AMAZONIA UNDER PRESSURE

2020

RAISG
AMAZONIAN NETWORK OF GEOREFERENCED SOCIO-ENVIRONMENTAL INFORMATION

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DECEMBER 2020
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Acknowledgements
EcoCiencia: Ana Maria Acosta and Sylvia Villacis,
FAN: Sara Espinoza and Fabio Cotrina
Gaia: Alejandra Salazar
IBC: María Rosa Montes
ISA: João Victor Siqueira (consultant) and William Pereira Lima
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About RAISG

The Amazonian Georeferenced Socio-environmental Information Network (RAISG) is a consortium of civil society organizations formed in 2007 that advocates the socio-environmental sustainability of the region, with the support of international partners.

RAISG generates and disseminates spatial and statistical socio-environmental information on Amazonia, developed through protocols common to all the national organizations that make up the consortium.

RAISG currently comprises eight organizations from six Amazonian countries: Bolivia, Brasil, Colombia, Ecuador, Perú, and Venezuela.

Suggested document citation:
RAISG, 2020. Amazonia Under Pressure, 68 pgs.
(www.amazoniasocioambiental.org)

Dados Internacionais de Catalogação na Publicação (CIP)
(Câmara Brasileira do Livro, SP, Brasil)

Amazonia under pressure / realização RAISG [tradução Tony Gross]. -- 1. ed. -- São Paulo : ISA - Instituto Socioambiental, 2021.

Título original: Amazonía bajo presión
Vários colaboradores.
ISBN 978-65-88037-07-2

1. Amazônia - Condições econômicas 2. Amazônia - Condições sociais 3. Amazônia - Clima 4. Amazônia - Desenvolvimento 5. Área de proteção ambiental - Amazônia 6. Biodiversidade - Amazônia 7. Conservação da natureza - Amazônia 8. Desmatamento - Amazônia 9. Povos indígenas - Territórios 10. Problemas sociais 11. Queimadas - Amazônia

21-56015 CDD-363.705

Índices para catálogo sistemático:

1. Amazônia : Povos indígenas : Atlas de pressões e ameaças : Problemas sociais 363.705

Maria Alice Ferreira - Bibliotecária - CRB-8/7964

ISBN 978-65-88037-07-2

To see the original (2012) version of **"Amazon under Pressure"**, access www.amazoniasocioambiental.org

Support

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INTRODUCTION

Amazonia is a region that has attracted the world's attention for various reasons: its huge biodiversity, broad hydrographic network, cultural diversity and the role it plays in regulating the climate as the most extensive continuous tropical forest on the planet, are causes for wonder. However, its natural riches have been and continue to be coveted, which over time has generated great transformations in the landscape, the composition of its population and its future prospects, putting the maintenance of the natural and cultural elements that characterize it at risk.

In 2020, the Covid-19 pandemic has made the fragility of the region even more evident. This is not a new claim, but one that has been repeatedly mentioned by researchers, civil society organizations and, above all, by its native inhabitants. Nevertheless, this global epidemic has highlighted the degree of vulnerability of the region's inhabitants and especially its indigenous peoples.

The results of the latest study carried out by RAISG, in alliance with MapBiomas Amazonia, show that as of 2018 Amazonia had retained 83.4% of its natural vegetation cover. However, between 1985 and 2018 the biome had lost 724,000 km^2 of its natural vegetation, an area similar in size to the territory of Chile.

Science, in its various aspects, is advancing with its task of providing information on the growth of degradation, as well as offering alternatives. On the part of RAISG, with our team of scientists, researchers and cartographers, we remain committed to bringing to light the principal problems facing Amazonia and collectively proposing innovative solutions based on data and evidence that can ensure for present and future generations the well-being of its inhabitants and the protection of these invaluable ecosystems.

The "Amazonia Under Pressure" Atlas, first published by RAISG in 2012, presented a panorama of the serious situation facing the Amazon region and its peoples as a result of road and hydroelectric megaprojects, the promotion of extractive industries and the growth of illegal activities. The regional context appears to have been profoundly transformed in these few short years, with the fundamental rights of nature, of indigenous peoples and socio-environmental protection taking a back seat. In this landscape, revisiting the issues discussed in "Amazonia Under Pressure" is crucial to promoting the maintenance of a system as complex as Amazonia.

Revisiting the main pressures on and threats to Amazonia, we have incorporated other perspectives and themes, and have evaluated the changes that have occurred in those issues common to both, to make the analysis useful for decision-makers at various levels and for those who work in the ongoing discussions essential for protecting the region.

Few topics reveal the centrality of Amazonia in our lives as much as studies of its hydrological cycle. Today we know that it is not only those who live in the region and the multiple life forms that inhabit it who depend on the rhythm of rains and floods in this enormous basin. The South American continent, whether in the Andes, the River Plate basin, or the vast granary that is the Cerrado, is connected to Amazonia. For this reason, the present publication contains a special supplement on the question of the state of preservation of the headwaters that feed the great Amazon River, as well as the most important flood zones.

Sisi-wen waterfall ("Home of the Swallows" in the Ingarikó language), upper Cotinga River, Raposa Serra do Sol Indigenous Land and Monte Roraima National Park on the Brasil-Guyana border. *Taylor Nunes, 2007.*

ANALYTICAL PROCESS

Since the beginning, all RAISG products have been based on the use of geographic information and cartography. This poses great challenges as it involves normalizing the databases of nine countries and developing a regional structure based on national information.

To achieve this, it was necessary to define common protocols for the collection, compilation, analysis, and representation of the data. This means having common legends where each element of the topics included in the analysis has the same meaning in each country. The principal methodological considerations of the data and analyses contained in this publication are summarized below.

Boundaries of Amazonia

The exercise of bringing these databases into a single regional map reveals that the official cartographies of each country, as regards international boundaries, do not automatically adjust to each other. This results in overlaps and even gaps between boundaries. To solve this problem, the RAISG technical group has normalized these boundaries, first by adjusting those limits that are waterways and watersheds, and then the straight lines.

The result is a map of "referential limits", which is why the surface areas of each country may differ to official data, as well as differences attributable to the geographic projection used at the regional level, which may be different from that used in the national context of each country.

Analytical Approach

Protected Natural Areas (PNAs) and Indigenous Territories (ITs)

The main purpose of our publications, including "Amazonia Under Pressure", is to communicate the importance of Indigenous Territories (ITs) and Protected Natural Areas (PNAs). This publication compiles the information that RAISG has accumulated since it was founded in 2007. It is thus possible to find information here on the extent of these protected lands throughout Amazonia collectively over time.

PNAs constitute a tool for societies to conserve the components of biodiversity and the physical-natural elements of the landscape. Through PNAs, societies seek to conserve natural ecosystems and, thus, the benefits these provide. On the one hand, ITs are, for the most part, lands that have been ancestrally occupied by indigenous peoples coexisting with nature in a balance that enables the persistence of ecosystems in states closely corresponding to their natural evolution. Levels of recognition by national governments vary according to their political constitution, the importance they give to cultural diversity, and the diligence of the institutions in charge.

PNAs in Amazonia operate in different administrative contexts (national, departmental, and municipal governments, as well as in the private sector). Also, they vary in terms of types of activities permitted, restricted, or prohibited in accordance with so-called "use categories" related to the level of conservation that each area aims for. There are thus PNAs for i) indirect use, whose objective is to keep natural ecosystems as intact as possible, with research, recreation and education allowed in ways compatible with conservation objectives; ii) direct use, which permits compatible controlled activities while protecting resources, iii) direct/indirect use, which are mixed areas, in which use is defined by zoning; and finally iv) transitory categories, which are reserved areas of forest ecosystems that may or may not become protected areas or concessions, according to the results of research.

Concerning ITs, four categories have been considered, depending on progress in the legal recognition process that each territory has reached at the national level. We have: i) officially recognized ITs, those that have legal instruments recognising their territorial rights, ii) ITs without official recognition, iii) Indigenous Reserves or Intangible Zones and iv) Proposed Indigenous Reserves.

For this publication, when ITs and PNAs extend beyond Amazonia, only the area lying within the limits of Amazonia is considered. In the case of coastal areas, only their continental coverage is included.

Pressures and threats

In this chapter, we present the main topics analysed for their potential to induce environmental degradation: infrastructure projects (with analysis of the advances of roads/highways and investments in hydroelectric plants) and activities associated with extractive industries (mining and hydrocarbons), as well as agricultural and livestock activities. We have also given special attention to activities occurring outside the law, such as illegal mining, unauthorized logging, and illicit crops, due to the repercussions they have for the transformation of space.

The classification "Pressure and threats" has been used by RAISG since the first edition of "Amazonia

Mount Katantika, Apolobamba National Park, La Paz, Bolivia. *Marcelo Arze/FAN, 2013.*

Antisa volcano seen from the Cayambe Coca National Park, Ecuador. *Esteban Suárez Robalino, 2019.*

Under Pressure". By pressure we mean those activities that are ongoing or in the process of installation and whose impacts can be measured, while threats are projects and planned investments, whose characteristics allow us to estimate their future impacts.

This study is based on calculations and estimates resulting from an analysis carried out with Geographic Information System tools, reflecting trends. They may therefore differ, to some extent, from official values at national level.

Symptoms and consequences

There is a diversity of pressures that affect Amazonia. In the chapter on "Pressures and threats", we consider several of these. However, they are not the only ones at play. One way to address the changes that all activities, taken together, generate on the natural terrestrial ecosystems of the region is to examine three consequences of these: deforestation, fires, and changes in the amount of stored carbon. The closeness of the connection between the different activities may vary, but it nevertheless exists.

In 2012 we devoted space to the process of deforestation and to fire pixels. This time, we have deepened our analysis to incorporate changes in stored carbon in forest biomass. In this way, we can provide an assessment that better enables us to understand the process of environmental degradation, foresee potential impacts on climate regulation, and identify those areas that have experienced the greatest transformation.

Synthesis maps

Thematic analysis, especially multi-temporal analyses, are particularly useful for understanding the socio-environmental dynamics taking place in Amazonia. Thematic units of analysis are often used to carry out such analyses. National boundaries and PNAs and ITs areas have been used in RAISG analyses offered in the previous version of the Atlas and in other publications.

Constituting a methodological innovation and a tool for synthesising the components of pressures, threats, symptoms and consequences of human activity presented in its different chapters, this Atlas establishes homogeneous units of analysis (UHA), also known as tesserae due to their close relationship with the matrix system that uses the raster format. Twenty km^2 hexagons are used for this. Their definition is based on histograms or frequency graphs of the size of the polygons of the variables under examination, such as oil, mining, and agricultural activity. In this way, Amazonia has been divided into approximately 424,000 homogeneous units of analysis.

To undertake synthesis analysis by UHA, each category of each pressure and symptom is assigned a weight, based on expert criteria. In this way, using the metrics of the weighted sums, the "threat" value of each cell is established, which allow the identification of pressures, threats, symptoms and consequences when contrasted with PNAs and ITs, within each unit.

Basin Headwaters and Flood Seasonality

Of the topics addressed in this publication, we have decided to give special emphasis to hydrological issues and so an analysis of the water productivity of hydrographic basins has been carried out for the whole RAISG area.

To assess the importance of the headwaters of hydrographic basins at the Amazonian scale, an analysis was undertaken beginning by identifying small basins (micro-basins of approximately 500 km^2) and ranking these according to the Strahler order (an index of rivers or waterways that varies from level one on slopes to seven for rivers with more tributaries). This analysis was combined with altitude to differentiate the headwaters of basins at higher elevations. Likewise, information on water balance indexes, generated from precipitation and evapotranspiration (HydroSHEDS) was integrated to identify areas with the highest excess water. The map resulting from this calculation differentiates: 1) basin headwaters with Very High Productivity, High Productivity, and Producing Zones; 2) Hydro-ecological connections, differentiating Water Connectivity Zones; and 3) Accumulation Zones (medium to very high).

To complete this analysis, a detailed look at the rhythm of inundations across the region is included. Thus, for the flood seasonality map, we have created a classification that classifies areas from very low to very high.

All the related analytical maps can be found on the special inserts of this publication.

2012 to 2020: Changes over time

Since the previous publication in 2012, the methodology, access to information and cartographic precision of RAISG's analyses have improved. As a result, there may be some disparities concerning the 2020 data. Therefore, comparative analyses over time are only reference points.

In this publication, we have been able to incorporate information extending up to the boundaries of the Amazon basin in the Andean portion, which was beyond the limits of the analysis undertaken in 2012. Taking these differences in the areas of analysis into account, in each chapter information corresponding to the new (wider) limits is included and comparisons over time are incorporated where the area analysed is the same for 2012 and 2020. These adjustments have been made specifically for each topic. We, therefore, recommend that, in general, researchers, communicators, activists and citizens use "Amazonia Under Pressure" as a reference and that, when comparing the situation in 2012 with that of 2020, they consider the provisions of each chapter

Part of the Raisg team. *Sebastian Tapia, 2019.*

AMAZONIA

In our analysis of "Amazonia Under Pressure" we have used the term Amazonia to refer to the set of national Amazon regions that make up this regional unit. However, irrespective of whether 'Amazonia' or 'the Amazon region' is the term used, it must be assumed that its definition and delimitation consider its various aspects. For example, some use the term to refer to the area occupied by tropical forest, often called the Amazon biome. Others talk of the Amazon River basin which, from a hydrographic perspective, refers to the area drained by the rivers that feed their waters into the Amazon River. Some define the area based on administrative boundaries, related in some cases to environmental variables. Thus, there are different ways of understanding the meaning of the terms Amazonia or the Amazon region, at both regional and national levels.

Over the years, various organizations and researchers have tried to determine the extent of Amazonia. Among these, the work of the Amazon Cooperation Treaty Organization (ACTO) and the Amazonian Scientific Research Institute (SINCHI) of Colombia stand out, both warning of the impossibility of adopting a single parameter for describing the region.

"The expressions Amazonia, Panamazonia, South American Amazon, Amazon Region or Greater Amazonia, comprise different approaches, insights and spatial representations. In general, these terms refer to the largest humid tropical forest on the planet, located in the north of South America; to the hydrographic basin of the Amazon River; to the Nations that have territory in these vast regions; (...) to the peoples that inhabit it, and to their terrestrial and aquatic fauna."[1]

In an article published in 2001 in the Latin American Research Review, David Cleary points out a common mistake in the characterization of Amazonia. "Scholars typically take refuge in the illusory certainties of physical geography and use the term Amazon as a synonym for the Amazon basin, the area drained by the main channel of the Amazon and its tributaries. But this approach is also problematic since in this part of the world the boundary between land and water fluctuates".[2]

Upper image: Table-top mountains in the Serrania de Chiribiquete National Natural Park, Colombia. *Wilfredo A. Garzón Paipilla, 2013.*

1 Cardona, C.A.S. & Umbarila, E.R. (2015). Perfiles urbanos en la Amazonia colombiana, 2015. Bogotá: Instituto Amazónico de Investigaciones Científicas «sinchi».

2 Cleary, D. (2001). Towards an Environmental History of the Amazon: From Prehistory to the Nineteenth Century. Latin American Research Review, 36(2), 65-96.

MAP 1. BOUNDARIES OF AMAZONIA AND THEIR MULTIPLE CRITERIA: THE BASIN, THE BIOGEOGRAPHIC AND THE RAISG BOUNDARIES

— RAISG BOUNDARY (Maximum boundary of Amazonia) biome + administrative regions + hidrographic basin
8.470.209 km²

— ADMINISTRATIVE REGION
Ecuador (RAE) and Brasil (Amazônia Legal)

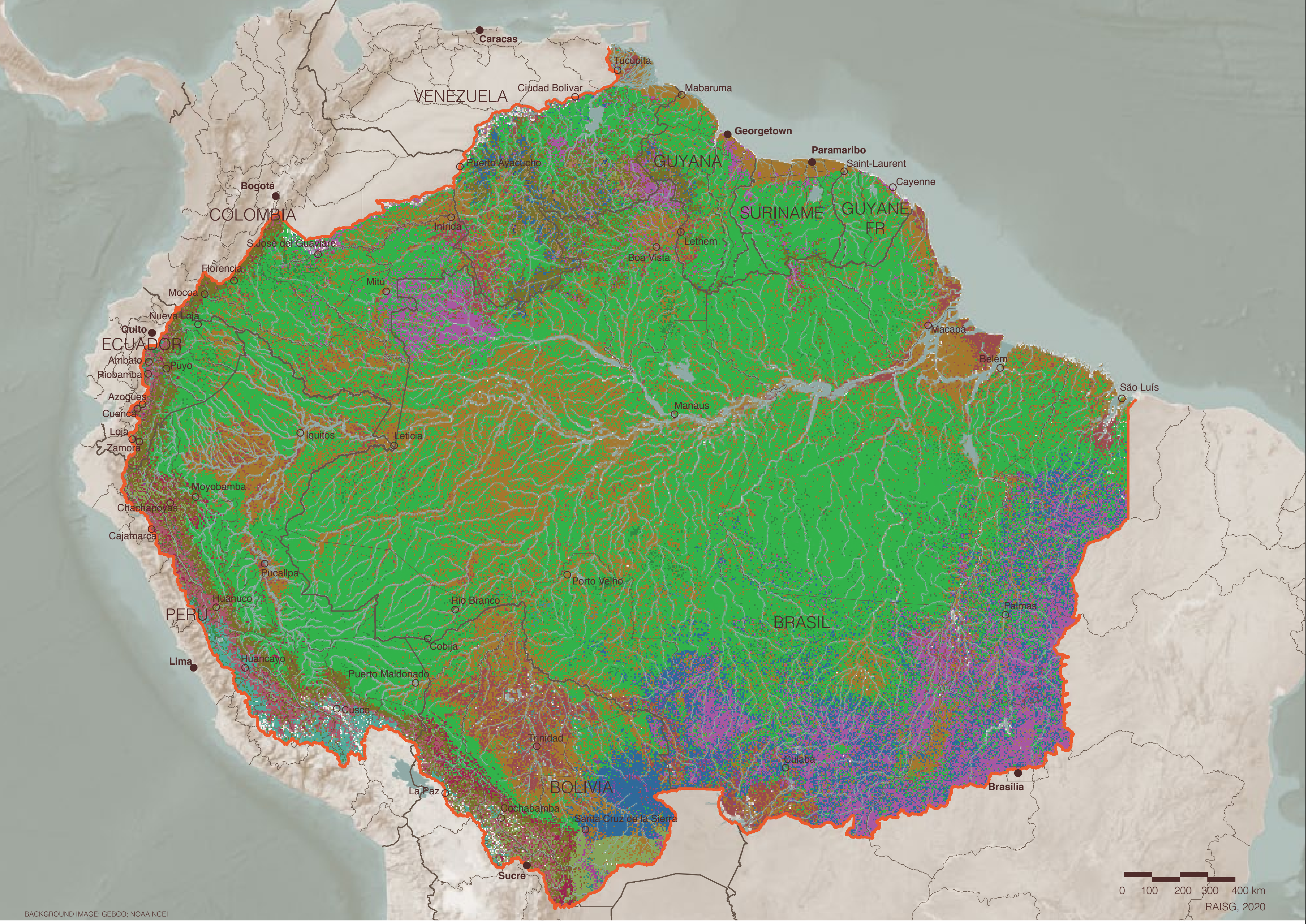
BIOGEOGRAPHIC BOUNDARIES
7.004.120 km²

HIDROGRAPHIC BASIN
(AMAZONAS, ARAGUAIA-TOCANTINS AND MARAJÓ)
6.925.918 km²

TABLE 1. AREA OF AMAZONIA BY COUNTRY AND PROPORTION OF TOTAL AREA IN EACH

Country	Bolivia	Brasil	Colombia	Ecuador	Guyana	Guyane Française	Perú	Suriname	Venezuela	Amazonia
Amazon area of the country (km²)*	714,834	5,238,589	506,181	132,292	211,157	84,226	966,190	146,523	470,219	8,470,209
% of Amazonia in the country	8.4%	61.8%	6.0%	1.6%	2.5%	1.0%	11.4%	1.7%	5.6%	100.0%

* Area calculated by GIS using Sinusoidal Projection, -600 meridian and adjusted to national boundaries. GIS coverages may differ from national level data.



