis, which must be complemented with work on the ground and further dialogue with stakeholders in the region, in order to develop the appropriate policy actions.

This final section of the study applies the data-driven framework developed in previous sections to the analysis of four thematically relevant policy questions, providing insights into related issues and identifying potential geographical areas and populations that could benefit from targeted interventions. The first challenge focuses on environmental degradation, with deforestation and ecological disturbances being analyzed. The second addresses the potential that the Amazon Region presents for the development of green businesses.[52] The third question focuses on the isolation that affects parts of the region and the role of connectivity paths such as routes of integration that can reduce this isolation. The fourth and final question highlights the importance of a regional-scale dialogue for supranational and transboundary issues.

Figure 4. Four transversal key regional challenges that hinder the sustainable development of the Amazon Region



Source: Developed by the authors.

[52] Green businesses are institutions and private-sector businesses engaged in green and sustainable activities, categorized as sustainable agriculture, aquaculture, and livestock as well as ecotourism and research and technology of sustainable activities.

4.1 Environmental degradation

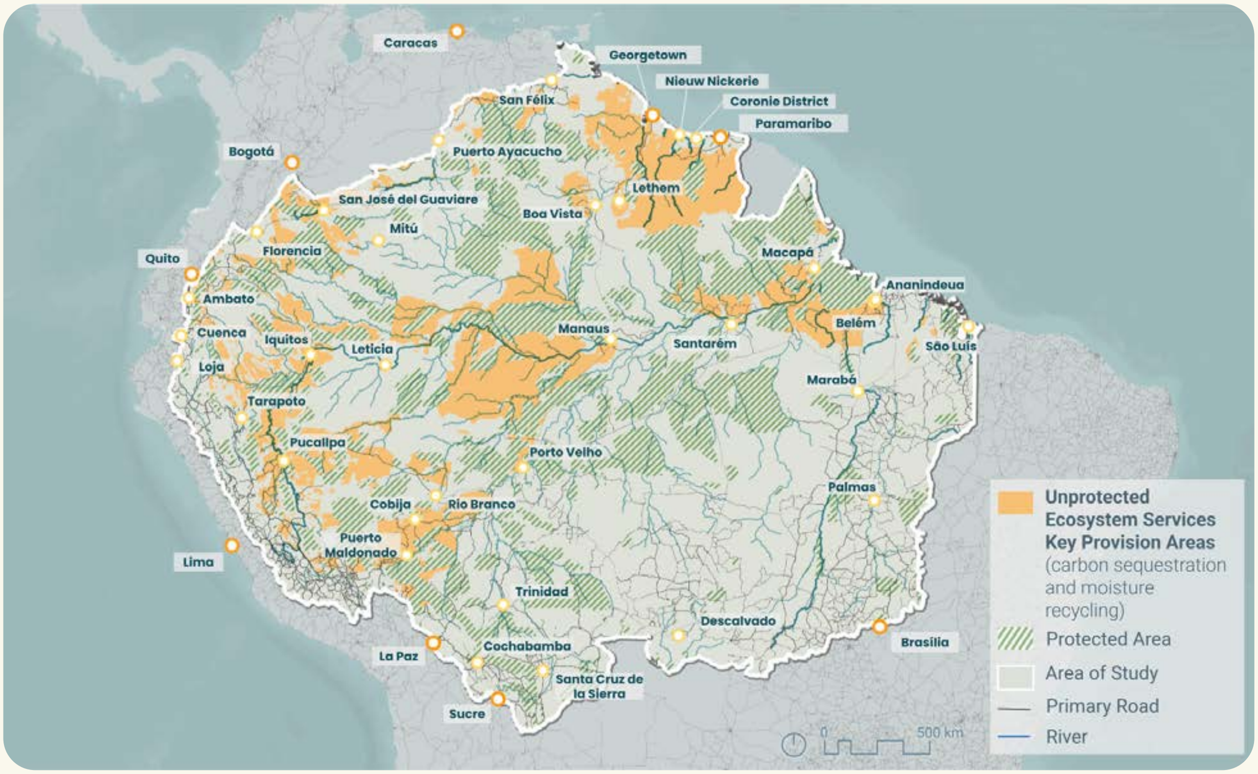
Environmental degradation is a key policy challenge in the region, in relation to which protection measures play an important role. Communities within the Amazon Region have benefited from a high provision of ecosystem services that make invaluable contributions to human well-being. Increased risk due to climate change, wildfires and other climate events and the excessive degradation of resources in order to realize short-term benefits, creates long-term challenges and a poorer physical environment for human development. Protection policies are in place across the whole region and make use of different instruments and policies to reduce the pace of environmental disturbance, deforestation, and degradation of the natural capital. Indigenous territories, present both in the deep forest and along the edge of the region, also play a vital role in environmental protection. However, it is difficult to assess at a regional scale whether areas that have the greatest need for protection are indeed covered by these measures and whether protection measures are effective against deforestation and disturbance. **Figures 5A** and **5B** provide some initial insights on these policy challenges that could inform policy dialogue and regional diagnostics.

There are significant environmentally rich areas of the Amazon that are currently not protected. **Figure 5A** presents areas with high ecosystem services that are unprotected (understood as areas with high levels of carbon sequestration and moisture recycling). The results shows that 36 percent of the Amazon Region contains a critical level of globally supportive ecosystem services. However, 43.8 percent of that portion of the region lacks a management or protection plans. Areas in the center, north, and eastern parts of the Amazon Region are particularly vulnerable to this challenge.

Protected areas still face the risks of disturbance and deforestation. Despite the implementation of vast protected areas across the region, **Figure 5B** suggests that there are still many protected territories facing ecological disturbance, particularly along the so-called Arc of Deforestation.[53] Protected areas in the north around Boa Vista as well as between Macapá in the north, Cochabamba in the south, and west to Pucallpa have been disturbed at rates similar to those of unprotected areas in the same region. Moreover, despite containing globally valuable resources, areas around Santarem, San Jose de Guaviare, Cobija, Pulcallpa, and to the west of Boa Vista are marked by deforestation that exceeds the critical 10 percent threshold. Degradation of these critical areas could lead to a maximum loss of over 7.7 billion tons of sequestered carbon into the atmosphere, or about one-eighth of the carbon in the Amazon Region (Maisonnave, 2024). This presents opportunities to reinforce the existing environmental management system, make currently successful protected areas more resilient to future threats, and improve enforcement in areas where legislation is not effectively implemented.

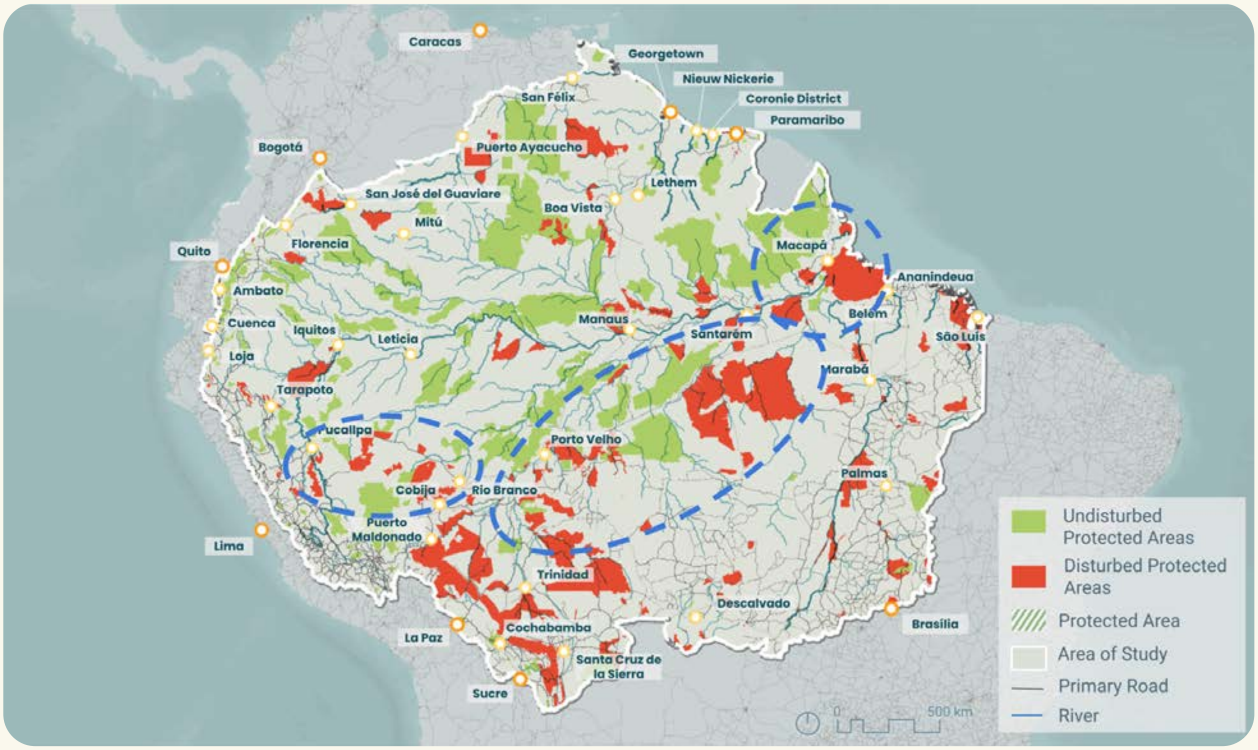
[53] Arc of Deforestation refers to the westward encroachment of deforestation in the eastern half of the Amazon Region, from Macapa in the north to Porto Velho and Cobija.

Figure 5A. Key ecosystem service provision areas that could benefit from expanded protected areas



Source: Developed by the authors.

Figure 5B. Protected areas with disturbance (red) or lack of disturbance (green)



Source: Developed by the authors

4.2 Potential for green businesses

Green businesses are operating and thriving in the Amazon Region. These types of businesses are particularly present around the edges of the Amazon Region, along the Andean crest, and in eastern Brazil. They are generally near larger settlements and cities and engage in activities such as sustainable agriculture, ecotourism, and aquaculture. Importantly, these businesses depend on the natural resources within the region for their operations; thus, proximity or connectivity to sustainable resources as well as a healthy regional private-sector environment are critical to their success. However, the fragility of ecosystems must also be considered. Having a territorial approach that can identify patterns of existing areas with production potential, ecosystem fragility, and private-sector presence can provide initial insights on strategies to support green growth and production. Such an approach could lead to targeted strategies that, complemented with qualitative data, could support private-sector development that emphasizes a resilient green, inclusive, and sustainable economy that is respectful and inclusive of the region's environmental and cultural diversity.

The analysis conducted identifies areas within the Amazon Region with the potential to develop green and sustainable production. As seen in Figure 6, there are various areas with a high potential for green and sustainable production.[54] Although these can be found throughout the region, they are particularly concentrated along the Andean crest, the area east of Puerto Ayacucho in the northern Amazon Region, Manaus, the eastern and southern Brazilian Amazon, and along the Beni rivershed between La Paz and Porto Velho. However, the fragility of ecosystems also must be considered when analyzing green and sustainable production potential. Areas along the Negro River, Essequibo River, and other ecosystem areas located in the transboundary headwaters of the Amazon River and near its mouth in Brazil are fragile in nature and although they have potential for green and sustainable activities, these areas might be better off being protected and not considered in private-sector promotion strategies.

Figure 6 also presents regional patterns of the existence of green businesses. As well as showing areas with potential for green production, Figure 6 displays patterns of the locations of green businesses. For example, there is both a presence of firms and potential for green activities in areas between São Luís in the northeast and Marabá in northern Brazil, the Peruvian Andes, and around Descalvado in southern Brazil. Here, further investment in firm growth and market-enabling conditions could be fostered. In areas with a concentration of firms but limited potential for green activities (such as those in the eastern Amazon Region in Colombia and Ecuador and in the southeastern territories of Brazil), green businesses could benefit from enhanced connectivity and value chains that are better integrated. Finally, there are large rural regions with high green and sustainable development potential but few firms, for which the opportunities for greater private-sector promotion could be assessed. These are located along the Suriname and Maroni Rivers in Suriname and the Negro River north of Manaus, as well as in northern Bolivia east of Cobija. Understanding why these high-potential areas lack green businesses could help identify infrastructure, human capital, security, or policy constraints that hinder their development.

[54] Regions with a high provision and usage of natural assets or environmental conditions to support sustainable use (references water quality regulation, pollination-dependent crops, fodder, silviculture & fuelwood production, flood regulation, riverine harvest, and access).

Figure 6. Areas with potential for green business in the Amazon Region

Source: Developed by the authors.

4.3 Fostering regional routes of integration

Promoting greater regional integration is pivotal to unlocking the region's opportunities. With millions of people in the Amazon Region facing limited access to economic opportunities, basic services, and markets, addressing connectivity and value chains is crucial for fostering equitable and sustainable development.[55] Isolation is not homogeneous in nature across the territory; there are a variety of causes and thus there could be an array of solutions. Foremost among these, however, is the creation of adequate infrastructure, so that areas with production potential can be linked to areas with consumption and export market potential. At the same time, infrastructure provision must be properly targeted in this region, ensuring integration is not carried out at the expense of natural capital and the environment.

The map below identifies areas of productive potential alongside infrastructure gaps, underscoring areas that would benefit from integrated and multimodal connectivity solutions. **Figure 7** depicts the areas of productive potential, infrastructure gaps, and the regional routes of integration (IDB, 2024), highlighting parts of the territory that could benefit from multimodal transport corridors to foster the growth of regional value chains. Based on this analysis, territories located around San Felix and Boa Vista in the north, around Manaus, to the west around Puerto Maldonado and Rio Branco, and in the south around Cochabamba show potential for targeting policy considerations toward value chain promotion. The southern route in particular surrounds a vast area of economic potential, while the northern route covers a diverse path of infrastructure gaps, economic potential, and coastal conditions. Moreover, the map shows that making greater use of riverways for

[55] The team acknowledges that there might population groups within the region that would prefer to remain in isolation. Any project should consider these groups before designing interventions.

fluvial transport is an interesting approach to better connecting opportunity and gap areas in the region and developing more-comprehensive value chains.[56]

Targeting infrastructure investments in connectivity-deficient areas could help foster sustainable livelihoods for areas that have over 4.6 million people of working age and better utilize over 273,000 km² of the Amazon Region for green and sustainable development potential. As seen in Figure 7 below, areas experiencing infrastructure gaps (red) that are in close proximity to areas of green and sustainable development potential (brown) present more-promising opportunities for connecting economic activity with sustainable resources. Doing so in accordance with the routes of integration could also enhance value chains not only in the region, but also to better link production in the region to national and international markets. There are also areas where fluvial transport opportunities may be more efficient. Fluvial transport is locally in use but could be employed throughout the region; the river segments in blue offer the greatest opportunities for region-wide economic enhancement, depending on hydrological conditions.[57] Key fluvial corridors could connect the areas of potential south of Porto Velho with the main Amazon River and downstream cities via the Purus and Madeira Rivers, as well as the Boa Vista area to the north, via the Branco River. These fluvial corridors could mitigate road infrastructure gaps in a way that reduces the risk of deforestation and aligns with the Routes of Integration, connecting the route in the north with those in the south. To realize these possibilities, future efforts should consider carrying out multimodal mobility studies and data collection to support integrated and resilient planning.

Figure 7. Isolation of people in the Amazon Region from economic opportunities[57]

Source: Map developed by the authors.

[56] Amazonian communities currently utilize a multimodal transport network, encompassing fluvial, road, and air transport. Bringing a wider network into being will require balancing needs with opportunities for and costs to the environment and communities, ensuring targeted investments are made where they are most needed and that these do not ignore environmental and social considerations.
[57] All fluvial conditions including navigability are dependent on current and future climate and weather conditions.
[58] The regional routes of integration were obtained from the IDB's Amazon Coordination Unit (ACU) in September 2024.

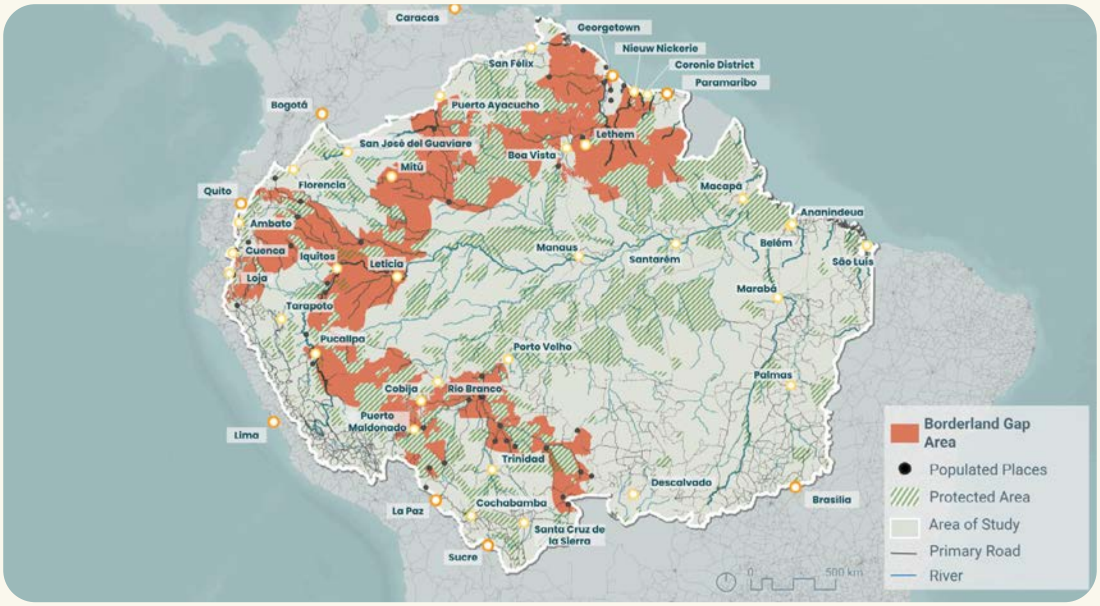
4.4 Transboundary conditions and regional coordination

The Amazon Region epitomizes a transboundary environment where development challenges extend beyond political borders, impacting multiple countries and their populations. The gap analysis conducted reveals that there are issues that affect communities across borders, underscoring the critical need for regional coordination. Given the specific efforts to design indicators that are consistent across all eight countries analyzed, this study is a powerful tool for identifying areas of transboundary challenges and opportunities.

Opportunities abound to capitalize on transboundary synergies for public-service provision. As seen in Figure 8, border municipalities[59] with gaps in the same sectors[60] are present at almost every international border in the region. Key communities that face these types of gaps include Boa Vista in the north; Leticia, Cobija, Rio Branco, and Porto Velho between the Andes and the interior of the region; and other key settlements along the mountain ridge such as Mitu, Iquitos, and Pucallpa. In many cases, providing these services from countries' capital cities would be a much more complex endeavor than considering service provision support from regional hubs that might be closer. Leticia and Tabatinga, for example, are much closer to each other than to their respective capital cities, creating opportunities for envisioning service provision support, when required, between them.

Addressing gaps in social services through transboundary approaches could improve service provision in areas that are home over 7.3 million people (15.1 percent of the region's population). Based on the map presented in Figure 8, the opportunities are significant and therefore could make greater regional coordination between policy makers worth it. In a region that faces isolation and a vast array of transboundary challenges, employing such an approach would greatly benefit both communities and ecosystems in the territory.

Figure 8. Transboundary conditions and lack of regional coordination in the Amazon Region



Source: Map developed by the authors.

[59] To account for the reality that municipalities in border regions tend to be isolated and large in area, only parts of the municipalities within 150 km of the border have been shown.
[60] The map presents two basic service gaps and one environmental gap: limited access to drinking water, limited access to sanitation services, and potential areas for sustainable management of water supply.

05 Conclusion

This study employs a data-driven approach to shed light on development challenges in the Amazon Region. By undertaking a georeferenced analysis of development gaps across multiple sectors, this study provides a data-driven foundation for a better understanding of the scope and location of some of the region's most pressing challenges. The results reveal distinct patterns of lagging conditions, emphasizing the necessity of a territorial approach that integrates human development, economic well-being, and environmental sustainability when analyzing the region. The results, however, must be taken with care. The gap analysis results from the varying assumptions required for a cross-sectoral analysis and could vary based on the imputation method used and the chosen benchmark.