MAP 2. VEGETATION TYPES IN AMAZONIA

— RAISG BOUNDARY

VEGETATION TYPES
classified by phytophisionomy and floristic composition

- Xeromorphic Shrubland, Grassland & Savanna
- Xeromorphic Shrubland & Grassland
- Xeromorphic Scrub & Woodland
- Swamp & Flooded Forest
- Lowlands Interior Brackish Marsh
- Shrubland & Savanna
- Shrubland & Grassland
- Salt Marsh
- Montane Shrubland & Grassland
- Montane Humid Forest
- Montane Dry Forest
- Montane Cliff, Scree & Rock Vegetation
- Montane Bog
- Mangrove
- Lowland Shrubland, Grassland & Savanna
- Lowland Humid Forest
- High Montane Scrub & Grassland
- Freshwater Marsh, Wet Meadow & Shrubland
- Freshwater Marsh & Shrubland
- Freshwater Aquatic Vegetation
- Flooded Forest
- Lowland Dry Forest
- Cool Semi-Desert Scrub & Grassland
- Cool Semi-Desert Cliff, Scree & Other Rock Vegetation
- Cliff, Scree & Rock Vegetation
- Bog & Fen

Source: extracted and modified from Comer PJ, Hak JC, Josse C, Smyth R (2020) Long-term loss in extent and current protection of terrestrial ecosystem diversity in the temperate and tropical Americas. (v. pág. 67).

MAP 3. VEGETATION CLASSES IN AMAZONIA

— RAISG BOUNDARY

VEGETATION CLASSES

- SHRUBLAND & GRASSLAND
- ROCK VEGETATION
- POLAR & HIGH MONTANE SCRUB & GRASSLAND
- FOREST & OPEN WOODLAND
- DESERT & SEMI-DESERT
- AQUATIC VEGETATION

0 200 400 km

RAISG, 2020

Source: extracted and modified from Comer PJ, Hak JC, Josse C, Smyth R (2020) Long-term loss in extent and current protection of terrestrial ecosystem diversity in the temperate and tropical Americas. (v. pág. 67).

Yellow Ipê. Flight between Volta Grande and IT Ituna Itatá. *Marcelo Salazar / ISA, 2019*

Nine countries have portions of what we here call Amazonia: Bolivia, Brasil, Colombia, Ecuador, Guyane Française, Guyana, Perú, Suriname and Venezuela. The territories of Suriname, Guyana and Guyane Française are not part of the Amazon River basin but are covered by forests similar in form and composition to the rest of the region.

RAISG has compiled information from national databases for each of the three approaches to Amazonia: the Amazon and associated basins, Amazonian ecosystems, and administrative regions.

The intention is not to establish definitive boundaries for Amazonia, but to delimit the area of analysis such that the information is useful to different users and reflects the complexity of the environmental and social characteristics of the region.

The boundary used by RAISG in this publication (8,470,209 km2) is a sum of the three criteria mentioned, always considering the largest option. This results in a boundary formed by: i) the limits of the Amazon biome in Colombia and Venezuela; ii) the limits of the Amazon basin in Ecuador, Perú and Bolivia; iii) the sum of the limits of the basins (Amazonas and Araguaia/Tocantins) and the limits of the administrative Legal Amazon in Brasil; iv) the whole continental territories of Guyana, Guyane Française and Suriname.

BIODIVERSITY AND CULTURAL DIVERSITY IN AMAZONIA

Although known for its extensive rainforest, Amazonia houses a wide diversity of landscapes, with different geological and evolutionary histories. Thus, the central lowlands are surrounded to the south and east by the Cerrado, an area with a predominance of savanna[3]; To the north, on the Guiana Shield, there are other formations of savannas and grasslands, within a mountain environment, with its famous table-mountain formations (tepuis); and to the west, a gradient of ecosystems on the eastern slopes of the Andean mountain range can be observed. Thus, different stages in the history of the earth's formation are joined together, ranging from the oldest (the Precambrian period) in the north, the Tertiary in the west, and the Quaternary (the most recent) along the rivers of its central and southern areas.

Scientific evidence suggests that Amazonia currently contains the most extensive tropical forest in the world; but also a great diversity of ecosystems, as well as a high number of species from different biological kingdoms, many of them exclusive to this region, which makes estimating its biodiversity practically impossible. This is one reason why Amazonia is fundamental to strategies for the conservation of global biodiversity.

To understand why this diversity of life and landscapes continues to be conserved, we need to recognize the role of indigenous peoples in the protection of their territories through their traditions and customs. These territories currently occupy 27.5% of Amazonia, that is 2.3 million km². There are 410 indigenous groups living here, of which 82 (Table 2) are in voluntary isolation and have not been contacted by other peoples or societies.

As well as the indigenous population, among the inhabitants of Amazonia are both large landowners and settlers with small plots of land who came to Amazonia in search of new opportunities, sometimes encouraged by official settlement policies. These colonizing populations encountered the original riverine and indigenous populations, which has led in some areas to permanent territorial disputes.

In this publication, we also consider the issue of the Urban Amazon (see box 1). It is impossible to understand contemporary Amazonia without considering the rapid process of urbanization that has occurred in recent decades and which has also contributed, through migratory flows, to the diversity of the region's population. The social background of Amazonia comprises immigrants of various origins, a large-scale process of mobilization that continues, as we can see for example in the migration of Andean populations to the Peruvian, Ecuadorian, Bolivian and Colombian Amazon regions, the movements of settlers from southern Brasil to its southern and central Amazon regions, or the exodus of Venezuelan refugees to other cities in the region.

3 Marques, E.Q. et al. (2020). Redefining the Cerrado-Amazonia transition: implications for conservation. Biodiversity and Conservation, 29(5), 1501-1517.

Baniwa community of Tucumã-Rupitã, upper Içana River, Alto Rio Negro Indigenous Land, São Gabriel da Cachoeira, Amazonas, Brasil. *Beto Ricardo/ISA, 2008.*

TABLE 2. INHABITANTS OF AMAZONIA BY COUNTRY, ACCORDING TO STATISTICAL SOURCES CONSULTED BY RAISG

Country	Indigenous peoples	Isolated groups	Population	% Pop. Amazonia	% Country	Date	Source	Amazonian population	Source & date	Country population	Source
Bolivia	32	7	243 006	2.9%	2.1%	2011	Fundación Tierra / 2011	8,276,645	FAN /2020/2014	11633371	INE
Brasil	190	54	752 421	2.6%	0.4%	2020	SESAI / 2020	29,062,426	IBGE / 2019	210,147,125	IBGE / 2019
Colombia	62	2	169,513	11.6%	0.4%	2018	DANE / 2018	1,460,833	DANE / 2018	48,258,494	DANE / 2018
Ecuador	11	1	245,014	25.6%	1.4%	2010	INEC / 2010	956,699	INEC / 2019	17,510,000	INEC / 2019
Guyana	9	yes	68,675	9.1%	9.1%	2002	Bureau of Statistics / 2007	751,223	Bureau of Statistics / 2007	751,223	Bureau of Statistics / 2007
Guyane Française	6	0	7,850	3.3%	3.3%	2009	Davy, D. and Grenand, P. (CNRS) / 2009	237,549	Insee / 2013	237,549	Insee / 2013
Perú	61	14	418,364	10.3%	1.3%	2017	IBC-SICNA / 2020	4,076,404	INEI / 2017	31,237,385	INEI / 2017
Suriname	10	yes	18,200	3.4%	3.4%	2013	IWGIA / 2013	534,500	World Bank / 2012	534,500	World Bank / 2012
Venezuela	29	4	257,079	12.5%	0.9%	2020	Wataniba / 2020 (INE 2001-2011)	2,064,243	Wataniba / 2020 (INE 2001-2011)	29,805,860	Wataniba / 2020 (INE 2001-2011)
TOTAL	**410**	**82**	**2.188.122**	**4,6%**	**0,6%**			**47.420.522**		**350.115.507**	

Notes on indigenous populations
Bolivia: Indigenous population estimated by FAN following Terra Foundation 2011; **Brasil:** Data by ISA compiled from Sesai/2020 and based on communities by municipality. According to SisArp/ISA, the population of Indigenous Territories is approximately 355,000 individuals (compiled from different sources and dates); **Colombia:** Data concerning indigenous population and population of the Colombian Amazon compiled from the DANE/2018 Census; **Ecuador:** Data from the Population and Housing Census 2010. National Institute for Statistics and Census (INEC); **Guyana:** Data from the Government of Guyana (2007), 2002 Population & Housing Census - Guyana National Report, Georgetown, Bureau of Statistics; **Perú:** Data from the National Institute of Statistics and Informatics - INEI, 2017. The figure of 418,364 does not include indigenous population of the peasant communities; **Suriname:** IWGIA indigenous population data (2013) The Indigenous World 2013 http://www.iwgia.org/regiones/Latin America/Suriname; **Venezuela:** Wataniba/2020 (INE/2001-2011).

BOX 1 THE URBAN AMAZON

When visiting cities such as Iquitos in Perú, Florencia in Colombia or Manaus in Brasil, one common feature stands out: they are dense urban environments, with intense traffic and poorly maintained and neglected road infrastructure. They are cities where the collection and treatment of wastewater, as well as the disposal of solid waste, are deficient or non-existent. They are also urban settlements whose rates of violence are among the highest and of quality of life among the lowest.

In all the countries of Amazonia, cities are growing at a rapid rate, a trend that began decades ago. Population growth in urban settlements, driven largely by the economic cycles of extractive industries, is proportionally one of the highest in South America. In 2009, among countries that make up Amazonia, an estimated 33.5 million people were Amazonian, of whom 62.8%, equivalent to 20.9 million people, lived in urban areas.[i]

As researcher Eduardo Brondizio of the University of Indiana observes, this percentage is highest in Brasil. Currently, three-quarters of the population of the Brazilian Amazon live in medium and large cities and suffers from such problems as lack of sanitation and violence. Three Amazonian capitals of Brasil are among the fifty most violent cities in the world, based on homicides per 100,000 inhabitants: Manaus (23), Belém (26) and Macapá (48).[ii]

Bertha Becker, one of the leading researchers on the urban Amazon in Brasil, began to demonstrate in the 1980s that even spaces that could not be termed cities were greatly influenced by cities. In her words, the Brazilian Amazon had become an "urban forest".

Becker's conclusions pointed to a systemic connection between rural areas and cities, where the latter's demands ended up modifying Amazonian economy and society. At an even more basic level, today we can see a close relationship in Amazonia between urban areas and economic activities established in the forested regions, whether agricultural or extractive. For example, once roads have improved, access to natural resources is inevitable and this relationship becomes stronger when there are roads that facilitate the exploitation of forest resources and the production of food in rural areas for consumption and transformation in the "city".

Growth in Perú is also strong. According to information compiled by Marc Dourojeanni and collaborators in the report "Peruvian Amazon 2021[iii], the Amazon region continues to be a magnet for the migration of Andean populations, in search of the jungle economy, opportunity, and cheap land. As in Brasil, most of the region's population (56%) already lives in urban areas. Poverty rates for this population (48%) are higher than the national average.

In its report "Urban Profiles of the Colombian Amazon", the Sinchi Institute (see reference pg 08) suggests that in Colombia two types of settlement can be distinguished. One is the ring of settlement, a rural-urban consolidation that "corresponds to an area of continuous population, organized into hierarchies of cities or towns, with a communication network that integrates the whole and whose economy is based on the production of goods (extractive productive activity of generation of surpluses for consumption and commercialization)" and the other is the Amazon lowlands, an area predominantly of tropical forest, with a dispersed population, mostly indigenous, whose economy is largely subsistence-based and where ecological impacts are lower.

No matter how affected cities are by violence and poverty, they still seem to be full of opportunities. Towns are especially attractive to young river dwellers and indigenous peoples, who are the main victims of the lack of opportunities, as the towns are not designed for remote areas. For families, it is common to have a house in the town, as well as in the community since this means access to health and education.

The Sinchi Institute has estimated that 25% of the population in urban settlements of Amazonia is indigenous. Towns absorb indigenous people but are not designed to preserve indigenous culture. For example, the Institute observes that those who occupy the settlement ring have very different productive activities (mainly in the provision of labour) from those of indigenous people who occupy the Amazonian forests, where they are oriented towards the sustainability and production of self-consumption resources.

i PNUMA, OCTA, & CIUP. (2009). GEO amazonia. In Programa de las Naciones Unidas para el Medio Ambiente (Vol. 168).

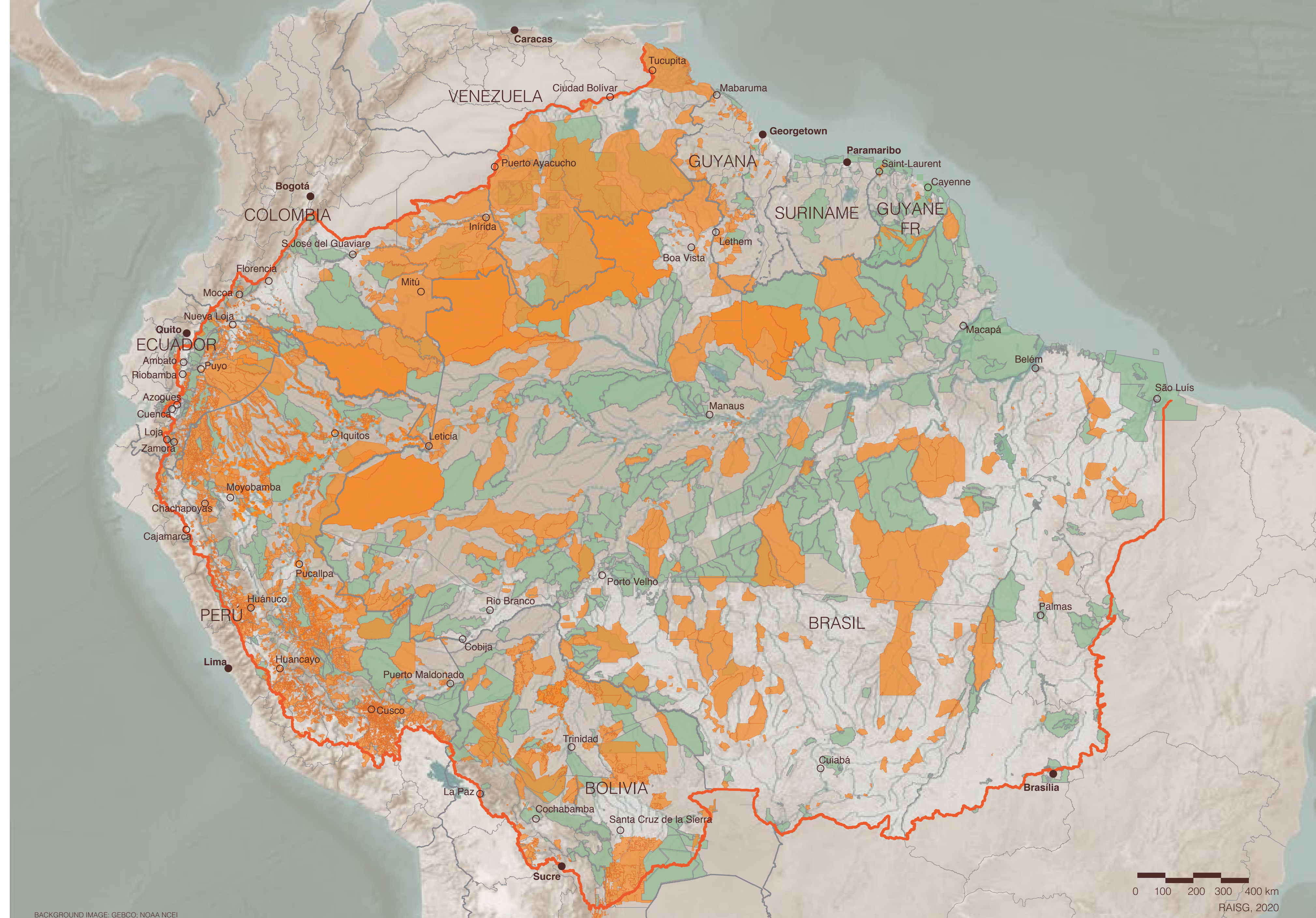
ii Brondizio, E.S. (2016). The Elephant in the Room: Amazonian Cities Deserve More Attention in Climate Change and Sustainability Discussions https://www.thenatureofcities.com/2016/02/02/the-elephant-in-the-room-Amazonian-cities-deserve-more-attention-in-climate-change-and-sustainability-discussions/

iii Dourojeanni, M. et al (2009). Amazonía peruana en 2021. Explotación de recursos naturales e infraestructura: ¿Qué está pasando? ¿Qué es lo que significa para el futuro? SPDA; DAR; ICAA https://spda.org.pe/wpfb-file/20120216164858_amazonia-peruana-pdf/

San José del Guaviare and the Guaviare River. *Wilfredo A. Garzón Paipilla, 2013.*

Morona Cocha is a settlement on the outskirts of the city of Iquitos, Perú. It is a distinct neighbourhood and port in the province of Maynas, Loreto region. *Álvaro Del Campo/The Field Museum, 2014.*

INDIGENOUS TERRITORIES AND PROTECTED NATURAL AREAS



MAP 4. INDIGENOUS TERRITORIES AND PROTECTED NATURAL AREAS IN AMAZONIA

INDIGENOUS TERRITORY
PROTECTED NATURAL AREAS
RAISG BOUNDARY
FOREST OUTSIDE IT / PNA

The recognition of the territorial rights of indigenous peoples and the establishment of natural protected areas are crucial for safeguarding socio-environmental diversity.

ITs currently comprise 2,376,140 km², equivalent to 27.5% of Amazonia, while there are 2,123,007 km² in PNAs, representing 24.6% of the region. In order not to overstate this proportion of the area, we need to bear in mind that 17.7% of the area of ITs overlaps PNAs (420,563 km2). Together, ITs and PNAs cover 47.2% of Amazonia, according to information available in December 2019.

Direct use PNAs are the most numerous in Amazonia (50.5%) and cover the largest area (1,071,799 km²). They are followed by indirect use PNAs (48.2%), with more than a million square kilometres (1,022,415 km²).

For their part, ITs may vary in the level of recognition they enjoy. According to this criterion and based on national data, four categories have been established: traditionally used and occupied territories that are officially recognized, traditionally used and occupied territories that are not officially recognized, Indigenous Reserves or Intangible Zones (reserved for indigenous peoples in isolation), and proposed Indigenous Reserves.

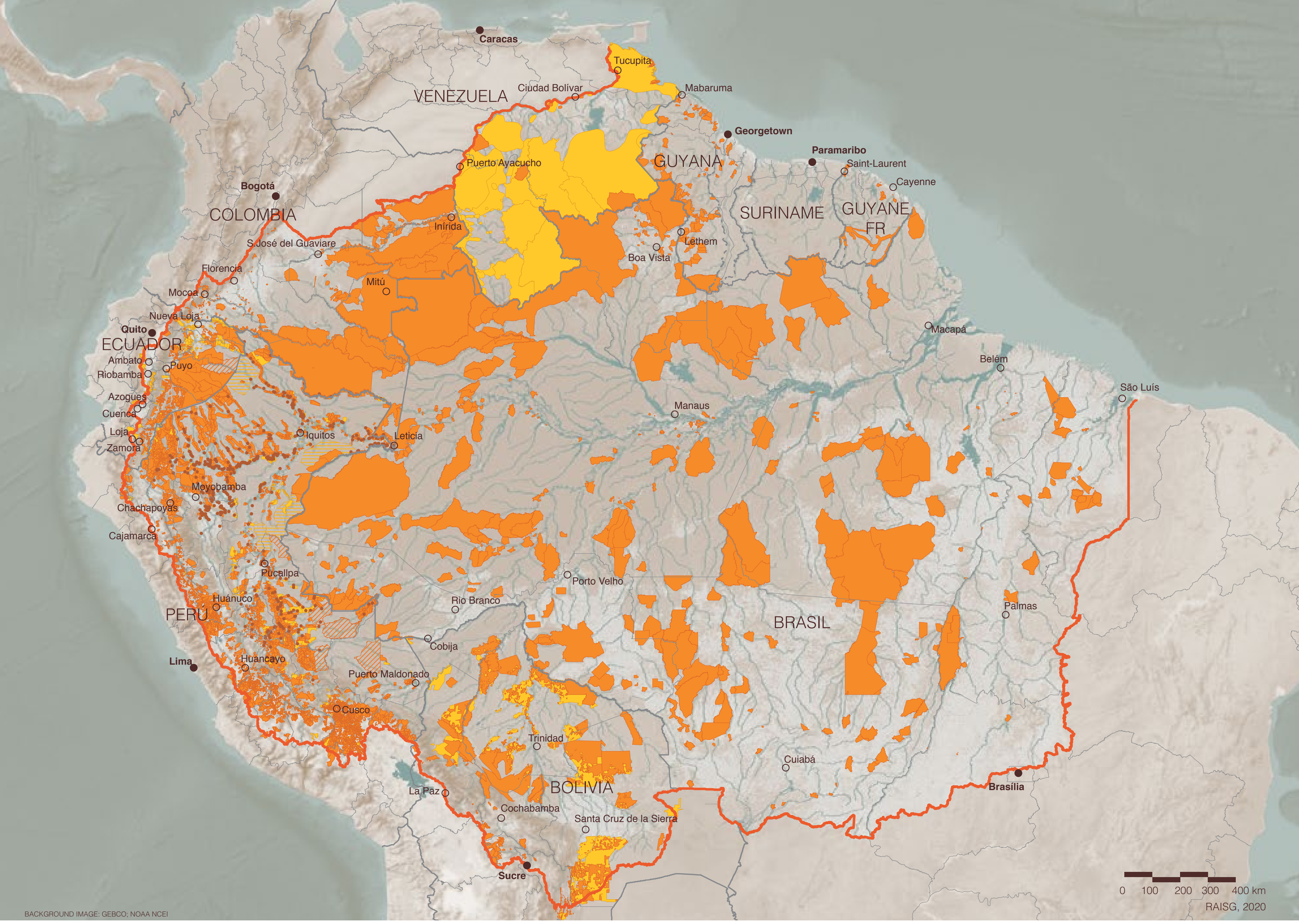
Since 2012, when "Amazonia Under Pressure" was published, there has been an increase of 211,879 km² (6% of the 2012 total) in the area recognized as ITs and PNAs in six of the Amazonian countries.

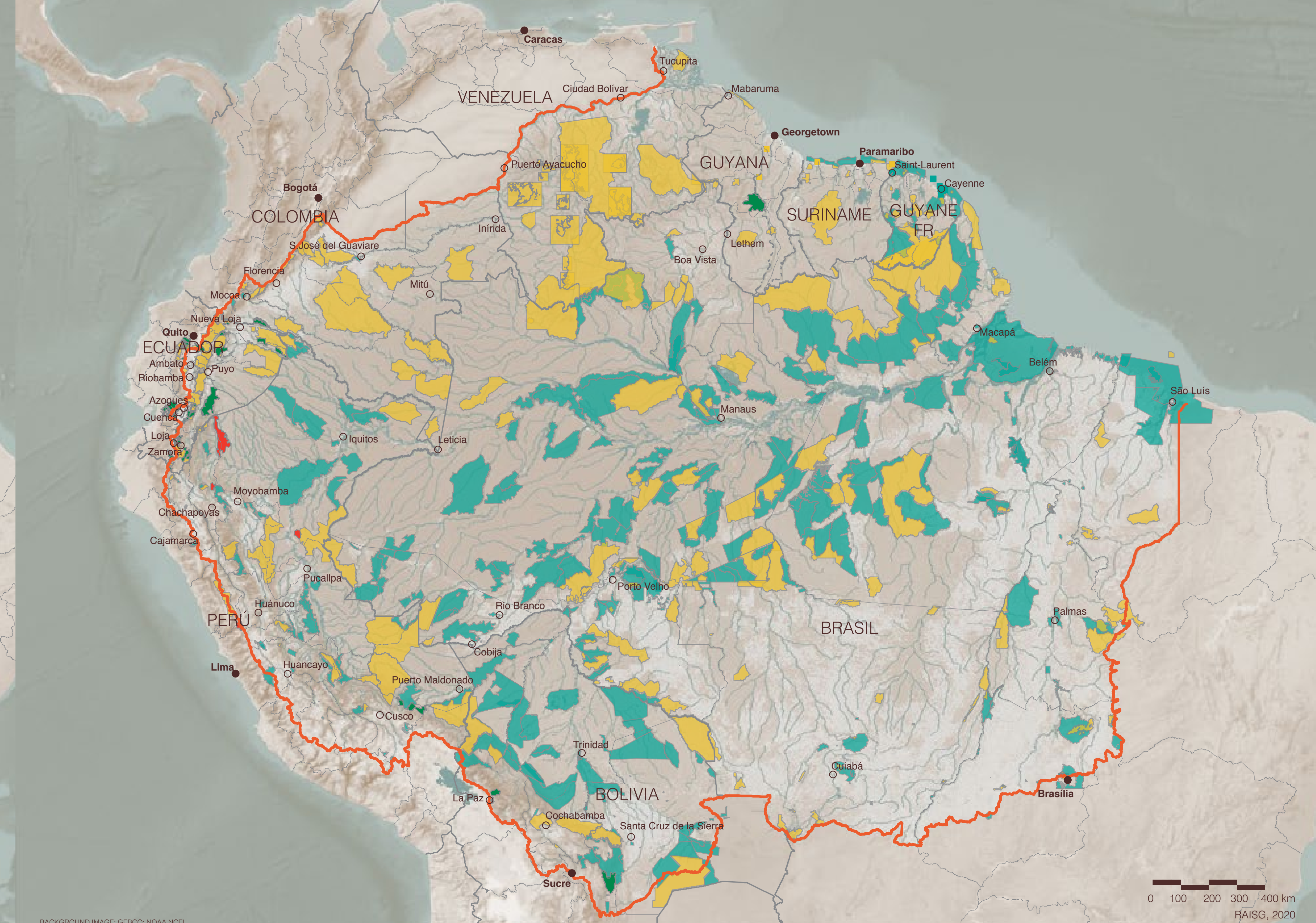
Although the data is positive, government efforts to consolidate policies that guarantee the recognition and due protection of ITs and PNAs are weak in most Amazonian countries, and in some cases, such as in Brasil, they have become paralysed in recent years.

Because it encompasses the major part (61.8%) of Amazonia, Brasil contains more PNAs and ITs. However, in accordance with these figures, proportionally it is the country with the least protected Amazonian territory (42.2%).

Upper image: Waorani women in Gareno, Napo province, Ecuador. *Ana María Acosta / Fundación EcoCiencia, 2019.*

Right image: Raudal de Ceguera and the Autana Natural Monument mesa, Venezuela. *Alberto Blanco, 2015.*





MAP 5. INDIGENOUS TERRITORIES IN AMAZONIA (BY LEVEL OF OFFICIAL RECOGNITION)

- OFFICIALLY RECOGNIZED IT
- INDIGENOUS RESERVE OR INTANGIBLE ZONE
- IT NOT OFFICIALLY RECOGNIZED
- PROPOSED INDIGENOUS RESERVE
- COMMUNITIES AWAITING RECOGNITION
- FOREST OUTSIDE IT
- RAISG BOUNDARY

MAP 6. PROTECTED NATURAL AREAS IN AMAZONIA (BY USE TYPE)

- DIRECT USE
- DIRECT / INDIRECT USE
- INDIRECT USE
- TRANSITORY USE
- FOREST OUTSIDE PNA
- RAISG BOUNDARY

TABLE 3. PROTECTED NATURAL AREAS AND INDIGENOUS TERRITORIES IN AMAZONIA (KM²) - SUMMARY TABLE

	Bolivia	Brasil	Colombia	Ecuador	Guyana	Guyane Française	Perú	Suriname	Venezuela	Amazonia	%
Protected Natural Areas	217,641	1,240,795	113,068	52,810	10,357	61,794	203,354	26,047	197,142	2,123,007	24.6%
Indigenous Territories	187,418	1,153,825	269,786	73,653	31,671	7,068	327,202	s.i.	325,517	2,376,140	27.5%
Overlaps between PNAs and ITs	55,510	104,985	32,202	17,941	997	6,289	32,889	s.i.	169,750	420,563	4.9%
Total areas protected by PNAs and ITs	349,549	2,289,635	350,652	108,522	41,031	62,573	497,667	26,047	352,909	4,078,585	47.2%
% of Amazon PNAs and ITs in each country	49.3%	42.2%	69.4%	82.3%	19.1%	74.3%	51.6%	17.8%	77.0%		

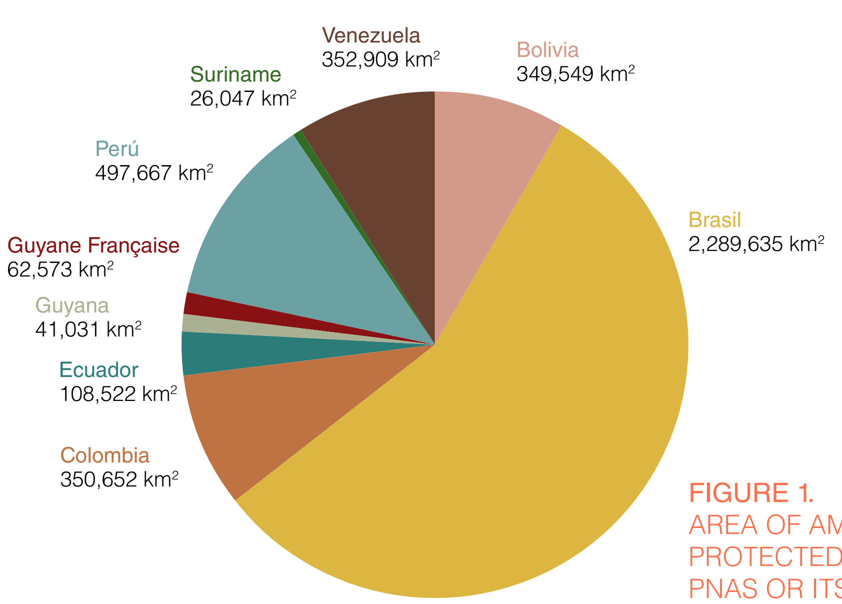


FIGURE 1. AREA OF AMAZONIA PROTECTED (UNDER PNAS OR ITS)

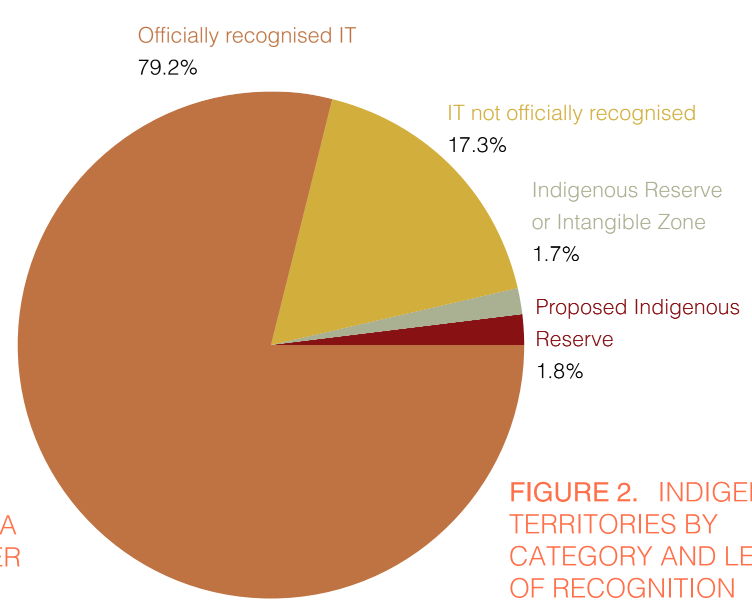


FIGURE 2. INDIGENOUS TERRITORIES BY CATEGORY AND LEVEL OF RECOGNITION

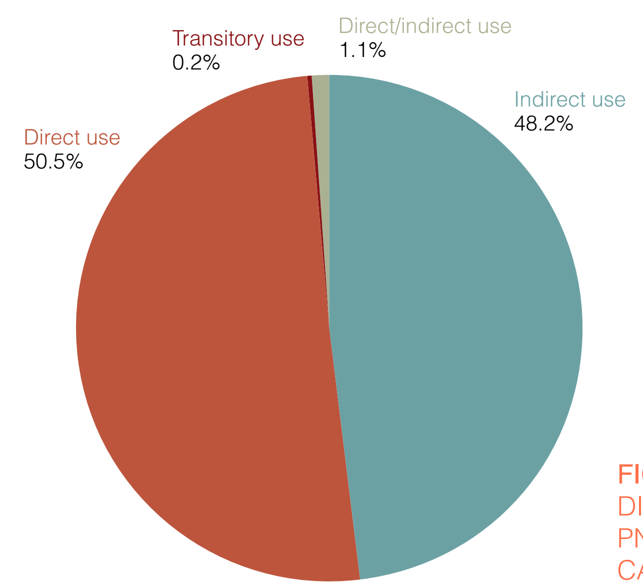


FIGURE 3. DISTRIBUTION OF PNAS AREA BY CATEGORY

Upper image: Queue of trucks on the BR-163 highway in Pará, Brasil. *Daniel Paranayba / ISA, 2017.*

PRESSURES AND THREATS

Amazonia is not isolated from the impact of infrastructure and extractive industry mega-projects, such as highway and road construction, building of hydroelectric plants, and mining and oil concessions. What are the real dimensions of projects already underway and those being planned?

INFRASTRUCTURE

Roads

Road construction promotes processes of land use change across the planet and its defence is offered by numerous actors (government bodies and the private sector, among others) using logistical and economic arguments, such as the transport of goods and raw materials to ports, as well as the strengthening of regional trade.

As well as leading to the development of markets and of some societies, road construction encourages unplanned land occupation, promotes socio-environmental change, and generates environmental pollution by noise, particles and air pollution, waste, sedimentation of rivers, and biodiversity disturbance. It is also associated with activities that predate natural resources, such as illegal exploitation of wood, minerals, fauna, agricultural activity, urbanization projects and changes in land values leading to distortions in land tenure and ownership, among other things.

For Amazonia - with its extensive forest coverage, a vocation for conservation and a wide river transport network - other transport and development models should be promoted that support the conservation and sustainable use of the natural environment (in particular forests and biodiversity), that safeguard indigenous cultures and their rights, and that is based on concepts of equality and equity.

Multiple authors have established that, in the Amazon region, roads have an impact from 5 to 50 km on both sides of their routes[4].

Although a highly important variable for evaluating regional impacts, the relevant information is deficient in terms both of spatial scale and the individual features of roads. In the present report, RAISG has used the best available data for each country, building an information layer with more than 96,000 km of terrestrial road networks. Roads are classified into paved, unpaved, and planned. Trails or service roads are not considered[5].

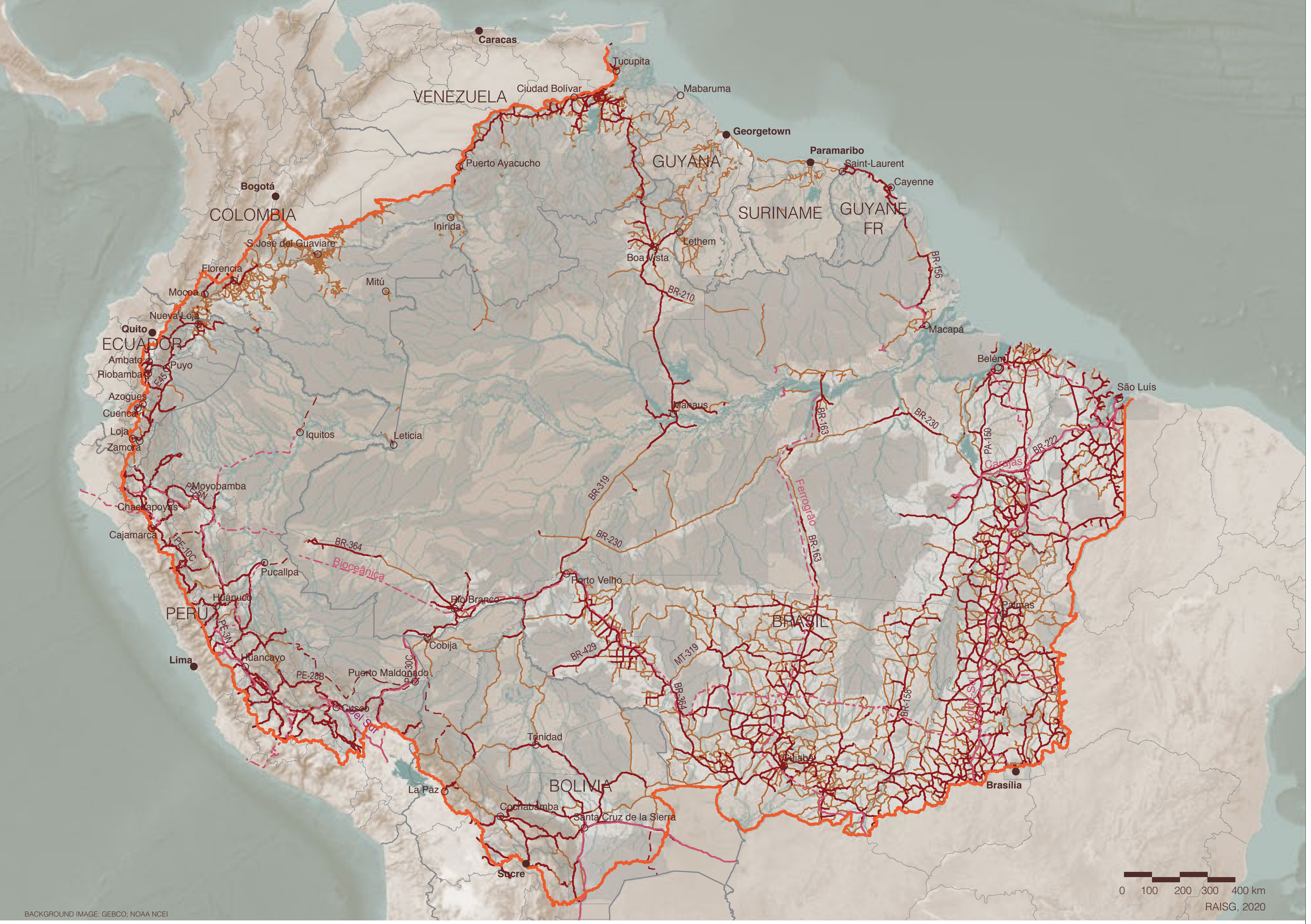
Paved roads are those that cause the greatest impact and correlate strongly to deforestation processes. For this analysis, all roads were assigned an area of impact of 40 km on both sides, while in the case of railways this was 20 km.