A balance of social, economic, and environmental factors ought to be considered when analyzing development challenges in the region. The analytical framework of this study reveals that any development model in the Amazon Region must balance environmental challenges with economic prospects and inclusion. Moreover, given the region's complexity, transboundary and multisector approaches are need if the goal is to consider the development challenges in a more realistic light. Both the multisector gap and policy question analyses provide initial evidence on the complicated nature of some of these challenges and how response actions can start considering synergies across sectors and countries. They also highlight the possible trade-offs policy makers might have to consider when tackling challenges in different dimensions (for example, economic and environmental priorities). Moreover, one must not forget that although this framework provides some initial much-needed and data-driven insights into these challenges, specific program design must always be informed by additional on-sight analyses and dialogue with local actors so as to provide an effective and context-specific response. Future analysis could develop specific recommendations and call to action using both this data, as well as sectoral expertise and on-sight verification.

The analysis highlights some pressing challenges that need to be tackled to unlock the region's potential. From among the 20 gaps analyzed, four severe challenges identified refer to the lack of investment to aid with climate resilience and adaptation, limited access to basic services (especially potable water and sanitation), and restricted geographic access to electric substations. These gaps are present in areas where an estimated 20.6 million, 11.2 million, 11.5 million, and 25.9 million people live, respectively, populations who could eventually benefit from measures to tackle such gaps.

Estimates reveal that nearly 6 million, 661,000, and 760,000 people in the Amazon Region live in areas that are marked by severe challenges in terms of human development, economic well-being, and environmental conservation, respectively. The multigap analysis not only reveals patterns of sector gap concomitance in a given territory, but also the areas across the region that face a greater confluence of development gaps in three key dimensions: human development, economic well-being, and environmental conservation. These estimates show that nearly 6 million people live in 23 key areas with a high human development gap concentration (6 or more concurrent human development gaps); 661,000 people live in areas with a high economic well-being gap concentration (5 or more concurrent economic gaps) and over 760,000 people live in areas with a high concentration of environmental conservation gaps (more than 5 concurrent gaps). Moreover, while human development and economic well-being concentration gaps seem to be more prominent in the southeastern and northern portions of the region, environmental conservation concentration gaps would seem to be more prominent in the center of the region, particularly around the Amazon River and the border between Brazil and Bolivia. Focusing dialogue and analyses on some of these key areas could foster a more targeted and comprehensive response that considers areas with greater compounded needs and conceives of development challenges as complex and interconnected across sectors.

Finally, the application of the gap analysis to study key policy challenges for the region yields some initial insights on the potential use of the data provided in this study. In this document, the gap analysis database has been used to analyze four important policy challenges for the region relating to (1) environmental degradation, (2) the potential for green businesses; (3), the fostering of regional routes of integration, and (4) transboundary conditions and opportunities for coordination. These analyses offer initial insights on the potential a data-driven approach has for thinking about and visualizing complex regional development problems, notwithstanding the need to further complement and corroborate these findings with in-country analyses. They highlight, to begin with, the delicate balance between conservation needs and protection efforts, emphasizing the need to ensure the latter are effective when applied. Second, while green businesses are thriving across the region, they would benefit from better connectivity to areas with potential for green and sustainable activities through, for example, effective value chains. Third, value chain promotion has great potential to enhance regional routes of integration. Multimodal connectivity options are an interesting option in this region for closing the infrastructure gaps and better connecting areas with production potential to local and export markets; enhancing economic and production opportunities without unnecessarily jeopardizing natural capital and the environment is crucial. Finally, the analysis undertaken in this study shows that the region's challenges are often transboundary in nature and with this framework one can quickly identify similar development challenges in some sectors on both sides of a border. Greater transboundary coordination would thus open the door to outside-the box solutions and provide more effective service provision, economic opportunities, and conservation solutions to populations and territories that are often closer to each other than to their own national capitals.

These insights could serve as a critical input for IDB to promote evidence-based strategies, reinforcing the importance of cross-border collaboration, private-sector engagement, and targeted policy interventions to address the region's multidimensional challenges. The analysis of development gaps across the region presented here highlights the urgent need for targeted investments in human capital, environmental protection, and a sustainable economic model. By strategically addressing critical priorities, such as improving access to basic services, fostering sustainable economic opportunities, and enhancing environmental conservation and resilience, the IDB can catalyze transformative outcomes. Leveraging its regional expertise, fostering an inclusive dialogue, and aligning interventions with cross-cutting priorities, such as is done in the program Amazonia Forever, the IDB is well positioned to drive integrated solutions that not only close development gaps but also promote long-term, inclusive, and sustainable growth in the Amazon Region. This framework highlights considerations and sectors where dialogue concerning interventions could be enhanced. It also serves as an important data source for other development actors that might be considering how to prioritize and better target interventions in the region.

06 Annexes

6.1 General scope and limitations

To ensure accurate interpretation of the results of the present study, it is important to highlight the key assumptions and limitations in the use of spatial datasets and other forms of disaggregated data. The detailed limitations and assumptions for the gap assessment can be reviewed in Annex 6.6. Below the general limitations of the study are listed:

1. The study was conducted as a desktop investigation and analysis. No fieldwork or local validation was incorporated by design and therefore the results are subject to local validation.

2. The scale and scope of the study is regional. The use of the analysis, data preparation, evaluations conducted, and findings should take this into consideration.

3. The use and considerations of this study on a subnational basis require further analysis at the local scale, which should include calibration in light of local and national policies and conditions and verification through fieldwork, which is not included in this scope.

4. All analysis was conducted using the most recent data sources available at the national level, at the time of the study; census data conditions are projected for the baseline year 2021.

5. Changes in the underlying data or operating assumptions may affect the analysis and conclusions.

6. Open-source regional data were supplemented with approximations, adjustments, and projections to achieve homogeneous and comparable measurements across the region. The techniques included

   6.1 Unifying census information and projecting from household surveys to the selected base year (2021).

   6.2 Scaling down the most recent data sources for granular representation.

   6.3 Extracting and using open data sources to fill voids in official sources.

Normalization, standardization, and comparability

This study did not include normalization of geospatial components due to the inherent differences in data sources, formats, and spatial resolutions. Each dataset was selected and processed based on its original scale and level of detail to preserve the specificity and accuracy of the data. Normalizing or standardizing these datasets could have introduced distortions, particularly in cases where discrete and continuous variables were needed for the same gap, leading to a potential loss of meaningful regional variations.

Furthermore, given the diverse nature of the indicators, ranging from socioeconomic variables to environmental and infrastructural data, applying a uniform normalization process would have required assumptions that may not have accurately reflected local realities. The original values were thus maintained to ensure that the analysis remained directly interpretable and actionable. While this approach limits direct comparability across all variables, it enhances the reliability of sector-specific insights and aligns with the methodological requirements of the study.

6.2 Key definitions

- **Disturbance:** Changes in land cover from forest to a unforested state from both human and natural causes, such as conversion to agriculture and forest fires.

- **Ecosystem Services:** Benefits from a healthy ecosystem to people and communities. In maps of environmental degradation, this references the climatic benefits of carbon sequestration and atmospheric moisture recycling.

- **Fragile Ecosystems:** Regions with the highest provision of biodiversity, water, and ecosystem services, as well as limited disturbance relative to the rest of the study area (<10 percent over 20 years).

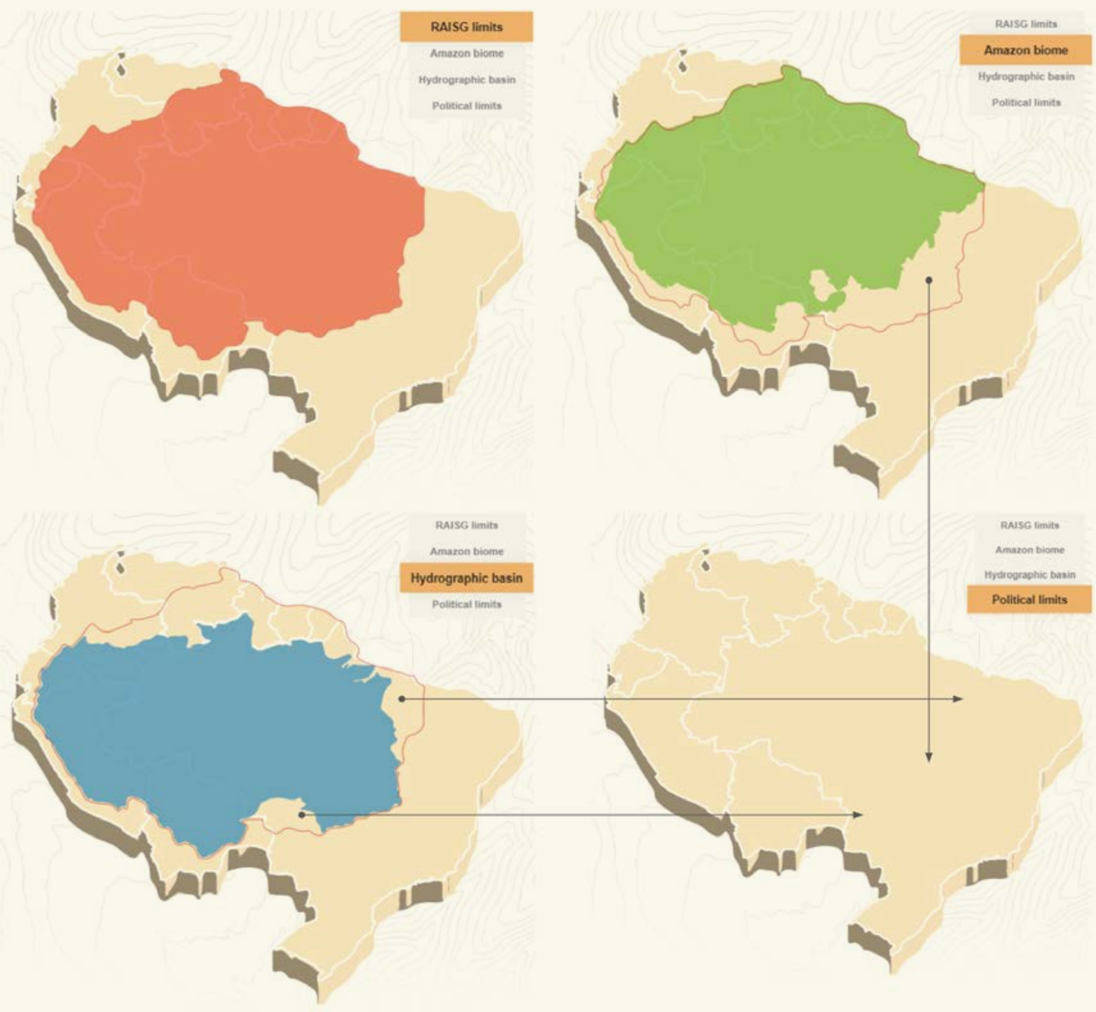
- **Green and Sustainable Economic Development Potential:** This is associated with regions with a high provision and usage of natural assets or environmental conditions to support sustainable use. It encompasses water quality regulation, pollination-dependent crops, fodder, silviculture and fuel wood production, flood regulation, riverine harvest, and access.

- **Green Businesses:** Institutions and private-sector businesses engaged in green and sustainable activities, categorized as sustainable agriculture, aquaculture, and animal husbandry as well as ecotourism and research on and technology of sustainable activities.

- **Regional Routes of Integration:** Corridors of opportunity for economic integration across the South American continent, particularly across the Southern Cone Region identified by the IDB.

- **Amazon Region:** The study area consisted of the Amazon Region, based on the definition of RAISG limit in the figure below, which extends across the countries of Bolivia, Colombia, Ecuador, Peru, Venezuela, Guyana, Suriname, and Brazil. The Amazon Region consists of the Amazon Biome, the Amazon river basin, and administrative regions within countries classified as Amazon. This is based on the Amazon region extent as defined by RAISG, which includes 8,470,209 km^2 of the Amazon biome and 7,004,120 km^2 of the Amazon basin (Amazonas, Araguaia, Tocantins, and Marajó). This definition of the Amazon region is intersected with the national boundaries of the eight countries to extract the study area and comprises the following administrative areas: Bolivia (8 departments: Beni, Chuquisaca, Cochabamba, La Paz, Oruro, Pando, Potosí, Santa Cruz), Brazil (15 states: Acre, Amapá, Amazonas, Bahia, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Piauí, Rondônia, Roraima, Tocantins), Colombia (13 departments: Cauca, Huila, Nariño, Guainía, Guaviare, Vaupés, Amazonas, Bogotá, Distrito Capital, Caquetá, Cundinamarca, Meta, Putumayo, Vichada), Ecuador (16 provinces: Azuay, Bolivar, Cañar, Carchi, Chimborazo, Cotopaxi, Imbabura, Loja, Morona Santiago, Napo, Orellana, Pastaza, Pichincha, Sucumbios, Tungurahua, Zamora Chinchipe), Guyana (all 10 regions: Barima-Waini, Pomeroon-Supenaam, Essequibo Islands-West Demerara, Demerara-Mahaica, Mahaica-Berbice, East Berbice-Corentyne, Cuyuni-Mazaruni, Potaro-Siparuni, Upper Takutu-Upper Essequibo, Upper Demerara-Berbice), Peru (20 regions: Amazonas, Ancash, Apurimac, Arequipa, Ayacucho, Cajamarca, Cusco, Huancavelica, Huanuco, Junin, La Libertad, Lambayeque, Lima, Loreto, Madre de Dios, Pasco, Piura, Puno, San Martin, Ucayali), Suriname (all 10 districts: Brokopondo, Commewijne, Coronie, Marowijne, Nickerie, Para, Paramaribo, Saramacca, Sipaliwini, Wanica) and Venezuela (7 states: Amazonas, Anzoátegui, Apure, Bolívar, Delta Amacuro, Guárico, Monagas).

Figure 9. The extent of the Amazon Region based on the RAISG definition



Source: RAISG (2020)

6.3 Green, inclusive, and sustainable development model

This project was originally structured through the lens of a bioeconomic development model, which refers to the use of biological resources, knowledge, science, technology, and innovation for the creation of new products and value-added processes that contribute to sustainable, inclusive, and resilient economic growth. However, the concept of 'bioeconomy' is not uniformly defined by all countries in the region and carries political sensitivities in some of the Amazonian countries, so the phrase "green, inclusive. and sustainable development" was adopted in order to encompass a wider definition of the development model. Country-specific definitions of this type of development are included below.

Bolivia: Intensive use of **knowledge** in **resources, processes, technologies,** and **biological principles** for the **sustainable production** of goods and services. (IICA)

Brazil: Productive and economic development based on values of justice, ethics and **inclusion,** generating products, processes and services based on sustainable use and conservation of **biodiversity,** incorporating **knowledge, innovations,** and **technologies,** for **value addition,** sustainability, and **climate** balance. (National Bioeconomy Strategy)

Colombia: The production, utilization, and conservation of **biological** resources, including related **knowledge, science, technology,** and **innovation,** to provide information, products, processes, and services in all economic sectors, with the purpose of advancing toward a **sustainable** economy. An economy that efficiently and sustainably manages biodiversity and biomass to generate new **value-added** products and processes, based on knowledge and innovation. (MinCiencias)

Ecuador: A new model of economic relationship, in which all productive forces and social, political, and academic actors articulate ourselves to make possible a new mode of **production** based on **knowledge, innovation,** and the **sustainable** use of **biological resources, principles,** and **processes,** to provide products and services to all sectors of commerce and industry, thus allowing Ecuador to advance toward a prosperous, sustainable, inclusive, and resilient economy. (Ministerio de Ambiente)

Guyana: A low carbon development model that aims to create a global model for recognizing the essential role of tropical forests in **combating climate change** and **conserving biodiversity.** The vision includes considerations on sustainable **forestry,** energy transition, **economic growth,** c**ommunity investment** and global leadership. (Low Carbon Development Strategy 2030)

Peru: Any economic activity based on the use of renewable natural **biological** resources, both terrestrial and oceanic, to obtain food, materials, and energy in a **sustainable** manner without compromising their availability for future generations. (DAR)

Suriname: Promoting economic development while prioritizing environmental preservation, with particular focus on forest resources, renewable energy transition, and climate resilience while supporting communities. (National Development Plan 2017-2021)

Venezuela: A paradigm shift in agricultural development, linking it to new challenges and emerging opportunities in tune with advances in **science** and t**echnology,** which involves incorporating new **bioprocesses** into the **production** of goods and services to obtain greater **added value** and generate numerous direct and indirect jobs. (FUSAGRI)

6.4 Identification of development priorities

The identification of development priorities for the region was carried out through the review of 41 development documents relevant to the Amazon Region. Despite the region's being a vast and diverse territory spanning eight countries, it was found that many of the development documents shared common development priorities across countries, allowing for the identification of summarized key "binding priorities" to represent the most important and representative development priorities of the region. The document review process began with a review of 22 key development documents, including the National Development plans, the IDB Group Country Strategies, and the Country Development Challenges (CDC) documents.

	Bolivia	Brazil	Colombia	Ecuador	Guyana	Peru	Suriname	Venezuela
National Development Plan	Economic and Social Development Plan 2021–2025	Federal Development Strategy 2020 (24)	National Development Plan 2018–2022	Plan for the Creation of Opportunities 2021–2025	Guyana's Low Carbon Development Strategy 2030 (9)	Strategic Plan for National Development 2050	Multi-annual Development Plan 2022–2026 (17)	Plan for the Homeland 2025
IDB Group Country Strategy	2022–2025	2019–2022 (4)	2019–2022	2022–2025	2023–2026 (10)	2022–2026	2021–2025 (8) 2021–2025 (8)	2011–2014
Country Development Challenges (CDC)	2019	2018 (13)	2022	2020	2016; Update 2019 (19) (14)	n.d.	Update 2020 (17)	—

The review of key development documents began with the National Development Plans of each country, yielding the identification of priorities based on keywords associated with the objectives of the study:

- Inclusion
- Natural and human capital
- Transnational development
- Bioeconomy potential
- Sustainable management
- Sustainable cities/infrastructure
- Amazon
- Forest

The key document review was continued with the review of the IDB Strategies for each country. The results of this process yielded 84 main guidelines that the bank identifies as priorities across the countries. Finally, the IDB' "Country Development Challenges" (CDC) documents for seven countries were reviewed, (Venezuela was not available for review). A total of 149 priorities were extracted from this process. A review of 18 additional documents supplemented the review for development priorities to gain a perspective on development from other official and regional documents. Once over 200 priorities were extracted, they were centralized in a database from which common patterns were identified, establishing their main themes and condensing the list to 31 unique priorities for the Amazon Region.

In order to further refine the regional priorities to the most important "binding" priorities, the summarized priorities were systematized in a matrix, where each priority was analyzed for its alignment with the study objectives, the Sustainable Development Goals (SDGs), and the operational capacity of the IDB. The final list of binding priorities guided the rest of the study and provided a relevant starting point for outlining regional needs and aligning the project with the IDB's interests and potential. Based on these representative priorities, relevant indicators were recommended for the analysis of gaps in lagging conditions and development opportunities as described in the following chapters.

6.5 Territories for sectoral gap evaluation

The study area of this effort corresponds to a large area with a great diversity of territories that converge and interact with each other. This is why there is a need to approach the analysis from different spatial perspectives grouped according to their common characteristics, taking into account aspects of population density along with natural, economic, political, and cultural uses. The territories influence the perspective with which the gaps are addressed, because the same spatial behavior of the processes surrounding the basic services in the region is not expected in urban territories as in rural ones, for example.

The identification of the criteria used for the selection of these territories included a detailed geospatial calibration process, which also considered the characteristics of the area of interest at all levels that are relevant to this effort. The description of these territories can be found below.

Urban territories: Based on the methodology of United Nations (2020),1 urban territories were selected considering population density intersected with administrative areas provided by theUnited Nations Office for the Coordination of Humanitarian Affairs (OCHA). Any administrative unit that intersects an area with population density greater than 300 people/km^2 was considered urban. Initially, under this methodology, the number of territories classified as urban was limited. However, considering the continuity of urban space as an area in constant expansion and dynamic influence, an intersection was made with level-three administrative areas of the countries (except for Ecuador and Colombia, where level two was used, and Suriname and Guyana, where level one was used) to select those where urban territories were present within the administrative unit. The selection of urban territories prioritized areas that meet the criteria for urban classification. If an administrative area contained both urban and rural zones, its classification as urban depended on its size and whether its population density surpassed that of the rural areas. This approach aligns with the UN's degree of urbanization methodology, which recognizes the strong spatial influence of urban zones. Therefore, priority was given to these territories to highlight their influence. In the case of Brazil, the country's official urban classification (IBGE) was used.

Rural Territories: Following the classification of urban territories, all of the administrative units that present ed less than 299 people/km^2 were considered rural. Once these densities were identified, they were intersected with level-three administrative areas (level two in the case of Ecuador and Colombia and level one in the case of Guyana and Suriname). Areas with a density between 0 and 1 inhabitant per km^2 were classified as hyper-rural but were integrated into rural territories by design. Rural territories were the second priority category, meaning that if an administrative area was classified as anything other than urban, its final classification corresponded to a rural territory. When a department or municipality intersected with both an urban and a rural territory, even if its area was not entirely contained within either, the concept of urban-rural hierarchy was applied, giving priority to the classification of urban territories due to their dynamism and diverse influences. In the case of Brazil, all of the administrative units that were not classified as urban by IBGE were considered rural.