National level information on roads was provided by each RAISG partner institution. This was later systematized and unified according to the criteria mentioned above. Guyana, Suriname, and Guyane Française were exceptions, as their data were not updated.

Considering an affected area of 40 km on both sides for roads and 20 km for railways, our analysis concludes that road infrastructure, in general, has disturbed 4.6 million km^2 of Amazonia, equivalent to 55% of its total area, impacting biological diversity and the human populations living there.

4 CIFOR. (2012). La pavimentación de la Amazonía: estudio permite predecir tasas de deforestación a lo largo de importantes carreteras https://forestsnews.cifor.org/8146/la-pavimentacion-de-la-Amazonia-estudio-permite-predecir-tasas-de-deforestacion-a-lo-largo-de-importantes-carreteras?fnl=

5 Although in the case of Colombia, trails that cause high impact resulting from land occupation processes are considered.



MAP 7. ROADS IN AMAZONIA

ROADS
- PAVED
- UNPAVED (OR NO INFORMATION)
- PLANNED

RAILWAYS
- BUILT
- PLANNED

- IT OR PNA
- FOREST OUTSIDE IT / PNA
- RAISG BOUNDARY

Road density in Amazonia, as a calculation of the extent of roads and territory, increased 51% between 2012 and 2020, from 12.4 km per km² to 18.7 km per km². The countries that saw the greatest expansion were Colombia, Perú, and Venezuela (Figure 4). In the case of paved roads, there was an explosion in road density during this period of 110%, going from 4.1 km per km² to 8.6 km per km². Perú, Suriname, and Brasil were the main participants in this expansion. Brasil's paved road network grew from 21,000 km in 2012 to 46,000 km (Figure 4).

PNAs and ITs are increasingly impacted and threatened by the expansion of the terrestrial road network. In this regard, there was an increase in network density of 45% in PNAs and 44% in ITs between 2012 and 2020.

Although the increase in road density within ITs occurred in both legally recognized and unrecognized territories, analysis of Intangible Zones raises new concerns. In these areas, where there are practically no roads, the density of planned roads is 4.3 times higher than the overall average within ITs.

Grain terminal in Miritituba, on the Tapajós River, Itaituba, Pará, Brasil. *Lalo de Almeida, 2018.*

TABLE 4. ROAD DENSITY BY TYPE AND COUNTRY IN AMAZONIA IN 2020

	Density ((km/km²)*1000)			
	Paved	Unpaved	Planned	TOTAL
Bolivia	5,9	7,2	0,7	**13,8**
Brasil	8,9	10,9	0	**19,7**
Colombia	1,2	21,7	0	**22,9**
Ecuador	21,1	10,8	0	**31,9**
Guyana	0	20,2	0	**20,2**
Guyane Française	9,9	0	0	**9,9**
Perú	13,8	0,2	1,6	**15,6**
Suriname	9,7	0	0	**9,7**
Venezuela	7,6	9,5	0	**17,1**
TOTAL	**8,6**	**9,8**	**0,2**	**18,7**

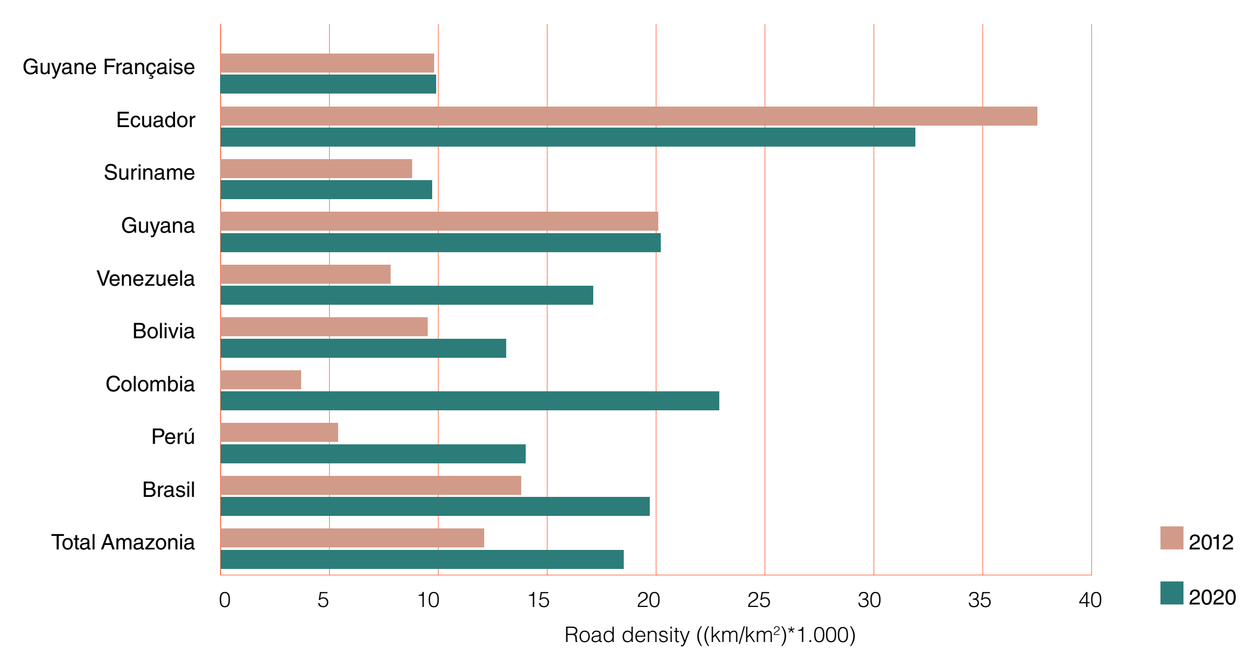


FIGURE 4. CHANGES IN THE DENSITY OF EXISTING ROADS IN AMAZONIA AND ITS COUNTRIES

Hydroelectric plants

The Amazon basin is seen, by governments and others, as an inexhaustible source of water resources useful for hydroelectricity generation. Most of these infrastructure projects are located on large tributaries of the Amazon River, with the serious result that once in operation they alter the flood regime, an important feature of Amazonian environments. This leads to the loss of biodiversity, land changes, forced migrations of indigenous communities, and decomposition of plant material generating greenhouse gas emissions.

Hydroelectric plants are found throughout Amazonia (mainly in basin headwaters). As of March 2020, there exist or are planned 833 hydroelectric plants, classified as 588 small hydroelectric plants (PCH, smaller than 30 MW) and 245 hydroelectric power stations (UHE, larger than 30 MW). Most of the active hydroelectric projects in the region are in Brasil (52%). However, the Ecuadorian forest, constituting 1.5% of Amazonia, concentrates 18% of active hydroelectric plants.

In Ecuador, Perú and Bolivia, hydroelectric plants are located mainly on the headwaters of Andean rivers, which represents an enormous risk of loss of connectivity between the headwaters of the basin and the lowlands.

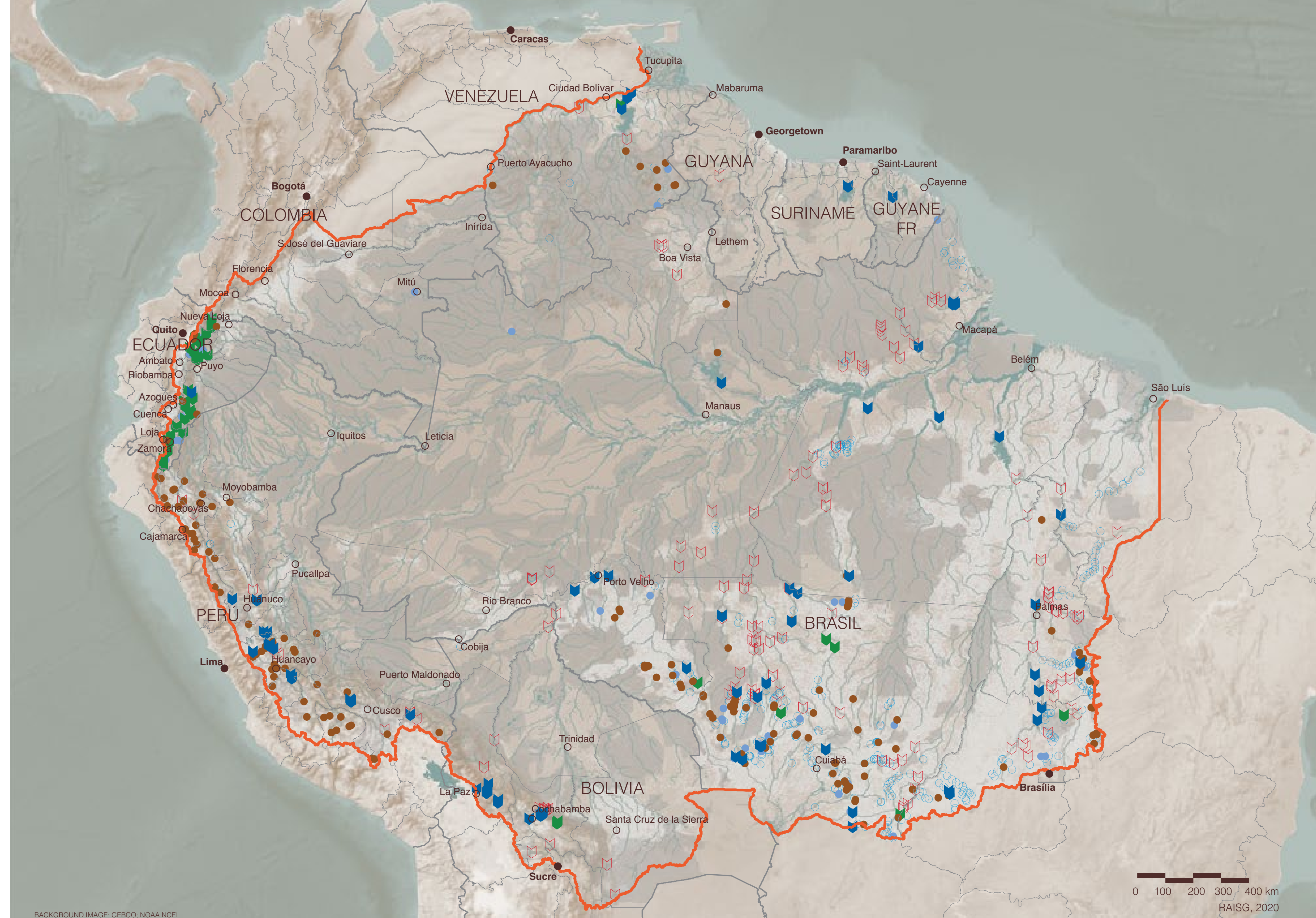
In 2012, a total of 171 hydroelectric plants were reported in operation or under construction within the RAISG Amazonia boundary, a figure that did not include those in the headwaters of Andean basins or in the south-eastern part of the Brazilian Amazon. In 2020 this number had increased by 4%, reaching a total of 177 hydroelectric plants (Figure 5). UHE had grown by 47%, from 51 in 2012 to 75 in 2020.

On the other hand, a 25% reduction in the number of planned hydroelectric plants can be seen, falling from 246 in 2012 to 184 in 2020. This may be due to socio-environmental political factors or because the projects were discontinued due to a lack of technical feasibility. We can infer that planning is now concentrated in the headwaters of the basins (Andes and south-eastern Amazonia in Brasil) since 483 hydroelectric plants are planned within the area of the current RAISG boundary (350 PCH and 133 UHE). In other words, the 184 currently planned represent only 38% of those planned in Amazonia for 2012.

Comparative analysis of hydroelectric plants in PNAs reveals that between 2012 and 2020 there is a 77% increase (from 13 to 23) in the number of hydroelectric plants in operation and/or under construction, while the number of those planned has remained almost stable (changing from 36 to 37), with a slight decrease in small hydroelectric plants (PCH) and a 31% increase in UHE (Figure 6).

Comparing the total number of hydroelectric plants in ITs in 2012 with 2020, we can see (Figure 7.) that there was a four-fold increase (from 6 to 26) in those currently in operation or under construction, while those planned increased by 60% (from 10 to 16).

According to current information (Table 5), PCH experienced the highest growth: there are 238 in operation and another 350 projected, while there are 112 UHE operating and another 133 planned. The latter are the most worrying as they are large projects, some with capacities above 2,000 MW (e.g. São Simão Alto and Chacorão in Brasil, Madera in Bolivia, and Tayucay and El Infierno in Venezuela).



MAP 8. HYDROELECTRIC PLANTS IN AMAZONIA

IT OR PNA

FOREST OUTSIDE IT / PNA

RAISG BOUNDARY

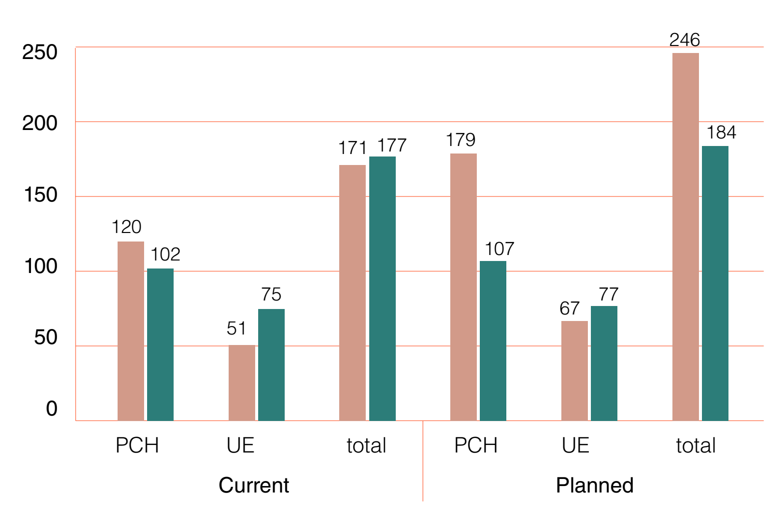
HYDROELECTRIC PLANTS (BY OUTPUT AND PHASE)

UHE PCH

IN OPERATION

UNDER CONSTRUCTION

PLANNED



2012

2020

*RAISG boundary
(See chapter Analytical process)

FIGURE 5. CURRENT AND PLANNED HYDROELECTRIC PLANTS IN 2012 AND 2020 IN AMAZONIA*

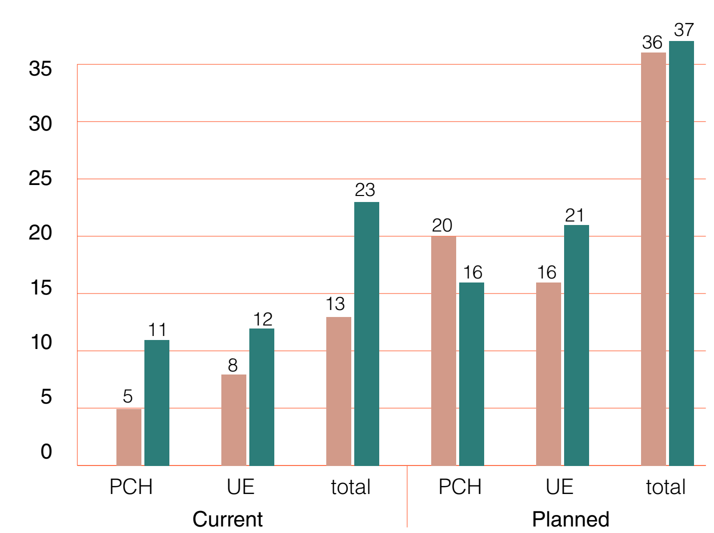


FIGURE 6. CURRENT AND PLANNED HYDROELECTRIC PLANTS IN 2012 AND 2020 IN PNAS IN AMAZONIA*

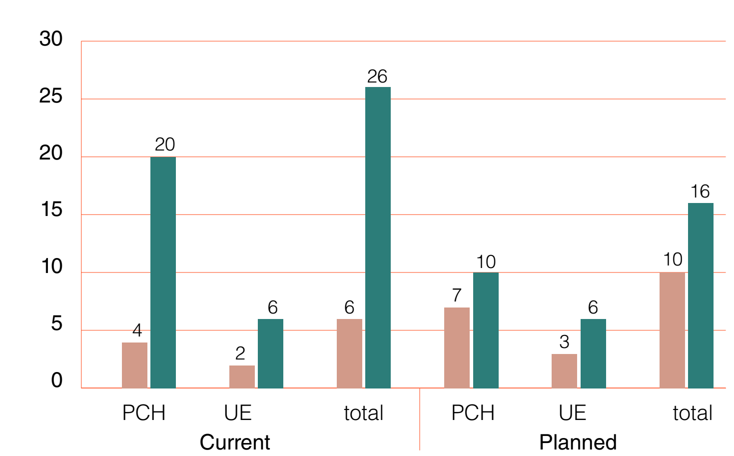


FIGURE 7. CURRENT AND PLANNED HYDROELECTRIC PLANTS IN 2012 AND 2020 IN ITS IN AMAZONIA*

Construction site of the Belo Monte hydroelectric dam (the third largest in the world) on the Xingu River, Altamira, Pará, Brasil. *André Villas-Bôas / ISA, 2015.*