Protected Areas and Indigenous Territories: These territories are key to the recovery and maintenance of healthy ecological levels of the Amazon Region. Geospatial extensions were represented based on georeferenced data provided by RAISG (2020). Protected areas totaled 2,046,915.75 km^2 and 2,420,082.25 km^2 of indigenous territories were considered for analysis. It should be noted that some territories fell within both classifications. Although indigenous territories and protected areas exhibited some similarities in their conservation capacity, key differences in the legal, political, population, and cultural characteristics of these territories supported treating them separately in this study. A key function of protected areas within the study was to remove protected areas from gaps relevant to population in order to focalize results around areas with a higher likelihood of being populated. Gap analyses that removed protected areas from consideration left out indigenous territories of consideration due to their populated nature.

Agricultural Lands: Based on the land cover and land use provided by MapBiomas, pastures, agriculture, forestry, palm oil, and mosaic of agriculture and/or pastures are classified as agricultural lands. A reclassification of these data was subsequently carried out in order to group all these values into the final category identified by this territory, to later be summarized at the administrative level so as to be used in the corresponding gap.

Natural Territories: Closed forests, bodies of water, and mangroves corresponded to sparsely populated or uninhabited areas within the study area, but due to their ecosystemic relevance were widely considered in gap and future multisector gap analyses. Depending on the gap addressed, these territories were used as territory or as exclusion zones. For the selection of this territory, a raster image of land cover from Copernicus (2019) was used, from which all closed forested areas within the area of interest were selected, plus mangroves and bodies of water.

6.6 Gap assessment limitations and methods

Each gap presents its own limitations in data sourcing and processing. Understanding these limitations is important to ensure that gaps are properly interpreted and utilized.

#	Gap	Limitations	Methods
1	**Limited access to drinking water**	1. Projections were used to bring the data to a baseline year (2021) and a single growth rate is applied within each level-one administrative unit. 2. If the applied compound annual growth rate (CAGR) projected a rate beyond 100%, the projected value was reduced to 100% to reflect real-world limitations. 3. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 4. Benchmarks were established based on UNICEF's 2020 piped water rate for landlocked developing countries.	1. Household surveys and census information were compiled to calculate a CAGR to project water rates to represent 2021. 2. The projected data were joined to the administrative shapefiles. 3. Administrative units with rates below 43% were extracted. 4. Protected areas were eliminated from analysis.
2	**Limited access to electricity in urban areas**	1. Projections were used to bring the data to a baseline year (2021) and a single growth rate was applied within each level-one administrative unit. 2. If the applied CAGR projected a rate beyond 100%, the projected value was reduced to 100% to reflect real-world limitations. 3. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 4. Benchmarks were established based on the World Bank's electrification rate for low- and middle-income countries.	1. Household surveys and census information were compiled to calculate a CAGR to project electricity rates to represent 2021. 2. The projected data were joined to the administrative shapefiles 3. Urban administrative units were selected from the dataset. 4. Administrative units with electricity rates below 96.4% were extracted. 5. Protected areas were eliminated from analysis.
3	**Limited access to electricity in rural areas**	1. Projections were used to bring the data to a baseline year (2021) and a single growth rate was applied within each level-one administrative unit. 2. If the applied CAGR projected a rate beyond 100%, the projected value was reduced to 100% to reflect real-world limitations. 3. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 4. Benchmarks were established based on the World Bank's electrification rate for low- and middle-income countries.	1. Household surveys and census information were compiled to calculate a CAGR to project electricity rates to represent 2021. 2. The projected data were joined to the administrative shapefiles. 3. Rural administrative units were selected from the dataset. 4. Administrative units with electricity rates below 81.3% were extracted. 5. Protected areas were eliminated from analysis.
4	**Limited access to sanitation services**	1. Projections were used to bring the data to a baseline year (2021) and a single growth rate was applied within each level-one administrative unit. 2. If the applied CAGR projected a rate beyond 100%, the projected value was reduced to 100% to reflect real-world limitations. 3. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 4. Benchmarks were established based on UNICEF's 2020 rate for landlocked developing countries.	1. Household surveys and census information were compiled to calculate a CAGR to project water rates to represent 2021 2. The projected data were joined to the administrative shapefiles 3. Administrative units with rates below 9% were extracted 4. Protected areas were eliminated from analysis.

5	**Limited geographic access to health centers in urban areas**	1. Health facilities were based on open-source data. 2. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 3. Travel time considerations were limited to the road network.	1. Motorized travel time to health centers was calculated (clinics, hospitals, doctors). 2. Travel time values for urban areas were extracted. 3. Values greater than 30 minutes of travel time to health facilities were extracted. 4. Data were converted to polygons. 5. Protected areas were removed.
6	**Limited geographic access to health centers in rural areas**	1. Health facilities based on open-source data. 2. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 3. Travel time considerations were limited to the road network	1. Motorized travel time to health centers was calculated (clinics, hospitals, doctors). 2. Travel time values for rural areas were extracted. 3. Values greater than 120 minutes of travel time to health facilities were extracted. 4. Data were converted to polygons. 5. Protected areas were removed.
7	**Limited geographic access to education in urban areas**	1. Education facilities were based on open-source data. 2. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 3. Travel time considerations were limited to the road network	1. Motorized travel time to schools was calculated (primary and secondary schools). 2. Travel time values for urban areas were extracted. 3. Values greater than 20 minutes of travel time to health facilities were extracted. 4. Data were converted to polygons. 5. Protected areas were removed.
8	**Limited geographic access to education in rural areas**	1. Education facilities were based on open-source data. 2. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized. 3. Travel time considerations were limited to the road network	1. Motorized travel time to schools was calculated (primary and secondary schools). 2. Travel time values for rural areas were extracted. 3. Values greater than 30 minutes of travel time to health facilities were extracted. 4. Data were converted to polygons. 5. Protected areas were removed.
9	**Limited access to primary road**s	1. Roads were based on open-source data. 2. Territories of high ecosystem value (closed forest, water bodies and mangroves) and protected areas were eliminated. 3. Travel time considerations were limited to the road network.	1. Roads with classifications related to primary roads in OSM were extracted. 2. Travel times from primary roads were calculated. 3. Values greater than 45 minutes of travel time from primary roads were extracted. 4. Data were converted to polygons. 5. Areas of dense forest, bodies of water, mangroves, and protected areas were eliminated.
10	**Limited access to secondary road**s	1. Roads were based on open-source data. 2. Territories of high ecosystem value (closed forest, water bodies and mangroves) and protected areas eliminated. 3. Travel time considerations were limited to the road network.	1. Roads with classifications related to primary roads and secondary roads in OSM were extracted. 2. Travel times from primary and secondary roads were calculated. 3. Values greater than 45 minutes of travel time from primary and secondary roads were extracted. 4. Data were converted to polygons. 5. Areas of dense forest, bodies of water, mangroves, and protected areas were eliminated.

11	**Limited geographic access in digital connectivity**	1. Closed forest, water bodies, mangroves, and protected areas were eliminated to focus the gap on populated lands for development. 2. Travel time considerations were limited to the road network.	1. OpenCellID information represents the infocommunications towers. Settlement data were used to approximate the location at a more granular level. 2. Based on the location of the towers, a cost-distance analysis was performed to calculate travel times from towers. 3. Values greater than 45 minutes from a cell tower were extracted and converted to polygons. 4. A buffer analysis was performed to identify zones within 5 km or 2 km of a tower. 5. Two layers were created to represent the cell tower access areas: the 45-minute area was merged with the 2 km buffer and the 5 km buffer in a separate layer. 6. The 45 minute/5 km area was removed from the rural territories and the 45 minute/2 km area was removed from the urban territories. 7. The remaining territories were merged to represent the areas outside of the access of cell towers. 8. Areas of dense forest, bodies of water, mangroves, and protected areas were eliminated.
12	**Limited geographic access to electric substations**	1. Closed forest, water bodies, mangroves and protected areas were eliminated to focus the gap on populated lands for development. 2. Travel time considerations limited to the road network.	1. A shapefile was generated with the location of the electrical substations in the study area 2. Substations were buffered at 4.5 km and 20 km. 3. Buffers of 4.5 km were erased from urban territories, and 20 km buffers were erased from rural territories. 4. The remaining territories were merged to represent the areas outside of access to substations. 5. Areas of dense forest, bodies of water, mangroves and protected areas were eliminated.
13	**Limited efficiency of agricultural lands**	1. Sectoral GDP calculations and projections were based on interpolation of available data. 2. Protected areas were removed due to different national regulations and different economic activities allowed, if authorized.	1. National GDP was weighted by subnational employment data in the case of Suriname and Guyana, and GVA in the case of Brazil, and converted to 2021 USD for standard comparison 2. Agricultural territory was summarized in km2 within administrative units. 3. GDP and agricultural territory were joined to the same shapefile and efficiency was calculated by dividing GDP by agricultural territory (USD/km2 4. Artifact ADMs (ADMs less than 50% in the study area) were removed to avoid obscuring the study area's distribution. 5. The bottom two quintiles of efficiency were selected as the gap territory. 6. ADMs were clipped to agricultural territory for visualization. 7. Protected areas were erased from the gap.
14	**Limited green and sustainable activities**	1. Green and sustainable firms were based on relevant activities considered to be indicative of bioeconomy. Firms were selected based on categorical criteria assigned by Meta.	1. Firm points were counted within ADMs. 2. The count of points was adjusted by the ADM population, separately for each country. 3. ADMs in the top two quintiles were extracted to represent the nongap area. 4. Nongap ADMs were erased from the territory.