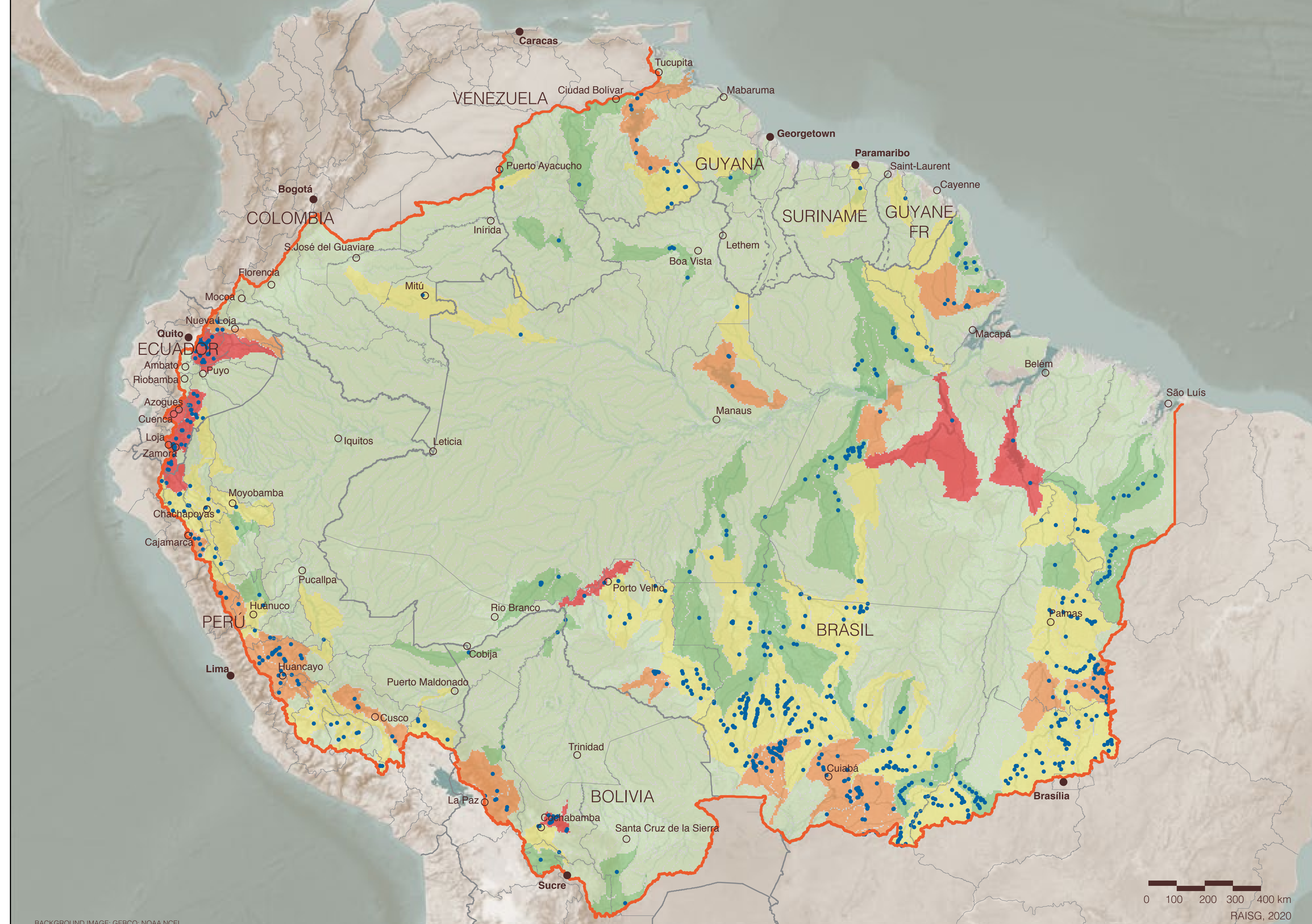
TABLE 5. HYDROELECTRIC PRESSURES AND THREATS BY COUNTRY

Country	Current			Planned			OVERALL TOTAL
	PCH	UHE	TOTAL	PCH	UHE	TOTAL	
Brasil	137	44	181	340	107	447	628
Perú	61	15	76	4	9	13	89
Ecuador	28	34	62				62
Bolivia	1	13	14	1	14	15	29
Venezuela	10	4	14	5	2	7	21
Colombia	1		1				1
Guyane Française		1	1				1
Guyana					1	1	1
Suriname		1	1				1
TOTAL	**238**	**112**	**350**	**350**	**133**	**483**	**833**

Hydroelectric plants can also be classified according to their energy generation capacity. There are 28 hydroelectric plants in operation in the region with a capacity above 300 MW. The highlight is the Belo Monte plant, the third largest in the world, located in the Xingu river basin in the Brazilian state of Pará, which began operations in 2016 in non-compliance with the mitigation plans for socio-environmental impacts.

It is estimated that over the next few years the numbers of this type of project will double, given that there are 33 projects with a planned generation of more than 300 MW each.

Map 9 identifies hydrological systems (basins of approximately 450 km²) that present very high vulnerability, due to the fact that hydroelectric plants alter the dynamics and seasonality of floods. These constitute a fundamental process for ecosystem functionality. They become wetlands in the rainy season and the soils are enriched in the dry season, generating their own ecological dynamics. This weighting was also assigned to basins with a high number of hydroelectric plants, such as in Ecuador and part of Perú, where there are 16 to



MAP 9. VULNERABILITY OF HYDROLOGICAL SYSTEMS TO HYDROELECTRIC CONSTRUCTION

RAISG BOUNDARY

HYDROELECTRICS

WEIGHTING OF SUB-BASINS BY IMPACT OF HYDROELECTRICS

VERY LOW

LOW

MODERATE

HIGH

VERY HIGH

Source: developed by FAN for RAISG, 2020 (see Analytical process, pg. 05)

25 hydroelectric plants in a single basin, several of them in the large power station (UHE) category. Similarly, in basins where power plants considered megaprojects because they are greater than 3,000 MW are located, they are assigned a very high vulnerability level due to their large size and impacts. This is the case of Belo Monte, Tucuruí, Jirau and Santo Antônio in Brasil.

High vulnerability defines basins with a high aridity index; that is to say, at great risk of droughts, since these are intensified by the impounding of water for the generation of electricity. In such hydrological systems, between 6 and 15 hydroelectric plants in operation or under construction have also been identified, some of them large power stations (2 to 5 UHE).

Medium vulnerability represents basins with high generation of emissions that contribute to the greenhouse effect through the accumulation of nitrous oxide and methane, resulting from the decomposition of trees and flooded vegetation. This category also identifies basins that are subject to greater pressure from existing irrigation areas (Andes and upper basins in the southern portion in Amazonia in Brasil), as well as taking into account that in several basins there are from 1 to 5 hydroelectric plants, one of them a large power station (1 UHE).

Finally, category low represents basins that are under threat from hydroelectric plants that will exert strong pressure when implemented. Brasil offers a very worrying outlook, as there are plans to densify hydroelectric plants in various headwaters and tributaries of basins located in the southern and south-eastern Amazon region. In some basins, hydroelectric plants may increase from 16 to 25, and this will be further intensified with the possible installation of up to 10 large power plants (UHE).

EXTRACTIVE INDUSTRIES

Oil

The Amazon countries have a vast concentration of oil reserves. By their nature, depending on the phase at which they are found, extractive activities pressurise and threaten ecological balance and communities inhabiting the region.

The advance of extractive activities is largely explained by governments' expectations of capitalizing on these resources to boost the regional economy. Furthermore, it is well known that, when drawing up policies for the extractive sector, measures for the prevention and mitigation of socio-environmental impacts are not sufficiently considered, nor are the investments needed to offset those impacts that, directly or indirectly, such activity generates in the region.

Environmental damage from these activities includes soil, water, and air pollution, as well as changes in the distribution of species, among other impacts. For their part, social impacts include migration, the establishment of new human settlements, and processes of social decomposition. These, in turn, facilitate access to natural resources through the construction of associated road infrastructure, resulting in additional environmental impacts.

In order to identify and quantify the area of influence of this activity, RAISG compiled information updated to December 2019 from official sources by country, in most cases. Overlapping areas were eliminated so as not to overestimate the total area.

Oil blocks were classified according to the phase of the activity: under exploitation, under exploration, applied for, and potential. These last two phases, areas for which an interest exists but procedures have not yet been formalized, are the ones that generate the least impact. Those in operation represent the greatest impact.

Oil blocks occupy 9.4% of the area of Amazonia. Most of these (369) are in the Andean Amazon (Bolivia, Colombia, Perú, Ecuador), home to numerous indigenous peoples, including some uncontacted or in voluntary isolation.

While Perú, Brasil and Colombia have reduced the size of areas under some type of oil activity, Bolivia and Venezuela have moved in the opposite direction. Ecuador is the country with the largest portion of its Amazon territory (51.5%) designated for oil activities.

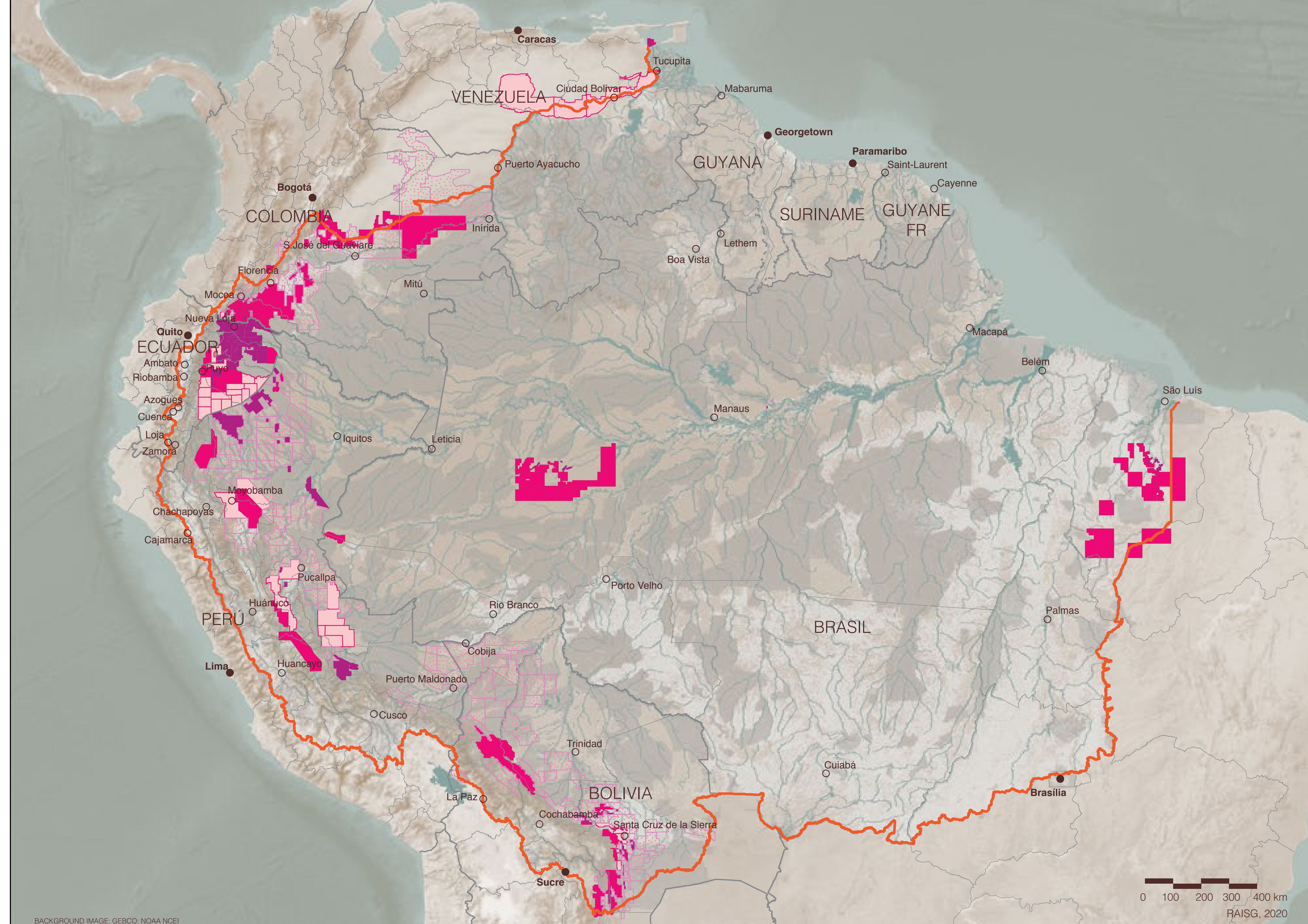
In Amazonia, oil blocks (in all their phases) overlap 11% (259,613 km^2) of the total area of ITs.

Between 2012 and 2020, the Amazon region registered an increase in the number of oil blocks. However, in the same period, the area occupied by this activity was reduced, whatever the phase, although this does not necessarily translate into a decrease in these industries in Amazonia.

The region went from a concentration of 327 blocks of crude in 2012 to 369 in 2020, representing an increase of 13%. In territorial terms, a reduction of 350,184 km^2 in the extent of Amazonia under oil activities can be seen in this period. This reduction is related to the blocks in the potential category that, having no interested bidders, are eliminated from official databases as these are periodically updated.

In Perú, for example, in 2012 the 18 sedimentary basins with hydrocarbon potential located in Amazonia appeared on the official maps. Currently, these areas have been excluded. This does not mean that in the near future they will not be included again in order to be offered for intensifying hydrocarbon contracting and exploration. Something similar happens in Brasil where reductions in area occur when blocks go to auction and attract no interest and, as a consequence, leave the official database.

Facilities at oil site 116 which is superimposed on the traditional territory of the Wampis and Awajún peoples, Loreto region, Perú. *Álvaro Del Campo / The Field Museum, 2011.*



MAP 10. OIL BLOCKS IN AMAZONIA
(BY PHASE OF ACTIVITY)

IT OR PNA
FOREST OUTSIDE IT / PNA
RAISG BOUNDARY
PRODUCING
PROSPECTED
APPLIED FOR
POTENTIAL

TABLE 6. NUMBER AND AREA OF OIL BLOCKS IN AMAZONIA, BY COUNTRY

Country	nº of blocks	Area of blocks (km^2)	% of Amazonia
Bolivia	130	205.607	28,8%
Brasil	54	75.346	1,4%
Colombia	111	138.018	27,3%
Ecuador	57	68.172	51,5%
Perú	71	298.213	30,9%
Venezuela	10	12.469	2,7%
Total	**433**	**797.824**	**9,4%**

Note: The oil reserves of Suriname, Guyana and Guyane Française are found in their marine territories and therefore outside the scope of analysis.

Bolivia went from 73,215 km² of oil areas in 2012 to 156,583 km² in 76 blocks in 2020. Venezuela, whose main oil reserves are in the north of Amazonia, showed an increase from 3,319 km² under oil activity in the Amazon region in 2012 to 12,137 km² in 2020. It should be noted that this increase in area is not due to the creation of new oil blocks, but mainly to an updated information layer in the official sources.

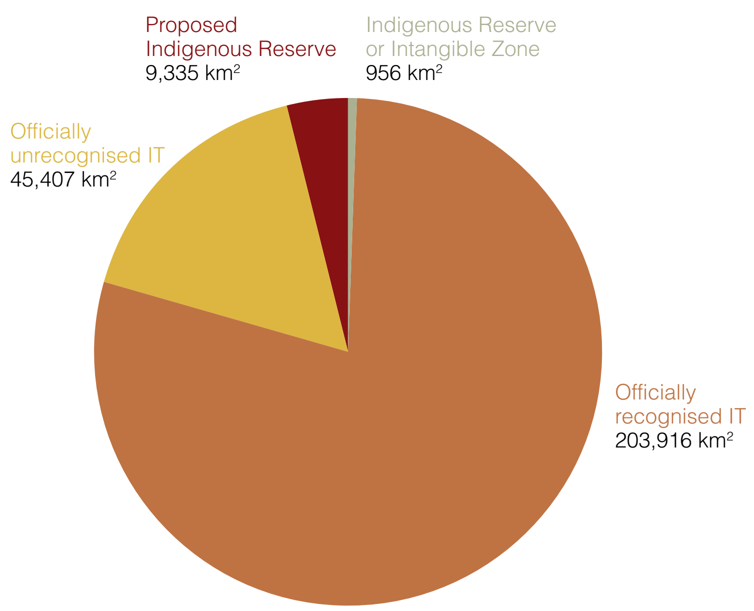


FIGURE 8. AREA OF OIL BLOCKS OVERLAPPING ITS IN AMAZONIA

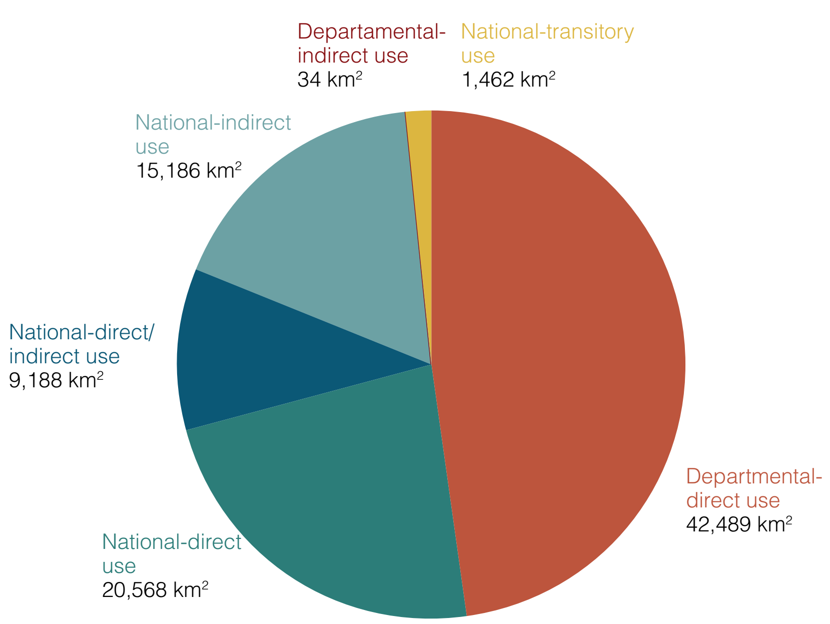


FIGURE 9. AREA OF OIL BLOCKS OVERLAPPING PNAS IN AMAZONIA

Mining

The increase in the price of gold in the international market in recent years has encouraged the expansion of this extractive activity, although so-called strategic minerals, such as coltan and niobium, constitute new incentives to exploit the region.

Geographic information from various sources was used at national level for each of the countries. The geographic database was compiled in early 2020 and the area of calculation was standardized under a single cartographic projection system. The legend corresponds to existing categories in each country, as follows: under exploitation, under exploration/under exploitation, under exploration, concession without activity, application, and potential.

Mining, present in all the countries of Amazonia, affects 17% of the region, involving 1,440,476 km², most of which (56%) is under exploitation and exploration activities.

96% of mining takes place in four countries: Brasil, Venezuela, Guyana, and Perú, with Brasil the country concentrating the most areas of interest for this (75%) in the region. More than one million square kilometres of its Amazonian area (equivalent to 12.8% of the mining areas of the entire Amazon) are devoted to legal activities in their different phases (potential, applied for, exploration and exploitation).

For its part, in 2016 the government of Venezuela established the Orinoco Mining Arc National Strategic Development Zone, covering an area of 111,843 km². This zone covers 24% of the Venezuelan Amazon and overlaps with environmental conservation areas and indigenous lands. It is dedicated to the extraction of gold, diamonds, and various other minerals, such as coltan. In addition, in April 2020 gold mining was authorized in four rivers in the region without any type of environmental evaluation or protocols for the free, prior, and informed consultation with indigenous peoples required under Venezuelan law (Resolution 1010). This has led to Venezuela concentrating 8% of legal mining in Amazonia.

The growth of mining development in protected natural areas amounts to 9.3% (195,535 km²). The greater part of these mining areas (88,558 km²) is superimposed on departmental direct use PNAs. These are followed in importance (77,262 km²) by national direct use PNAs. 50% of mining areas that overlap PNAs correspond to the application phase (97,632 km²).