15	**Limited investment in climate resilience and adaptation**	1. Investments were limited to georeferenced investments in the IATI database. 2. Climate hazard is an index composed of fire weather, global flooding, and projections of high temperatures and high rainfall.	To build the climate index: 1. Precipitation, temperature, fire weather, 10-year flood risk, and 100-year flood risk were reclassified into quintiles. 2. Precipitation, temperature, and fire weather were added and the top two quintiles taken as being at high risk for atmospheric climate phenomena. 3. Ten-year flood risk and 100-year flood risk were added separate from step 2 and the top two quintiles were taken as being at high risk for flooding climate phenomena. 4. The two separate indices were unioned for a climate risk index area. To identify the gap: 1. Climate investment points were counted within ADMs. 2. ADMs with investments were removed from the climate risk index area.
16	**Indigenous territories with limited investments in climate resilience or sustainable activities**	1. Suriname does not recognize indigenous territories 2. Investments were limited to georeferenced investments in the IATI database. 3. Indigenous territories included officially recognized indigenous territories, indigenous territories without official recognition, indigenous reserves or intangible zones, and proposed indigenous reserves and did not cover the locations of all indigenous peoples.	1. Sustainable activities investment points were counted with indigenous territories 2. Climate investment points were counted within indigenous territories 3. Indigenous territories with neither type of investment were selected as the gap territory.
17	**Indigenous territories exposed to climate hazards**	1. Suriname does not recognize indigenous territories 2. Climate hazard is an index composed of fire weather, global flooding, and projections of high temperatures and high rainfall. 3. Indigenous territories included officially recognized indigenous territories, indigenous territories without official recognition, indigenous reserves or intangible zones, and proposed indigenous reserves and did not cover the locations of all indigenous peoples.	1. See construction of the climate index in gap 15. 2. Indigenous territories were limited to the area of the climate risk index.
18	**Potential areas for the protection of biodiversit**y	1. Biodiversity data did not account for invertebrates or aquatic species, for which the Amazon Region is a hotspot. 2. Limitations of the survey methods from data source publications apply.	1. For high fauna, rasters of mammals, birds, and amphibians were added and areas above the 95th percentile globally were selected as high fauna biodiversity. 2. For flora, areas above the 95th percentile globally were selected as high flora biodiversity. 3. High flora and fauna were unioned to identify the area that is high in either category. 4. LULC was summarized within ADMs. 5. To calculate the gap territory, protected areas, indigenous territories, and ADMs with greater than 10% disturbance were erased from the high biodiversity areas.

19	**Potential areas for sustainable management of water supply**	1. Water supply was taken as a forecast of supply in the year 2030 based on data from 2015 to 2045. We assumed a business-as-usual global climate and local development scenario, although we highlight that these parameters resulted in negligible differences in the territory.	1. The top two quintiles of water basins were selected as high supply areas. 2. LULC was summarized within ADMs. 3. To calculate the gap territory, protected areas, indigenous territories, and ADMs with greater than 10% disturbance were erased from the high supply basins.
20	**Potential areas for protection of ecosystem services**	1. Due to the recency of the data, LULC changes were already accounted for. Therefore, to form a predictive model of disturbance on key ecosystem services, we summarized deforestation and ecosystem services within administrative units based on the premise that future deforestation would follow patterns of existing deforestation.	1. Global NCPs (ecosystem services, i.e. "Nature's Contributions to People") and LULC were summarized within ADMs. 2. ADMs above the 75th percentile in NCPs and above 10% deforestation were selected, as well as ADMs above the 75th percentile regardless of deforestation. 3. Protected areas and indigenous territories were erased from the gap area.

6.7 Multisectoral gap assessment limitations and methods

Each multisectoral gap is a product of an overlay analysis between gap and nongap components. In addition to multisectoral limitations, each multisectoral gap is subject to the limitations of its inputs, which for the gaps can be viewed in Annex 6.6. The economic well-being and conservation multisectoral gaps also contain nongap territories to represent important resources, lagging conditions, or threats to the thematic goal.

	Multigaps		
#	**Human Development**	**Economic Well-being**	**Conservation**
Limitations	1. Multisectoral gap inputs are equally weighted in the overlay analysis. 2. Analysis encompasses a sample of human development conditions, but is not exhaustive of all development factors.	1. Multisectoral gap inputs are equally weighted in the overlay analysis. 2. Gap inputs consider varying eligible territories (nonforest, agriculture, indigenous territories) and therefore different areas are eligible for different numbers of gaps.	1. Multisectoral gap inputs are equally weighted in the overlay analysis. 2. Legal and administrative conditions vary across the territory, creating unequal opportunities for conservation.
Inputs	1. Limited access to drinking water (Gap 1) 2. Limited access to electricity -Urban/Rural (Gaps 2 and 3) 3. Limited access to sanitation services (Gap 4) 4. Limited geographic access to health centers - Urban/Rural (Gaps 5 and 6) 5. Limited geographic access to education centers - Urban/Rural (Gaps 7 and 8) 6. Limited access to primary roads (Gap 9) 7. Limited access to secondary roads (Gap 10) 8. Limited geographic access to digital connectivity (Gap 11)	1. Limited access to secondary roads (Gap 10) 2. Limited geographic access to digital connectivity (Gap 11) 3. Limited efficiency of agricultural lands (Gap 13) 4. Limited green and sustainable activities (Gap 14) 5. Indigenous territories with limited investments in climate resilience or sustainable activities (Gap 16) 6. Nonbiodiverse areas 7. Areas without green and sustainable development potential	1. Limited investment in climate resilience and adaptation (Gap 15) 2. Potential areas for protection of biodiversity (Gap 18) 3. Potential areas for sustainable management of water supply (Gap 19) 4. Potential areas for protection of ecosystem services (Gap 20) 5. Forest at risk of disturbance 6. Deforestation

Methods	1. Sectoral gap analyses were performed following the methods documented in Annex 6.6. 2. An overlay of the inputs was analyzed to compute a gap condition composite of the Amazon Region. 3. Population statistics were calculated for each degree of gap overlap using zonal statistics.	1. Sectoral gap analyses were performed following the methods documented in Annex 6.6. 2. Nonbiodiverse areas were identified by all areas below the 95th percentile of global biodiversity, i.e., areas not considered eligible for potential areas for protection of biodiversity. 3. Areas without green and sustainable development potential were identified by the inverse regions of green and sustainable development potential identified in Section 4.2, i.e., areas below the 75th percentile. 4. An overlay of the inputs was analyzed to compute a gap condition composite of the Amazon Region. 5. Population statistics were calculated for each degree of gap overlap using zonal statistics.	1. Sectoral gap analyses were performed following the methods documented in Annex 6.6. 2. Forest at risk of disturbance was identified by extracting deep forest land cover that fell within a 5.5 km radius of primary/ secondary roads or agricultural lands. 3. Each administrative unit's degree of deforestation was calculated using Hansen forest loss data. Admininstrative units with forest loss greater than 10% of the unit's total area were extracted. 4. An overlay of the inputs was analyzed to compute a gap condition composite of the Amazon Region. 5. Population statistics were calculated for each degree of gap overlap using zonal statistics.

6.8 Household Data Projections

To accommodate the variety of temporalities, granularities, and measurement specificities of data across the region, a detailed information harmonization process was undertaken. To achieve a regional perspective in a multicountry territory, it was necessary to bring data on household conditions to a common baseline year while maintaining granularity. The year 2021 was identified as the most appropriate baseline year due to data availability and recency. Using the information available in the most recent household censuses and surveys in each country, spatial downscaling and temporal projection adjustment processes were developed on an as-needed basis. This process was applied to data on drinking water, electricity, and household sanitation.

Scaling for Recency

Brazil, Guyana, Suriname

Three countries had data available at the desired administrative level, but the data did not represent 2021, so a temporal projection of the data was required to achieve the baseline year. To achieve the baseline year in each country, a **compound annual growth rate (CAGR)** was calculated and applied to the existing data to represent conditions in 2021.[61,62,63]

[61] Due to the unique conditions during 2020, the literature suggests that household access to services in general did not grow during the year 2020; therefore 2020 was skipped when the CAGR was calculated and applied.
[62] In the case of Brazil, recently published 2022 data exist. To represent conditions in 2021, the CAGR was calculated and applied beginning with the earliest survey year (2010).
[63] Brazil's most recent electricity data were available at the ADM1 level, which led to calculating a weighted CAGR for each ADM1 unit.

For any projected administrative unit with access rates above 100%, a conditional process was applied to reflect a real-world maximum rate of 100%.

$$CAGR = \left(\frac{V_{final}}{V_{begin}}\right)^{1/t} - 1$$

$$V_{future} = V_{present} \times (1 + CAGR)^{n}$$

CAGR = compound annual growth rate
V_{begin} = beginning value
V_{final} = final value
t = time in years
V_{future} = projected (2021) value
$V_{present}$ = most recent survey value
n = years projected ahead

Scaling for Granularity

Bolivia, Colombia, Ecuador, Peru, Venezuela

Data representing 2021 were available for five countries, but the granularity was not at the desired level. A spatial downscaling process using granular census data from various past years and level-one administrative survey data[64] from 2021 were used to achieve the desirable granularity in the baseline year of 2021.

The process involved summarizing census data from a level-three administrative (ADM3) unit (municipality, district, or parish, depending on the country) to a level-one administrative (ADM1) unit (department, state, or province, depending on the country), which enabled the calculation of the level of access at the ADM1 level for the census year.[65,66] The growth rate between the census year and the household survey year (2021) was then calculated for each ADM1 unit. The growth rate obtained was then applied to each of the geographic units at the ADM3 level to simulate the growth experienced between the census year and the base year 2021. This approach is limited by assuming a standard rate of change within each ADM1 area, but it protects the granular representation provided by the census data.

$$ADM3_{2021} = ADM3_{old} \times \left(1 + \frac{(ADM1_{2021} - ADM1_{old})}{ADM1_{old}}\right)$$

For any projected administrative unit with access rates above 100%, a conditional process was applied to reflect a real-world maximum rate of 100%.

[64] Country level = Administrative level 0.
[65] Colombia's most granular administrative unit is level-two administrative (ADM2) (municipality), so in Colombia ADM2 data were used in place of ADM3.
[66] On average, Ecuador's ADM2 (canton) is comparable in size to the other countries' ADM3 units, whereas Ecuador's ADM3 unit (parroquia) is much smaller than that of other countries. To achieve the greatest consistency, Ecuador's most granular unit of analysis in this study is thus ADM2.

Country Data Sources

Although the most representative datasets available were used and consistency in indicators across countries was prioritized, available census and survey indicators may vary slightly between countries. Differences should be noted when comparing data between countries. The survey measures used for each country are detailed in the tables below:

Water

Country	Indicator	Year	Survey	Granularity	Source
Bolivia	Percentage of households with piped water from the network within the house or outside of the house but within the lot or yard	2012	Censo De Población Y Vivienda 2012	ADM3	Instituto Nacional de Estadística (INE). 2012. Censo de población y vivienda 2012. Table: Como se distribuye el agua que utilizan. http://datos.ine.gob.bo/binbol/RpWebEngine.exe/Portal?BASE=CPV-2012COM&lang=ESP
		2021	Instituto Nacional de Estadística, Encuesta de Hogares 2011–2021	ADM1	Instituto Nacional de Estadística (INE). (s. f.). Bolivia: Hogares según departamento y procedencia de agua, 2011-2021 [Conjunto de datos]. https://www.ine.gob.bo/index.php/estadisticas-sociales/vivienda-y-servicios-basicos/encuestas-de-hogares-vivienda/
Brazil	Percentage of permanent private homes with water supply from the general network by municipality	2010	IBGE Census	ADM2	IBGE, 2010 via INDE. Table: Percentage of permanent private homes with water supply from the general network; https://visualizador.inde.gov.br
		2022	IBGE Census, GeoAdaptive	ADM2	Census data from IBGE, 2022. Percentage of people in households (DPPO) supplied mainly with water from the general distribution network; https://censo2022.ibge.gov.br/apps/pgi/#/mapa/?share=WyJvc20iLDQuNTEzODU3MTQ1NzIxMTY4LFstNjA1MTE3My4yODI4MDAwNjksLTE2MDQyODYuMTM4MjU2ODA2XSxbWyJuYXQiLDEyMCx0cnVlLDEsMCwxXV1d%2F. Processed by GeoAdaptive, 2024 using IBGE, 2022 Table: Average number of residents in permanently occupied private households (people), by municipality.
Colombia	Percentage of households with water service	2018	Censo Nacional de Población y Vivienda 2018	ADM2	Departamento Administrativo Nacional de Estadística (DANE). 2018. Censo Nacional de Población y Vivienda 2018. Table: Cuenta con servicio de acueducto.
		2021	Índice Departamental de Competitividad 2022	ADM1	Consejo Privado de Competitividad (CPC). (s.f.). Índice Departamental de Competitividad 2022. Data Year: 2021. Table: Condiciones Habilitantes. https://compite.com.co/indice-departamental-de-competitividad-idc/
Ecuador[66]	Percentage of households with potable water service	2021	Boletín Estadístico Agua Potable y Saneamiento 2021	ADM2	Agencia de Regulación y Control del Agua (ARCA). (s. f.). Boletín Estadístico Agua Potable y Saneamiento 2021. https://www.regulacionagua.gob.ec/wp-content/uploads/downloads/2022/12/Boleti%CC%81n-estadi%CC%81stico-APS-2021_fn_v02.pdf

[67] Ecuador has 2021 data available at the desired granularity (ADM2), so a projection process was not required.

Guyana	Percentage of househo the lds with piped drinking water in dwelling or yard by region	2012	Guyana Bureau of Statistics	ADM1	Bureau of Statistics, 2012. Compendium 5- Housing Stocks and Amenities. Table: Main Source of Drinking Water: https://statisticsguyana.gov.gy/wp-content/uploads/2019/10/Final_2012_Census_Compendium5-1.pdf
		2019 2020	Multiple Indicator Cluster Survey (MICS)	ADM1	Bureau of Statistics, MICS, 2019-2020. Table: Percent distribution of household population according to main source of drinking water and percentage of household population using improved drinking water sources, Guyana 2019-2020 Survey (Page 462): https://mics.unicef.org/sites/mics/files/Guyana%202019-20%20MICS_English.pdf
Peru	Percentage of households with piped water from the network within the house	2017	Censos Nacionales de Población y Vivienda 2017	ADM3	Instituto Nacional de Estadística e Informática (INEI) - PERÚ, 2017. Table: Viviendas Particulares y hogares- Cobertura y Déficit de agua por red pública domiciliaria. https://censos2017.inei.gob.pe/redatam/
		2021	Encuesta Nacional de Programas Presupuestales (ENAPRES) 2021	ADM1	Instituto Nacional de Estadística e Informática (INEI). (s. f.). Dato completo de la Encuesta Nacional de Programas Presupuestales (ENAPRES) 2021 [Conjunto de datos]. En Plataforma Nacional de Datos Abiertos. https://www.datosabiertos.gob.pe/dataset/encuesta-nacional-de-programas-presupuestales-enapres-2021-instituto-nacional-de-2
Suriname	Percentage of households with piped drinking water in dwelling or yard by district	2010	Multiple Indicator Cluster Survey (MICS)	ADM1	Ministry of Social Affairs and Public Housing, Multiple Indicator Cluster Survey (MICS), 2018. Table: Percent distribution of household population according to main source of drinking water and percentage of household population using improved drinking water sources; https://suriname.un.org/sites/default/files/2020-09/Suriname%202018%20MICS%20Survey%20Findings%20Report_English.pdf
		2018	Multiple Indicator Cluster Survey (MICS)	ADM1	Base data from Suriname General Bureau of Statistics 2004 and MICS 2018. Elaborated by GeoAdaptive, 2024. Administrative unit shape from OCHA, 2017.
Venezuela	Percentage of households with water from an aqueduct or pipe	2011	Censo Nacional de Población y Vivienda 2011	ADM3	Instituto Nacional de Estadística (INE) - Venezuela. 2011. Censo Nacional de Población y Vivienda 2011.
		2020 2021	INSO - ENCOVI Indicadores Sociales - Encuesta de Condiciones de Vida	ADM1	Instituto de Investigaciones Económicas y Sociales de la Universidad Católica Andrés Bello (UCAB). (s. f.). Indicadores Sociales (INSO) - Encuesta Nacional de Condiciones de Vida (ENCOVI) 2020-2021 [Conjunto de datos]. https://insoencovi.ucab.edu.ve/indicador-de-vivienda-y-hogar/

Electricity

Country	Indicator	Year	Survey	Granularity	Source
Bolivia	Percentage of households with access to electricity	2012	Censo De Población Y Vivienda 2012	ADM3	Instituto Nacional de Estadística (INE). 2012. Censo de población y vivienda 2012. http://datos.ine.gob.bo/binbol/RpWebEngine.exe/Portal?BASE=CPV-2012COM&lang=ESP
		2021	Instituto Nacional de Estadística, Encuesta de Hogares 2011–2021	ADM1	Instituto Nacional de Estadística (INE). Hogares según departamento y disponibilidad de energía eléctrica, 2011–2021 [Conjunto de Datos]. https://www.ine.gob.bo/index.php/estadisticas-sociales/vivienda-y-servicios-basicos/encuestas-de-hogares-vivienda/
Brazil	Percentage of permanent private homes served by electricity from a distribution company by municipality	2010	IBGE Census	ADM2	IBGE, 2010 via INDE. Table: Percentage of permanent private homes served by electricity from a distribution company, in relation to the total number of permanent private homes; https://visualizador.inde.gov.br/
		2022	PNAD Annual continuous national household sample survey	ADM1	IBGE- PNAD Annual continuous national household sample survey, 2022. Table 6738. https://sidra.ibge.gov.br/tabela/6738
Colombia	Percentage of households with electricity service	2018	Censo Nacional de Población y Vivienda 2018	ADM2	Departamento Administrativo Nacional de Estadística (DANE). 2018. Censo Nacional de Población y Vivienda 2018.
		2021	Índice Departamental de Competitividad 2022	ADM1	Consejo Privado de Competitividad (CPC). Índice Departamental de Competitividad 2020-2021. https://compite.com.co/indice-departamental-de-competitividad-idc/
Ecuador	Percentage of households with public electricity service	2010	Censo de Población y Vivienda 2010	ADM1	Instituto Nacional de Estadística y Censos (INEC) (2010). Censo de Población y Vivienda 2010. https://www.ecuadorencifras.gob.ec/base-de-datos-censo-de-poblacion-y-vivienda-2010/
		2021	Estadísticas del Sector Eléctrico Ecuatoriano 2021	ADM2	Agencia de Regulación y Control de Energía y Recursos Naturales no Renovables (ARCERNNR). Estadísticas del Sector Eléctrico Ecuatoriano 2021 [Conjunto de datos]. https://anda.inec.gob.ec/anda/index.php/catalog/907/related_materials

Guyana	Percentage of households serviced with electricity from the public grid by region	2012	Guyana Bureau of Statistics	ADM1	Bureau of Statistics, 2012. Compendium 5 - Housing Stocks and Amenities. Table 5.30: Population and Housing Census - 2012 Household by Main Source of Lighting and Village (p. 58): https://statisticsguyana.gov.gy/wp-content/uploads/2019/10/Final_2012_Census_Compendium5-1.pdf
		2019 2020	Multiple Indicator Cluster Survey (MICS)	ADM1	Bureau of Statistics, MICS, 2019–2020. Table: Percent distribution of households by selected housing characteristics, according to area of residence and regions, Guyana 2019-2020 Survey: https://mics.unicef.org/sites/mics/files/Guyana%202019-20%20MICS_English.pdf
Peru	Percentage of homes with public electricity service	2017	Censos Nacionales de Población y Vivienda 2017	ADM3	Instituto Nacional de Estadística e Informática (INEI) - PERÚ, 2017. https://censos2017.inei.gob.pe/redatam
		2021	Encuesta Nacional de Programas Presupuestales (ENAPRES) 2021	ADM1	Instituto Nacional de Estadística e Informática (INEI). (s. f.). Dato completo de la Encuesta Nacional de Programas Presupuestales (ENAPRES) 2021 [Conjunto de datos]. En Plataforma Nacional de Datos Abiertos. https://www.datosabiertos.gob.pe/dataset/encuesta-nacional-de-programas-presupuestales-enapres-2021-instituto-nacional-de-2
Suriname	Percentage of households with electricity from public grid	2010	Multiple Indicator Cluster Survey (MICS)	ADM1	General Bureau of Statistics, 2004. Table: Census district profile- Population census, Demographic and Social Characteristics, Migration, Education, Employment, Transport, Fertility, Sports, Households, Living quarters, Environment, Crime; https://statistics-suriname.org/censusstatistieken-2004/.
		2018	Multiple Indicator Cluster Survey (MICS)	ADM1	Ministry of Social Affairs and Public Housing, Multiple Indicator Cluster Survey (MICS), 2018. Table SR.2.1: Housing characteristics; https://suriname.un.org/sites/default/files/2020-09/Suriname%202018%20MICS%20Survey%20Findings%20Report_English.pdf
Venezuela	Percentage of households with public electricity service	2011	Censo Nacional de Población y Vivienda 2011	ADM3	Instituto Nacional de Estadística (INE) - Venezuela. 2011. Censo Nacional de Población y Vivienda 2011.
		2020 2021	INSO - ENCOVI Indicadores Sociales - Encuesta de Condiciones de Vida	ADM1	Instituto de Investigaciones Económicas y Sociales de la Universidad Católica Andrés Bello (UCAB). (s. f.). Indicadores Sociales (INSO) - Encuesta Nacional de Condiciones de Vida (ENCOVI) 2020-2021 [Conjunto de datos]. https://insoencovi.ucab.edu.ve/indicador-de-vivienda-y-hogar/