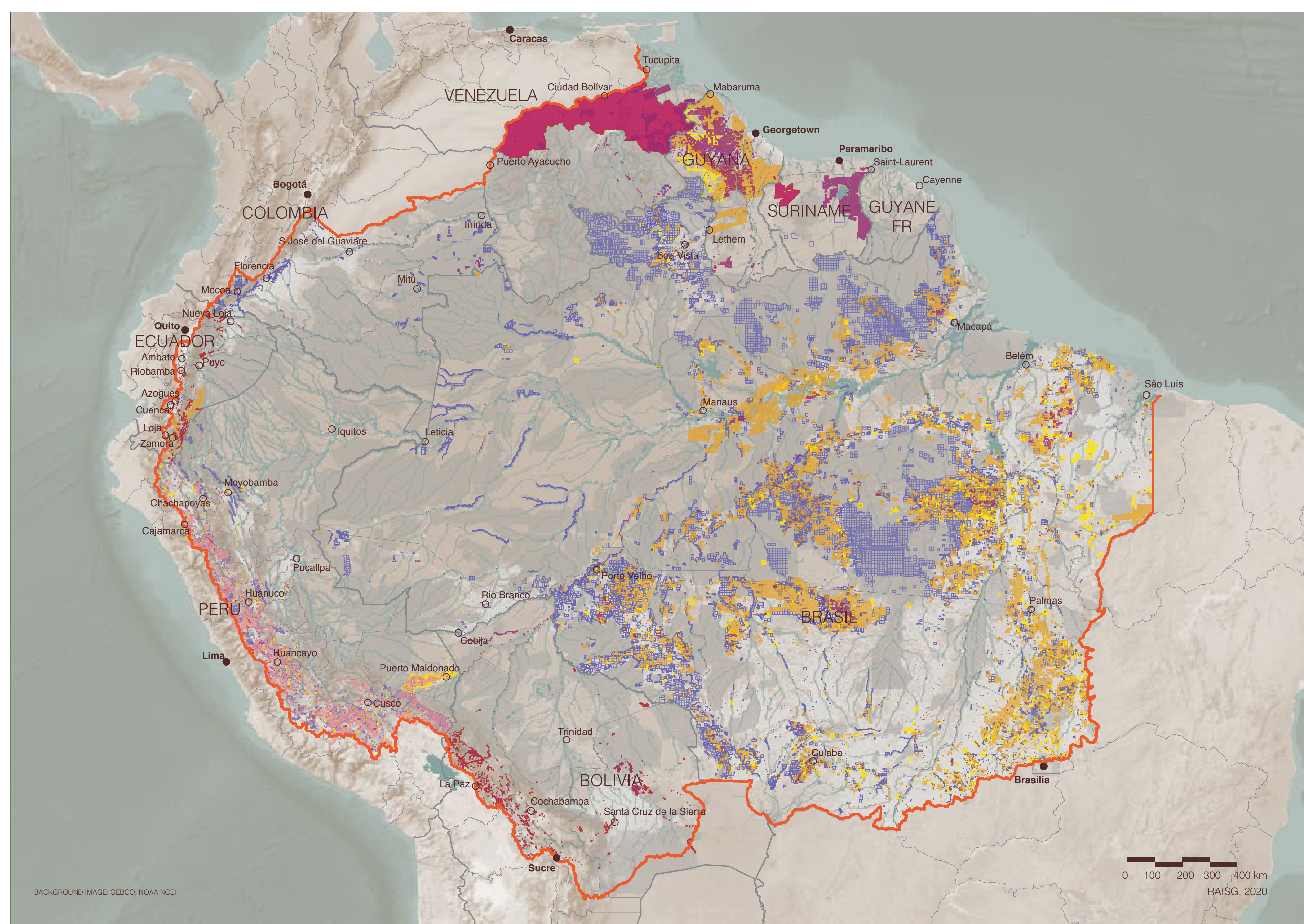
In the case of ITs, mining activity overlapping these territories corresponds to 9% (267,155 km²) of the area; the category of recognized indigenous territories is the most affected, with 85.8% (229,341

TABLE 7. NUMBER AND AREA OF MINING AREAS BY COUNTRY IN AMAZONIA

Country	Number of areas	Area of mining areas		
		Area (km²)	Amazonia as % of country	% of total Amazonia
Bolivia	3,632	11,116	1.6	0.1
Brasil	51,890	1,082,840	20.7	12.8
Colombia	807	9,004	1.8	0.1
Ecuador	3,796	10,021	7.6	0.1
Guyana	749	100,452	47.6	1.2
Perú	22,934	81,713	8.5	1.0
Suriname	11	30,194	20.6	0.4
Venezuela	948	115,136	24.5	1.4
TOTAL	**84,767**	**1,440,476**	**-**	**17.0**

Note: For this analysis we were unable to access cartographic data on current mining authorisations and projects in Guyane Française.

MAP 11. MINING AREAS IN AMAZONIA
(BY PHASE OF ACTIVITY)



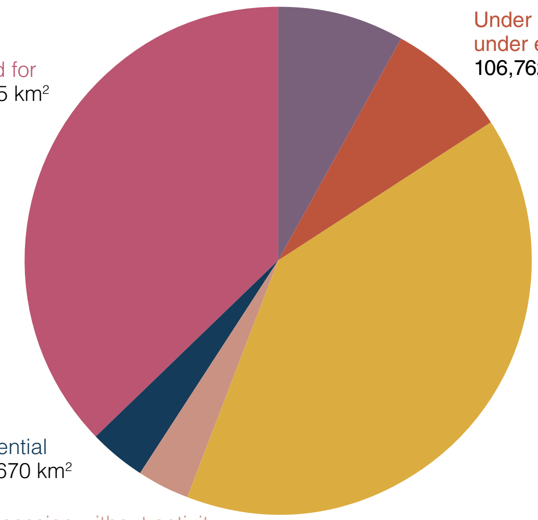


FIGURE 10. DISTRIBUTION OF THE AREA OF MINING AREAS IN AMAZONIA, BY PHASE OF ACTIVITY

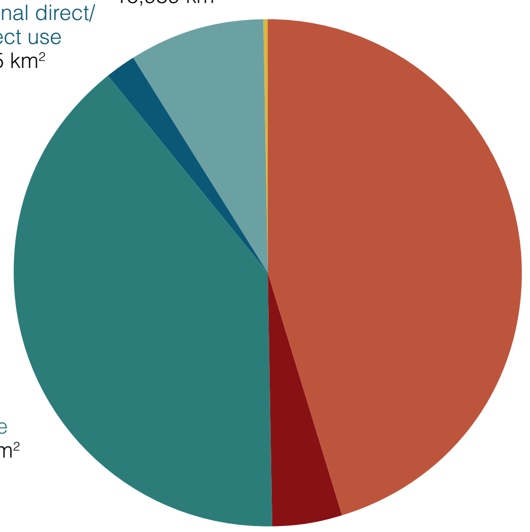


FIGURE 11. AREA OF MINING AREAS OVERLAPPING PNAS IN AMAZONIA BY USE TYPE

km²) of this overlap. Mining areas in the application phase show the greatest overlap, with 68% (182,076 km²) of the total.

Between 2012 and 2020 the Amazon region recorded an increase in the number of mining areas. However, the land area in question was reduced, although this does not necessarily translate into a decrease in these activities in Amazonia.

The region went from 52,974 mining areas in 2012 to 58,432 in 2020, representing an increase of 10%. In territorial terms, this period saw a reduction of 306,250 km² of Amazonia occupied by mining activity, from 1,628,850 in 2012 to 1,322,600 km² in 2020.

While Bolivia, Venezuela and Ecuador increased the number and size of areas under some phase of mining activity, Colombia, Brasil, and Perú moved in the opposite direction. In Colombia, this was mostly due to a process of cleaning up the mining cadastre that focused on application processes and verification of compliance with the legal requirements for this procedure.

Gold mining in Peixoto de Azevedo, Mato Grosso, Brasil. *Lalo de Almeida, 2019.*

AGRICULTURE AND RANCHING

The total agricultural area in Amazonia in 2000 was 794,429 km². In the following two decades there was an increase of 647,411 km² of land converted for agricultural activity, or an increase of 81.5%.

The transformation of natural ecosystems into areas of agricultural use occurs in two ways: deforestation of forest ecosystems and replacement of non-forest natural ecosystems. 71% of the new areas transformed between 2001 and 2018 replaced areas that until 2000 were forest, thus characterizing a process of deforestation.

The set of annual maps of Areas of agricultural use in Amazonia has been generated from the Coverage and land use maps of MapBiomas Amazonia, an initiative led by RAISG.

In the case of set 2, land cover and use maps are produced from the pixel-by-pixel classification of Landsat satellite images. The entire process is carried out using the Random Forest classifier on the Google Earth Engine platform and processed entirely in the cloud.[6]

From the maps generated for MapBiomas Amazonia, the RAISG technical team defined a protocol to derive, from the coverage and land use maps, a set of annual maps of new areas converted to agricultural use covering the period 2001-2018, with the year 2000 as the base year. For this purpose, all the pixels classified as agricultural use for that year were extracted.

For this section, we have divided the new areas converted to agricultural use into two: those that replace forest cover (generating deforestation) and those that replace non-forest areas.

Agricultural activity is responsible for 84% of deforestation in Amazonia, according to analysis by RAISG and MapBiomas. Consequently, the rate of conversion of these areas follows a pattern similar to that of deforestation: in 2003, 61,667 km² of Amazonian territory were converted into new agricultural areas. But after this point, the worst in the series under review, a decrease in this rate begins, reaching its lowest point in 2012, with 22,987 km² of areas converted for this economic activity. Since then, the figures have started to rise again, and 2018 ends with an area of 42,789 km² converted to agricultural use.

This expansion of the area destined for agricultural activity has hit ITs and PNAs hard. In 2000, 6% of the agricultural area was inside these protected territories, a proportion that increased in the following years. This expansion is mainly caused by land redistribution and the advance of agricultural activity generated by the private sector and the non-indigenous population.

Between 2001 and 2018, the increase in new areas of agricultural use within PNAs was more than 220%, transforming 53,269 km² of protected areas. 74% of this area had forest cover in 2000.

Upper image: Areas occupied by cattle ranches, pastures and banana plantations, borders of the WaiWai Indigenous Land, near the Anauá River, Roraima, Brasil. *Rogério Assis / ISA, 2018.*

6 Proyecto MapBiomas Amazonía. (2020). Colección 2.0 de mapas anuales de cobertura y uso del suelo del 1985 a 2018 de la Pan-Amazonía. https://amazonia.mapbiomas.org/

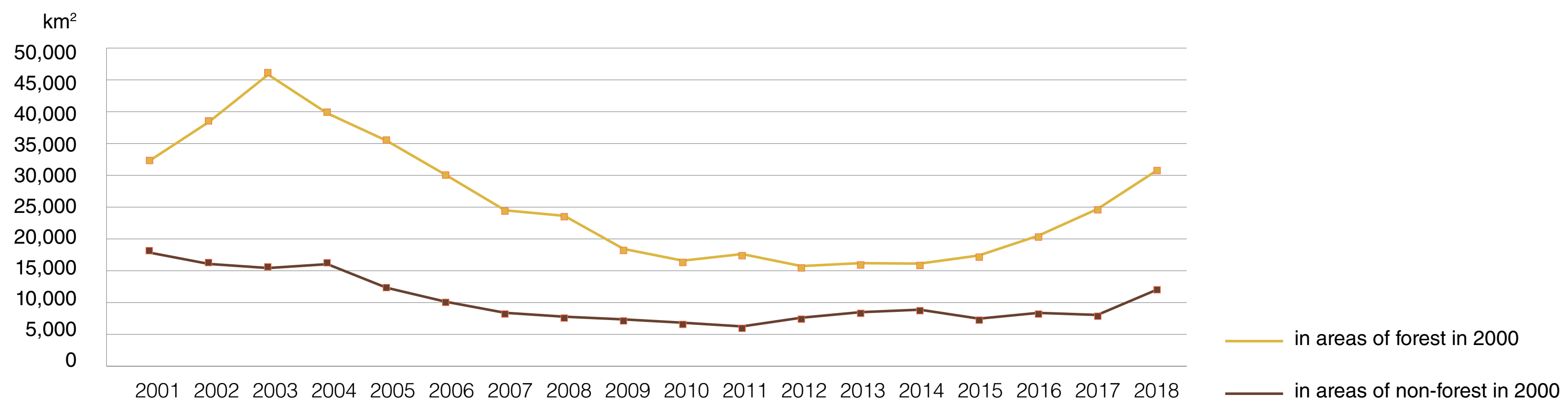


FIGURE 12. EXTENSION OF NEW AGRICULTURAL AREAS IN FOREST AND NON-FOREST AREAS (2001-2018)

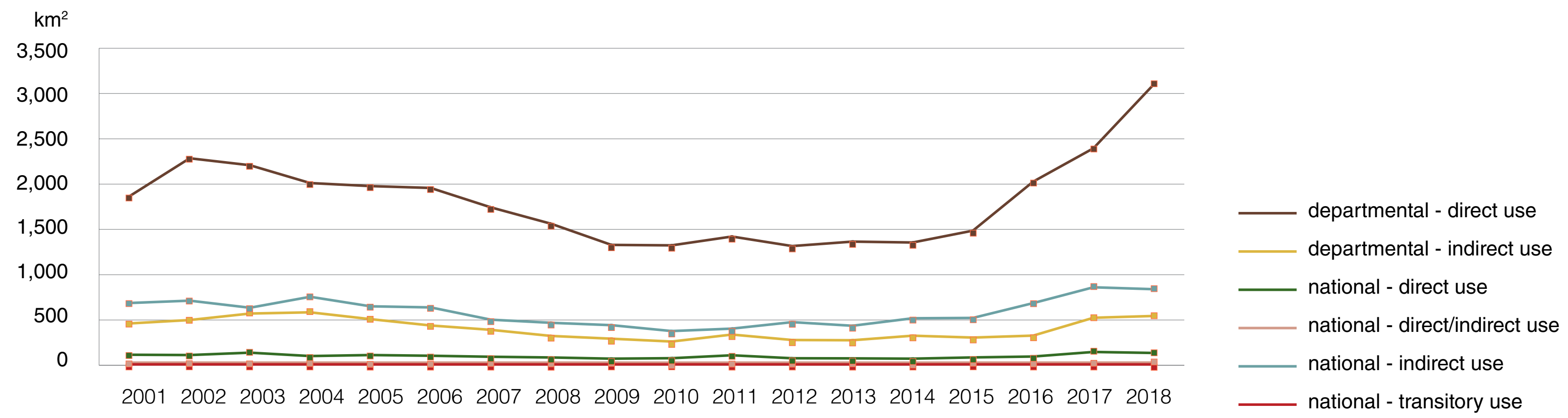


FIGURE 13. SIZE OF NEW AREAS OF AGRICULTURAL USE WITHIN PNAS (2001-2018)

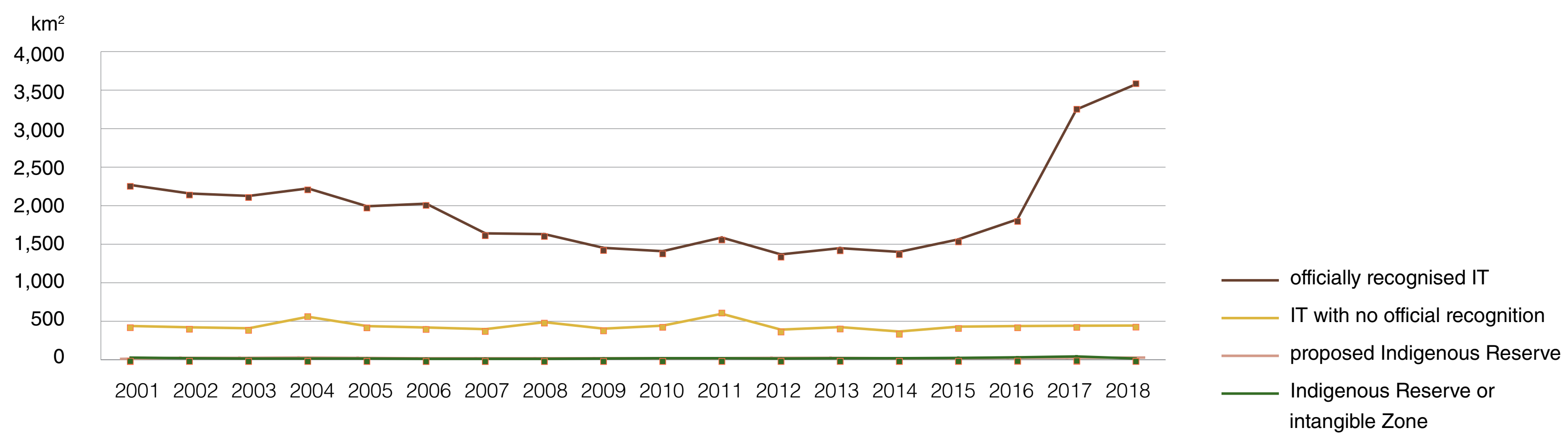
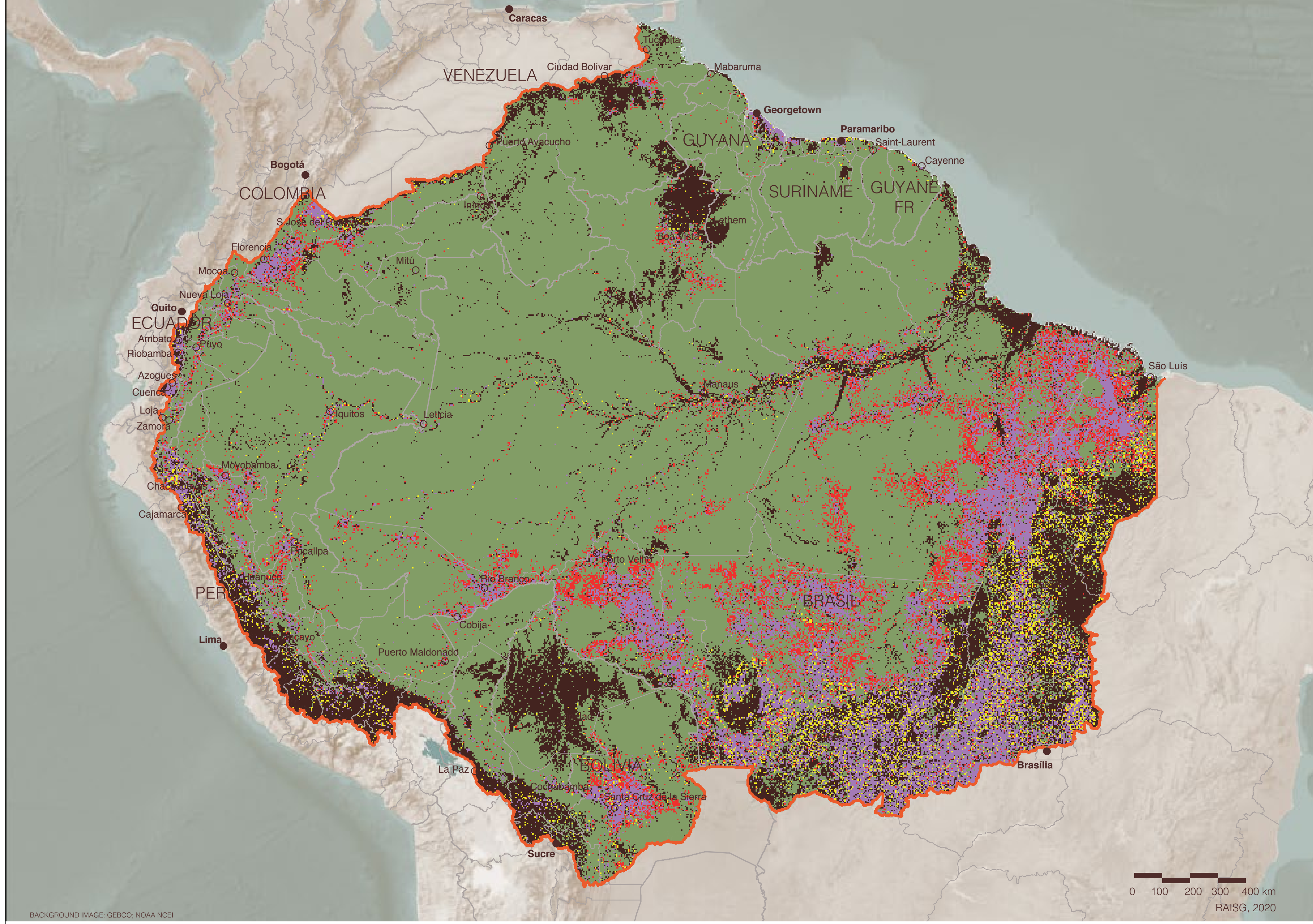


FIGURE 14. SIZE OF NEW AREAS OF AGRICULTURAL USE IN ITS (2001-2018)

During the same period, the increase in ITs was more than 160%, converting 42,860 km2 of these territories into new areas of agricultural use. More than 80% occurred in officially recognized ITs. As in the case of PNAs, most of these new areas (71%) were forest areas in 2000.

National policies have promoted agricultural activity in the region without the analysis needed to address negative impacts on the ecosystem and the value of the vegetation cover that is replaced, as has happened in Bolivia.

Incentives from some government agencies to create jobs, without following up on activities to prevent these from taking place in native or protected forest areas, have also favoured the expansion of agricultural frontiers in countries like Ecuador.



MAP 12. AGRICULTURE AND LIVESTOCK AREAS IN AMAZONIA

RAISG BOUNDARY

LAND USE 2000-2018

WOODED IN 2000

NOT WOODED IN 2000

AREAS OF AGRICULTURE AND RANCHING

AREAS WITH AGRICULTURE AND RANCHING ACTIVITIES IN 2000

NON-FORESTED AREAS CONVERTED TO AGRICULTURE AND RANCHING BETWEEN 2001 AND 2018

FORESTED AREAS CONVERTED TO AGRICULTURE AND RANCHING BETWEEN 2001 AND 2018

Source: MapBiomas Amazonia, 2000-2018

In other countries, an issue that demands attention is migration to the Amazon region in search of space to develop agricultural activities. This is the case in Perú, where inhabitants of the Andean region move to the tropical forest, obtain land under the invasion model and, after planting their crop, formalize their property. This modality took shape after decades of national policies in the region that promoted the occupation of an “empty Amazon”.

Land grabbing practices also thrive in some Amazonian countries, such as Colombia, revealing the need for stronger government controls and improvements in conventional farming practices that have been used for years, leaving soils eroded and with no productive capacity, generating the need for expansion of the so-called agricultural frontier.

It is also necessary to address the technological challenges that would enable increasing land productivity, to avoid expanding these areas.

BOX 2 ILLEGAL ECONOMY

The illegal economy that devastates the Amazon rainforest involves billions of dollars, year after year. With structures that exceed the capacity for surveillance and control by government agencies and with large investments proven to be lucrative, the operators that promote deforestation act on a territory whose natural wealth and size are simultaneously its strength and its vulnerability.

The extraction of wood, mining and illicit crops are three economic activities that recruit thousands of people and proliferate in the tropical forest sustained by demand for their final products in international markets.

Such illegality is associated with the increase in "forest roads", almost entirely illegal, which do not appear on official maps. The map of the Mapping of the Andes Amazon Project (MAAP) suggests that in the Peruvian Amazon between 2015 and 2018, 3,330 kilometres of this type of road were opened.[i]

The presence of such structures has been registered in studies such as that published by the non-governmental organization Human Rights Watch (HRW) in 2019, which provides extensive detail on the actors and methods that drive deforestation in the Brazilian Amazon.

"Criminal networks have the logistical capacity to coordinate the large-scale extraction, processing and commercialization of timber, while at the same time hiring armed men to intimidate and, in some cases, murder those who try to defend the jungle," said HRW at the launch of the report. [ii]

Analysis carried out using satellite images from various control systems has revealed that almost all deforestation in the region has taken place without authorization or in prohibited areas.

In northern Brasil, a report from the Imazon institute revealed that in the state of Pará alone, between August 2017 and July 2018, 385.73 km^2 of tropical forest were exploited by logging activity, 70% without authorization[iii].

i Villa, L. & Finer, M. (2019). Identificando Tala Ilegal en la Amazonía Peruana. MAAP: 99. https://maaproject.org/2019/maap99-tala-ilegal/

ii HRW (2019) Brasil: Redes delictivas actúan contra defensores de la Amazonia https://www.hrw.org/es/news/2019/09/17/brasil-redes-delictivas-actuan-contra-defensores-de-la-Amazonia

iii Cardoso, D., & Souza Jr., C. 2020. Sistema de Monitoramento da Exploração Madeireira (Simex): Estado do Pará 2017-2018 (p. 38). Belém: Imazon.https://imazon.org.br/publicacoes/sistema-de-monitoramento-da-exploracao-madeireira-simex-estado-do-para-2017-2018/

7,387 tree trunks from illegal clearing in the Piritití Indigenous Land, southern Roraima, Brasil. *Felipe Werneck / Ascom / Ibama, 2018.*

Excavator removing earth and preparing the riverbank while men repair a pump for use as a water jet for prospecting on the Rato River, a tributary of the Tapajós River, Pará, Brasil. *Lalo de Almeida, 2018.*

According to figures from RAISG, the loss of native forest increased steadily between 2000 and 2018 in all the countries that comprise Amazonia, and illegal extraction also spread as a practice.

The United Nations Environment Programme (UNEP) estimated in 2012 that 30% of internationally traded wood was of illegal origin and that globally the industry involved tens of millions of dollars..[iv]

Regional investigations reveal that timber harvested from indigenous territories or protected natural areas is mostly sold with false documents. The scheme is similar in countries such as Brasil, Perú, Ecuador, Bolivia, and Colombia. In the case of Colombia, government estimates are that, in 2018, 47% of the wood on the market was illegal[v].

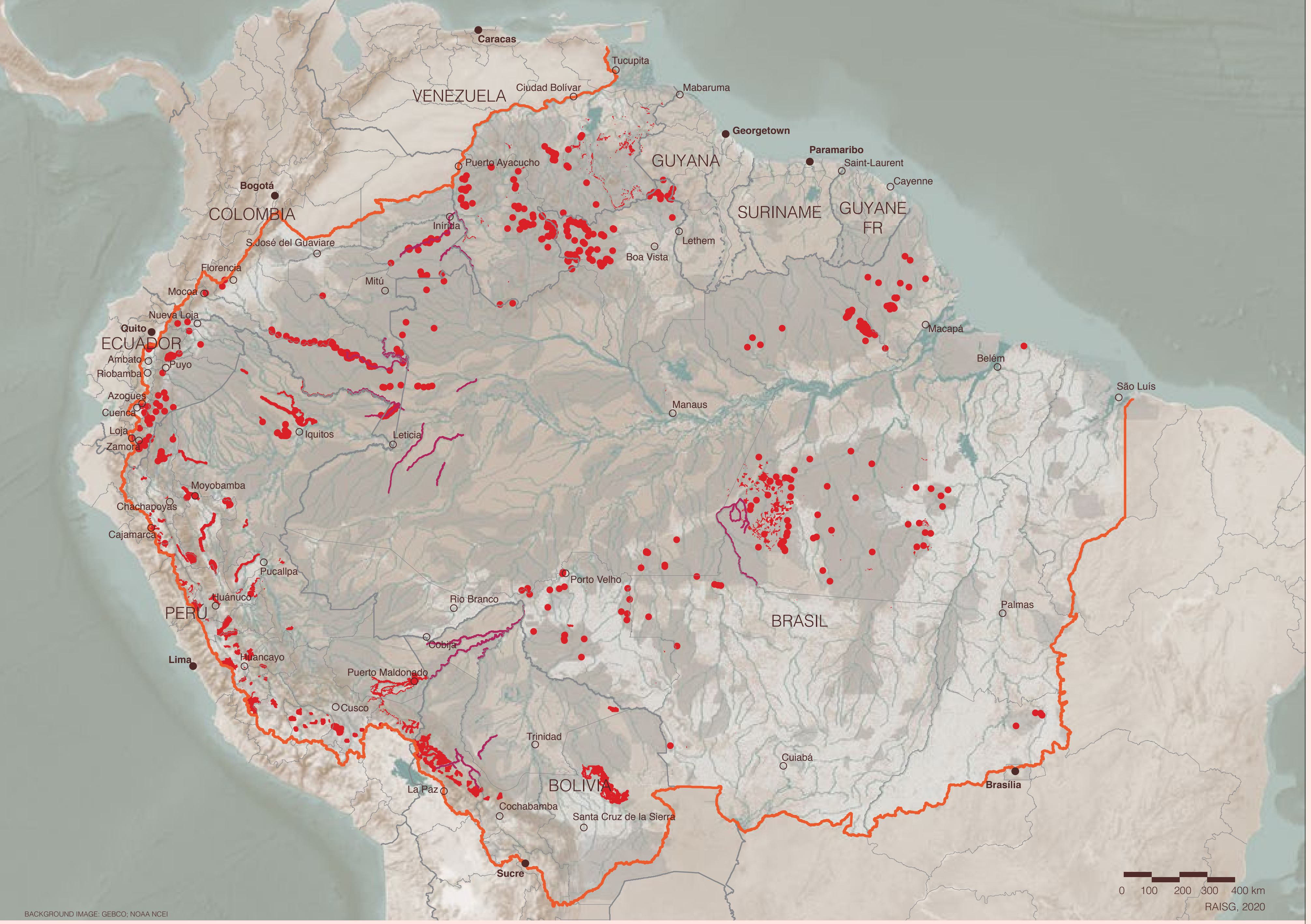
But the devastation of the Amazon region is also driven by the expansion of illicit crops.

In Colombia, although coca growing is not the main driver of forest destruction, the United Nations Office on Drugs and Crime (UNODC) has reported a 9% reduction of the area planted with coca in the country, from 1,690 km^2 in 2018 to 1,540 km^2 in 2019. However, since 2015 illicit crops tend to be located in areas that permit implementation of the full chain of production; in Amazonia, this situation occurs especially in the department of Putumayo.

This industry is also an important vector of environmental pollution, affecting water courses and impacting biodiversity.

iv Nellemann, C., Programa de INTERPOL sobre Delitos contra el Medio Ambiente (coord.) (2012). Carbono limpio, negocio sucio: tala ilegal, blanqueo y fraude fiscal en los bosques tropicales del mundo. Evaluación de respuesta rápida. PNUMA, GRID-Arendal. https://www.interpol.int/content/download/5153/file/The%20Environmental%20Crime%20Crisis%20-%20Threats%20to%20sustainable%20development%20from%20illegal%20exploitation%20and%20trade%20in%20wildlife%20and%20forest%20resources%20ES.pdf?inLanguage=esl-ES

v WWF. (2018). Colombia le apuesta a la madera legal https://www.wwf.org.co/?uNewsID=325008



MAP 13. ILLEGAL MINING IN AMAZONIA

IT OR PNA

FOREST OUTSIDE IT / PNA

RAISG BOUNDARY

LOCATIONS WHERE ILLEGAL MINING IS OCCURRING

RIVERS WITH ONGOING ILLEGAL MINING ACTIVITIES

In Perú, the world's second largest producer of coca after Colombia, these illicit crops continue to proliferate, driven by organised armed groups that invade territories, displacing native communities, to supply an industry whose largest markets are in Europe and the United States. The UNODC reported that in 2017 the country had a total of 49,900 hectares planted, an increase of 14% compared to the previous year. Most of the production, the report states, went to drug trafficking to make cocaine.

In Bolivia, coca production for traditional and ancestral use is allowed in 22,000 hectares of authorized areas. Production outside this area is considered illegal and subject to eradication. According to a report from the UNODC in 2019[vi] 25,500 hectares have been identified, detecting the presence of coca growing in six protected areas (Isiboro-Sécure, Carrasco, Cotapata, Amboró, Apolobamba and Madidi) where its cultivation is prohibited.

The tropical forest is also pressured and threatened by illegal mining carried out by actors operating over vast portions of the territory of several Amazonian countries.

RAISG registered, in 2020, 4,472 localities where illegal mining is practiced in Amazonia, 87% of them in the active phase of exploitation.

These localities account for sites with low-scale illegal exploitation (17%). The size of the exploitation areas can vary between one and several thousand square kilometres (83%). The sites also correspond to stretches of rivers where mining is carried out directly in the riverbed (0.05%).

vi UNDOC. (2017). Monitoreo de territorios afectados por cultivos ilícitos 2016. In Oficina de las Naciones Unidas contra la Droga y el Delito.

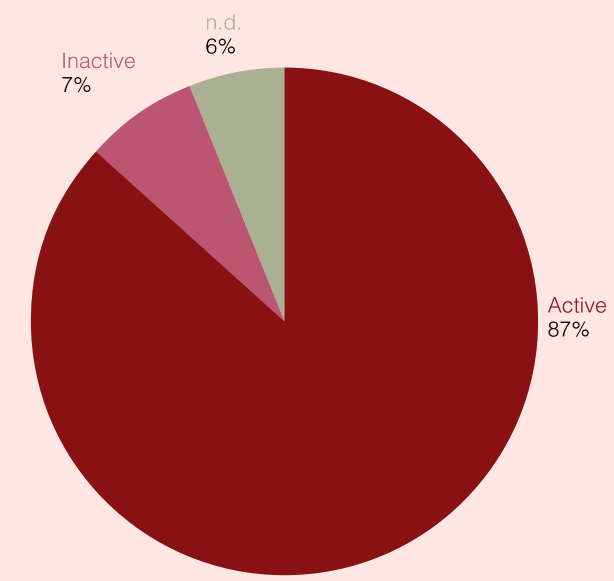


FIGURE 15. . CLASSIFICATION OF ILLEGAL MINING DATA IN AMAZONIA

RAISG's map of illegal mining[vii] was published for the first time in 2018 in an effort to make visible this scourge to the region. Constantly updated, it presents a new picture, one however which is not exhaustive due to the difficulty of recording and quantifying this activity.

Southern Venezuela has undergone a transformation in recent years, driven especially by the illegal mining of gold, which became the economic wager of thousands of citizens and even the government, following the collapse of oil prices after 2013.

According to local communities, after the creation of the Orinoco Mining Arc National Strategic Development Zone in 2016, the region was taken over by criminal and military groups disputing the mines. The illegal practice of this activity has become the main environmental and social threat in the southern Venezuelan region.

32% of the illegal mining locations (1,423) recorded in Amazonia are in Venezuela, a country that comprises only 5.6% of this territory. This result is the outcome of a systematic review by satellite imagery. Data collection on this topic does not necessarily represent the real level of activity in the region and does not permit direct comparisons between countries.

Brasil has also seen an expansion of the illegal sector. Among the regions most affected by the advance of illegal mining are the Tapajós River basin, home to the Munduruku indigenous people; the Yanomami Indigenous Land, in which there are an estimated 20,000 miners; and, also in the north, the Raposa Serra do Sol Indigenous Land, which in 2020 suffered the first large-scale invasion by illegal miners since its demarcation 11 years ago.

RAISG has found that more than half the localities with illegal activities in Amazonia (2,576) are in Brasil, and that 95% of these are active. These activities have important consequences for fishing resources and the health of the indigenous communities, due to the high concentrations of mercury detected.

In Bolivia, illegal mining is concentrated in the heart of Santa Cruz, on the banks of the Madre de Dios and Orthon rivers, and in the Yungas region, one of the regions with high endemism and biodiversity. Gold mining attracts the interest of locals and others, encouraging its uncontrolled expansion in the Bolivian Amazon.

The illegal development of mining, especially of gold, affects 17.3% (129) of the protected natural areas and 10% (664) of the indigenous territories of Amazonia.

vii RAISG. (2018). Minería ilegal https://mineria.amazoniasocioambiental.org

Right image: Operations to embargo illegal prospecting in the Munduruku Indigenous Land were halted on 5 August 2020 as a result of pressure by the prospectors. Pará, Brasil. *Caio Guatelli, 2020.*

Illegal cultivation of coca leaves in the Cotuhe River basin, Loreto Region, Perú. Identified during rapid appraisal of conservation areas by The Field Museum in 2010. *Álvaro Del Campo / The Field Museum, 2010.*

Aerial view of illegal prospecting in the Yanomami Indigenous Land, near the Ye'kwana community, Waikás region, Roraima, Brasil. *Rogério Assis / ISA, 2018.*

SYNTHESIS MAPS OF PRESSURES AND THREATS

More than half the units of analysis in Amazonia (65.8%) are subject to some type of fixed or ongoing pressure: whether extractive activities such as oil and mineral exploitation, development of road infrastructure, agricultural activity, or the presence of hydroelectric plants. It is important to note that this analysis does not include forest roads, timber concessions, coca and oil palm cultivation, or illegal activities.

With differing modalities, magnitudes and intensities, these pressures generate not only cumulative but synergistic impacts, which cause a high level of deterioration of environmental conditions in the region.

The analysis shows that 7% of Amazonia is subject to "very high" pressure and 26% to "high". The areas with the highest pressure are located in the peripheral areas of the biome: in areas of mountains and foothills located to the west, especially in Ecuador; in northern Venezuela; and, to the south, in Brasil, as can be seen in map 14.

From a regional perspective, most of the Amazon territory in all the countries is under some sort of pressure, with a prevalence of moderate and high indices. Ecuador is seen to be the most dramatic case, with 88% of its Amazonian territory affected by some type of pressure, with 18% classified as "high" and 45% as "very high", totalling 63%.