Sanitation

Country	Indicator	Year	Survey	Granularity	Source
Bolivia	Percentage of households with sewer connection	2012	Censo De Población Y Vivienda 2012	ADM3	Instituto Nacional de Estadística (INE). 2012. Censo de población y vivienda 2012. Table: El servicio sanitario, baño o letrina tiene desague http://datos.ine.gob.bo/binbol/RpWebEngine.exe/Portal?BASE=CPV2012COM&lang=ESP
		2021	Instituto Nacional de Estadística, Encuesta de Hogares 2011–2021	ADM1	Instituto Nacional de Estadística (INE). (s. f.). Hogares según departamento y desagüe del baño o servicio sanitario, 2011–2021. [Conjunto de datos]. https://www.ine.gob.bo/index.php/estadisticas-sociales/vivienda-y-servicios-basicos/encuestas-de-hogares-vivienda/
Brazil	Percentage of people in permanent private households with sewerage connected to the general network or rainwater network or septic tank connected to the network by municipality	2010	IBGE Census	ADM2	IBGE, 2010 via INDE. Table: Percentage of permanent private homes with a bathroom for the exclusive use of residents or a toilet and sanitary sewage via the general sewage or rainwater network; https://visualizador.inde.gov.br/
		2022	IBGE Census	ADM2	IBGE, 2022. Table: Percentage of people in permanent private households with sewerage connected to the general network or rainwater network or septic tank connected to the network; https://censo2022.ibge.gov.br/apps/pgi/#/mapa/?share=WyJvc20iLDQuNTEzODU3MTQ1NzIxMTY4LFstNjA1MTE3My4yODI4MDAwNjksLTE2MDQyODYuMTM4MjU2ODA2XSxbWyJuYXQiLDEyMCx0cnVILDEsMCwwXV1d%2F%2F
Colombia	Percentage of households with sewer connection	2018	Censo Nacional de Población y Vivienda 2018	ADM2	Departamento Administrativo Nacional de Estadística (DANE). 2018. Censo Nacional de Población y Vivienda 2018. http://systema59.dane.gov.co/bincol/RpWebEngine.exe/Portal?BASE=CNPVBASE4V2&lang=esp
		2021	Índice Departamental de Competitividad 2022	ADM1	Consejo Privado de Competitividad (CPC). (s. f.). Índice Departamental de Competitividad 2022 [Conjunto de datos]. Data Year: 2021. Table: Condiciones Habilitantes. https://compite.com.co/indice-departamental-de-competitividad-idc/
Ecuador[67]	Percentage of households with sewer service	2021	Boletín Estadístico Agua Potable y Saneamiento 2021	ADM2	Agencia de Regulación y Control del Agua (ARCA). s. f.). Boletín Estadístico Agua Potable y Saneamiento 2021. https://www.regulacionagua.gob.ec/wp-content/uploads/downloads/2022/12/Boleti%CC%81n-estadi%CC%81stico-APS-2021_fn_v02.pdf

[68] Ecuador has 2021 data available at the desired granularity (ADM2), so a projection process was not required.

Guyana	Percentage of households with connection to sewer network or septic tank by region	2012	Guyana Bureau of Statistics	ADM1	Census data from the Bureau of Statistics, 2012. Compendium 5- Housing Stocks and Amenities. Table: Distribution of Households by Types of Toilet Facilities Classified by Administrative Region, Guyana: 2012: https://statisticsguyana.gov.gy/wp-content/uploads/2019/10/Final_2012_Census_Compendium5-1.pdf.
		2019 2020	Multiple Indicator Cluster Survey (MICS)	ADM1	Bureau of Statistics, MICS, 2019–2020. Table WS.3.1: Use of improved and unimproved sanitation facilities: Percent distribution of household population according to type of sanitation facility used by the household, Guyana 2019–2020 (p. 486): https://mics.unicef.org/sites/mics/files/Guyana%202019-20%20MICS_English.pdf
Peru	Percentage of households with sewer network service	2017	Censos Nacionales de Población y Vivienda 2017	ADM3	Instituto Nacional de Estadística e Informática (INEI) - PERÚ, 2017. Table: Viviendas Particulares y hogares- Cobertura y Déficit de alcantarillado por red pública. https://censos2017.inei.gob.pe/redatam/
		2021	Encuesta Nacional de Programas Presupuestales (ENAPRES) 2021	ADM1	Instituto Nacional de Estadística e Informática (INEI). (s. f.). Dato completo de la Encuesta Nacional de Programas Presupuestales (ENAPRES) 2021 [Conjunto de datos]. En Plataforma Nacional de Datos Abiertos. https://www.datosabiertos.gob.pe/dataset/encuesta-nacional-de-programas-presupuestales-enapres-2021-instituto-nacional-de-2
Suriname	Percentage of households with sewer network or septic connections by district	2010	Multiple Indicator Cluster Survey (MICS)	ADM1	Ministry of Social Affairs and Public Housing, Multiple Indicator Cluster Survey (MICS), 2010. Table WS.5: Types of sanitation facilities- Percent distribution of household population according to type of toilet facility used by the household; https://www.statistics-suriname.org/wp-content/uploads/2019/02/suriname-mics4-2010-complete-with-cover.pdf
		2018	Multiple Indicator Cluster Survey (MICS)	ADM1	Ministry of Social Affairs and Public Housing, Multiple Indicator Cluster Survey (MICS), 2018. Table 5.9b : Households by Type of Sanitation Facility per District (Percentages); https://statistics-suriname.org/wp-content/uploads/2021/03/Final-9th-environment-pub-2020.pdf
Venezuela	Percentage of households with safely managed sanitation services	2011	Censo Nacional de Población y Vivienda 2011	ADM3	Instituto Nacional de Estadística [INE]-Venezuela. 2011. Censo Nacional de Población y Vivienda 2011.
		2020 2021	INSO - ENCOVI Indicadores Sociales - Encuesta de Condiciones de Vida	ADM1	Instituto de Investigaciones Económicas y Sociales de la Universidad Católica Andrés Bello (UCAB). (s. f.). Indicadores Sociales (INSO) - Encuesta Nacional de Condiciones de Vida (ENCOVI) 2020–2021 [Conjunto de datos]. https://insoencovi.ucab.edu.ve/indicador-de-vivienda-y-hogar/

6.9 IATI investment sector

IATI's investment lists are classified within sectors following OECD DAC CRS 5-digit purpose codes. For the purposes of this project, 52 sectors were identified as bioeconomy related and 12 sectors were identified as related to climate resilience and adaptation. The complete list of codes and sector definitions can be reviewed at https://iatistandard.org/en/iati-standard/203/codelists/sector/#codes

Bioeconomy-Related Sectors	
Agricultural water resources	Fishery research
Agricultural inputs	Fishing policy and administrative management
Agricultural research	Flood prevention/control
Agricultural services	Food crop production
Agricultural policy and administrative management	Forest industries
Agricultural alternative development	Forestry development
Agricultural extension	Forestry education/training
Agricultural development	Forestry policy and administrative management
Agricultural education/training	Forestry services
Agricultural land resources	Hybrid energy electric power plants
Agricultural financial services	Hydroelectric power plants
Agricultural cooperatives	Industrial crops/export crops
Agrarian reform	Livestock
Agro-industries	Mineral prospection and exploration
Basic metal industries	Mineral/mining policy and administrative management
Biodiversity	Nonagricultural alternative development
Disaster Risk Reduction	Oil and gas (upstream)
Electrical transmission/ distribution	Plant and postharvest protection and pest control
Energy generation, renewable sources - multiple technologies	Power generation/renewable sources
Energy policy and administrative management	River basins development
Energy sector policy, planning, and administration	Site preservation
Environmental education/training	Solar energy for centralized grids
Environmental policy and administrative management	Technological research and development
Environmental research	Tourism policy and administrative management
Fishery development	Water resources conservation (including data collection)
Fishery education/training	Water sector policy and administrative management

Climate-Related Sectors
Disaster risk reduction
Electric mobility infrastructures
Environmental education/training
Environmental research
Flood prevention/control
Solar energy
Solar energy - thermal applications
Solar energy for centralized grids
Solar energy for isolated grids and standalone systems
Technological research and development
Wind energy
Wind power

6.10 Quality assurance and quality control

To ensure high-quality, accurate results, all gaps and multigaps were subject to a quality assurance and quality control (QAQC) review process. The QAQC was structured in four phases. All identified errors were corrected by the team.

#	Phase	Process	Results
Round 1	Internal Review of all 20 Gaps	A 13-phase process performed by the project team to review file attribution, spatial representation, projections, data attribution, and methods.	Errors of file attribution, analytical exceptions, and data attribution identified and corrected.
Round 2	Blind External Review of Census and Survey Data	An external team performed a blind sampled review of census and survey data including transcriptions, projections, and attributions.	No errors in transcription, projection, or data attribution were identified.
Round 3	Blind External Review of Gap Pressure Points	An external team performed a blind review of high-risk points across the gap analysis, including reviews of cost-distance analyses, complex methodologies, and frequently used analyses.	No errors were identified.
Round 4	Internal Review of all 20 Gaps	A second round of 13-phase process performed by the project team to review file attribution, spatial representation, projections, data attribution, and methods.	Errors of file attribution and data attribution identified and corrected.

Multisectoral Gap Round 1	Spatial Review	The multigap analysis was rerun by the team, limiting the analytical extent to a four-country sample to maximize efficiency. The model was recreated from scratch to ensure any analytical errors were not carried over to the rerun of the process. The team then compared country results for accuracy in spatial representation, data attribution, and methods.	Errors of overlap in transboundary areas between countries were identified and corrected.
Multisectoral Gap Round 2	Statistical Review	Population statistics were calculated and compared to original country results. The study area was limited to a foue-country sample to maximize efficiency. The statistical model was recreated to eliminate any prior analytical errors. The team compared country results for accuracy in data attribution and methods.	Errors of population summary and disaggregation for the human development multisectoral gap were identified and corrected.

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