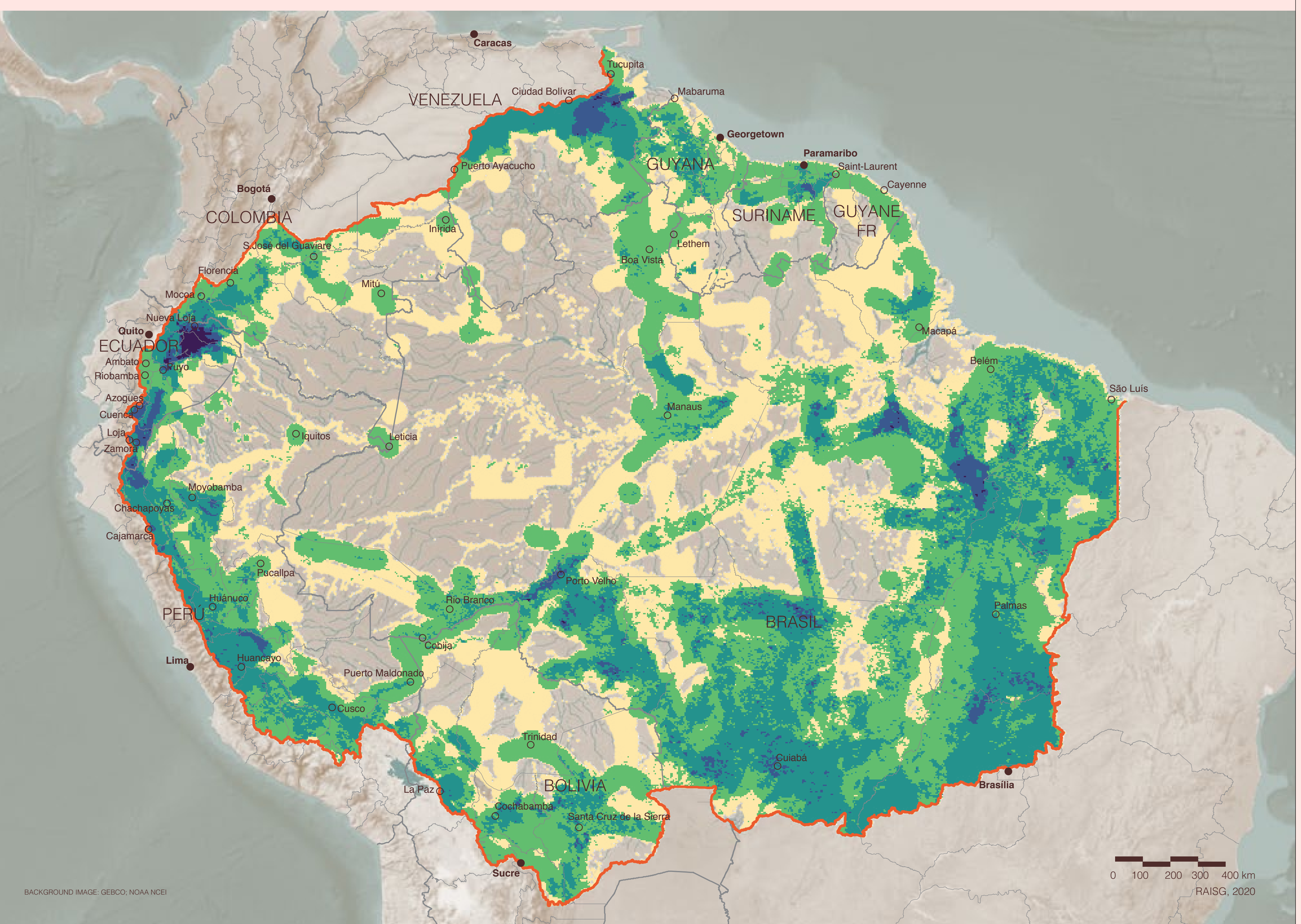
— RAISG BOUNDARY

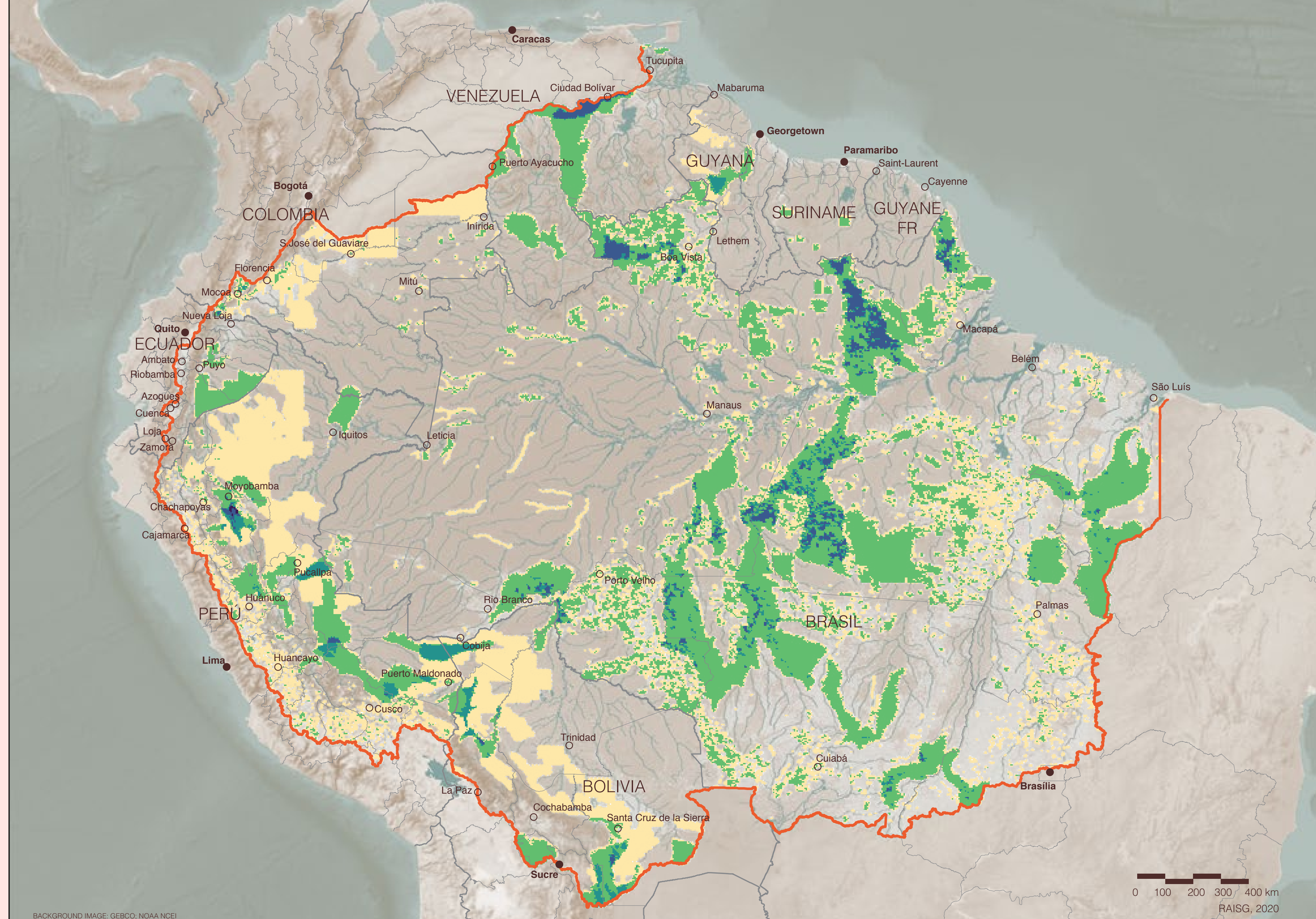
PRESSURE INDEX

- ≤20 VERY LOW
- ≤40 LOW
- ≤60 MODERATE
- ≤80 HIGH
- ≤100 VERY HIGH

Source: prepared by GAIA for RAISG, 2020 (see Analytical process, pg. 06).

MAP 14. SYNTHESIS OF PRESSURES IN AMAZONIA





MAP 15. SYNTHESIS OF THREATS IN AMAZONIA

— RAISG BOUNDARY

THREAT INDEX

- ≤20 VERY LOW
- ≤40 LOW
- ≤60 MODERATE
- ≤80 HIGH
- ≤100 VERY HIGH

Source: prepared by GAIA for RAISG, 2020 (see Analytical process, pg. 06).

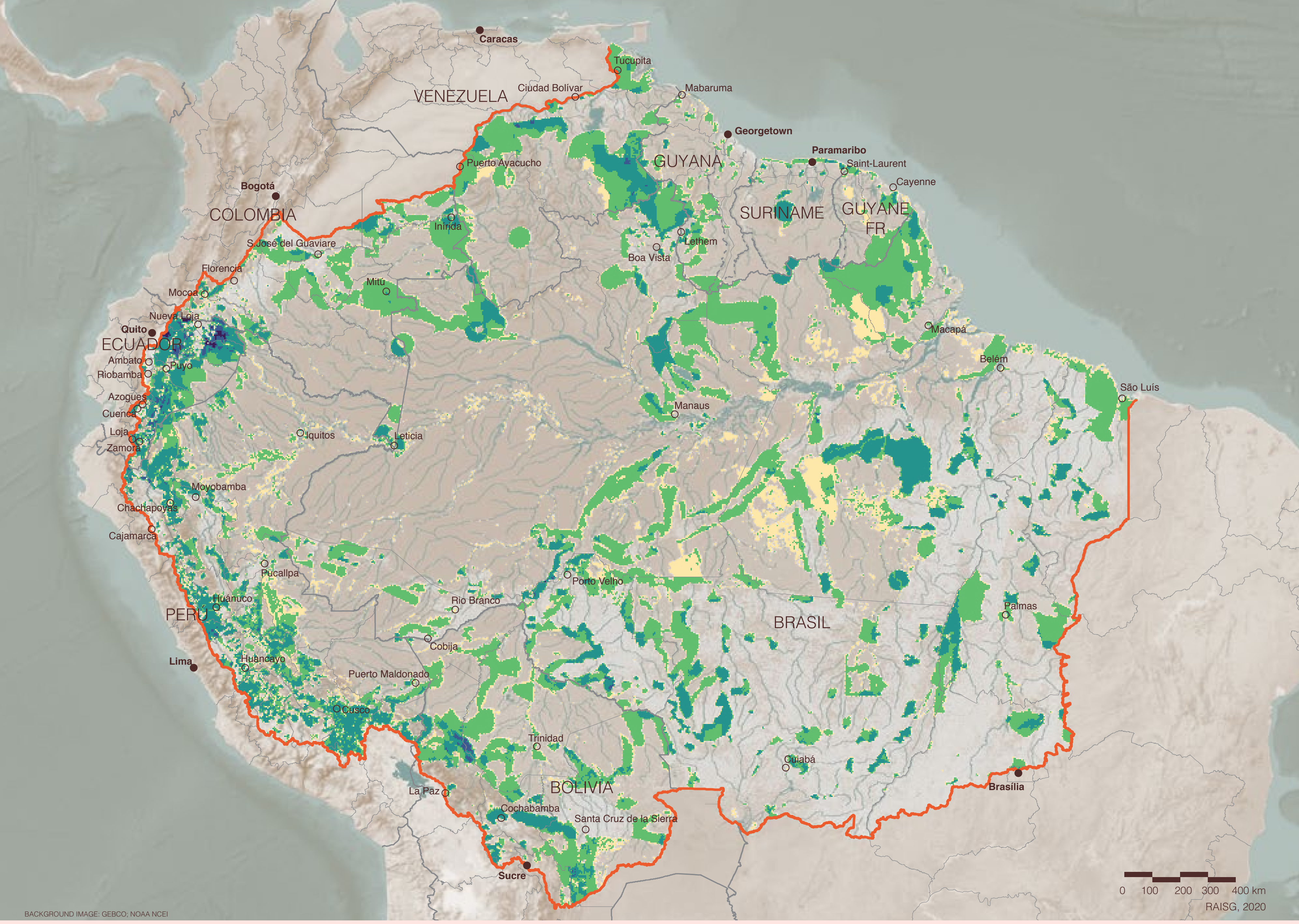
The remainder of the Amazonian countries show between 52% and 72% of their Amazonian portion under pressure, the majority suffering intensities that range between "moderate" and "very high". Similarly, Guyana has only 19% of its Amazonian portion free of pressure, with most of the rest under "moderate" pressure.

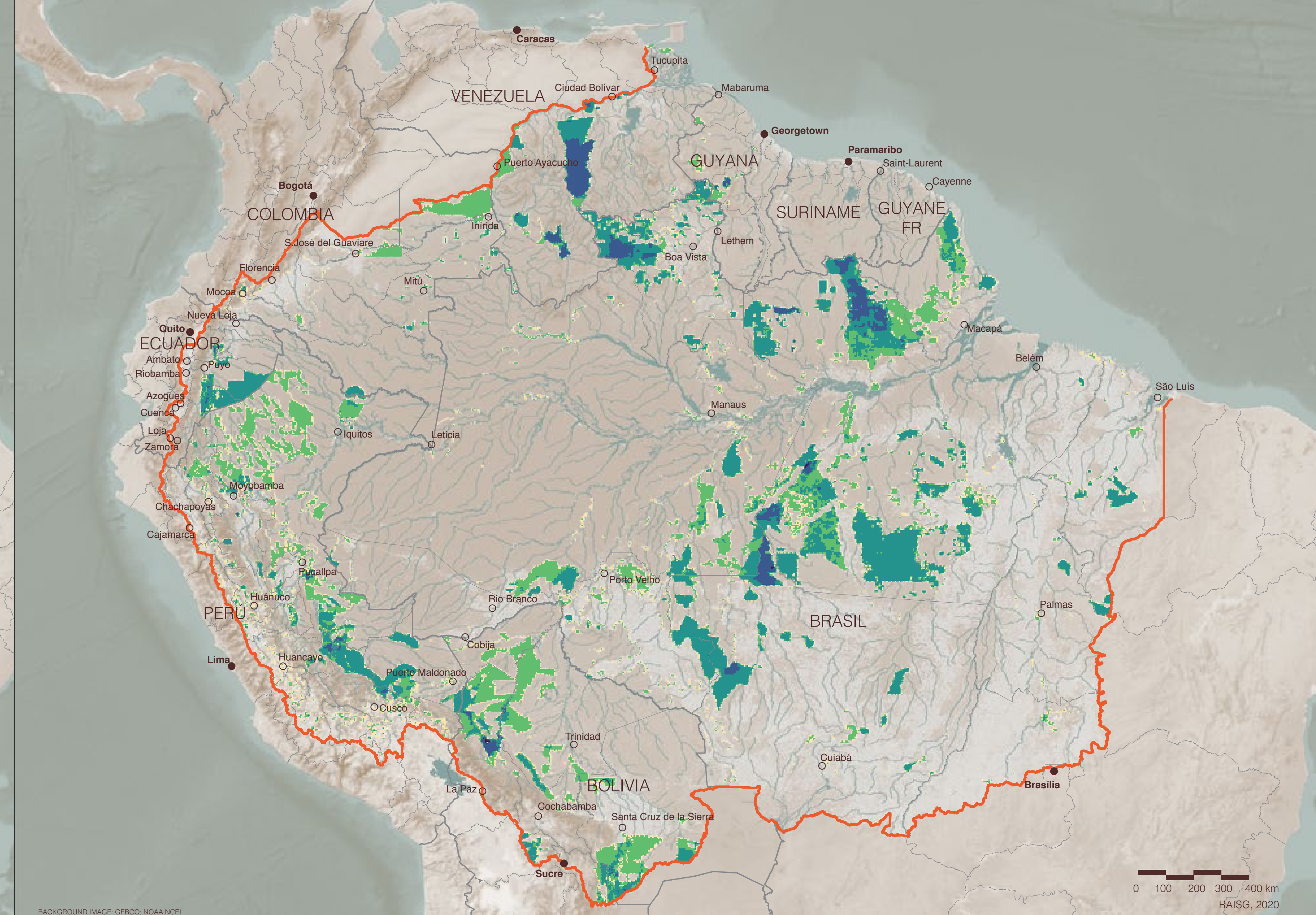
On the other hand, some type of threat hangs over 27% of Amazonia. Of those areas affected, 9% show "moderate" indices of intensity, 12% "high" and 2% "very high", as can be seen in map 15.

This map shows that to a greater or lesser degree, almost all the countries in the region have some part of their Amazon territory threatened by infrastructure projects (roads or hydroelectric plants) or extractive activities (mining or oil). Perú stands out as the country with the largest portion of its Amazon region threatened (42%), registering "very high" rates of threats from both road development and hydroelectric projects, as well as from oil exploitation.

In the case of Brasil and Venezuela (27% and 18% of territory under threat, respectively), hydroelectric and mining projects are threats that also fall into the "very high" category, while mineral extraction is also a threat in other countries of the region, although in the "very low" category. Bolivia reflects an extensive area of interest mainly in hydrocarbons, followed by mining and hydroelectric plants. In 15% of the territory the threat is "medium to very high". Colombia does not show "very high" threats; however, the possibility of mining and oil exploitation remains in its Amazonian territory.

Soy plantation near the Ngôjwêrê indigenous community, Querência, Mato Grosso, Brasil. *Fábio Nascimento / ISA, 2016.*





RAISG BOUNDARY

MAP 16. INDEX OF PRESSURES IN ITS AND PNAS

≤4 VERY LOW
≤16 LOW
≤36 MODERATE
≤64 HIGH
≤100 VERY HIGH

Source: prepared by GAIA for RAISG, 2020 (see Analytical process, pg. 06) .

Pressures and threats in ITs and PNAs

In contrast to the rest of Amazonia, Protected Natural Areas and Indigenous Lands continue to demonstrate their importance as a strategy for the preservation of the biome. However, due to the advance of extractive activities and infrastructure development, these areas are highly pressured and threatened, and show degradation as a result of human activities.

Based on the data collected and the boundaries of the protected areas, we can identify those areas where extractive activities or infrastructure construction conflict with the preservation of the Amazon biome, especially in areas demarcated for their environmental and social importance.

The analysis carried out (map 16) shows that 52% of Amazonia's protected areas, whether PNAs or ITs, suffer some form of pressure. Although most of them are under pressure of "very low" (12.6%) or "low" (28%) intensity, 11% of the protected areas suffer from "moderate" pressures, while 0.4% from "high" or "very high".

The majority of the units analysed as being under "very high" and "high" pressure, in protected natural areas or indigenous lands, are located in Ecuador (65%), while the areas under "moderate" pressure are mainly in Brasil, Perú, Ecuador and Bolivia.

When distinguishing by protected area type, we have found that 51% of the area classified as PNAs in Amazonia is under some type of pressure - the majority in the "moderate" (21%) and "low" (19%) categories, while 1% and 3% are under "very high" and "high" pressure, respectively.

MAP 17. INDEX OF THREATS IN ITS AND PNAs

RAISG BOUNDARY

≤4 VERY LOW
≤16 LOW
≤36 MODERATE
≤64 HIGH
≤100 VERY HIGH

Source: prepared by GAIA for RAISG, 2020 (see Analytical process, pg. 06).

No country is exempt, but the case of Ecuador stands out as the most dramatic, showing some level of pressure in 90% of its Amazon PNAs and disproportionately accounting for 56% of high pressure levels occurring in all Amazon PNAs: 32% of "high" and 24% of "very high" levels respectively.

Most of the PNAs under pressure in Amazonia face "moderate" or "low" pressures; However, all countries, except for Guyana, already register pressures considered "high" in some of their protected areas. In detail, 7% of the protected areas of Amazonia have more than half their area suffering "high" or "very high" pressures and about 15% of the protected areas of Amazonia are free of pressures; most of them (56%) in Brasil.

The picture is similar in ITs, 48% of which are under some kind of pressure. Although only 0.25% of the territory in these units register a "very high" pressure index, a third of the indigenous lands of Amazonia have more than half their area under "high" and "very high" pressure indices.

Ecuador and Guyana are the most critical cases, with only 22% and 7% of their indigenous lands free of pressure, respectively. Ecuador has a higher proportion of very high and high indices, while Guyana has more area with low and moderate indices. Also, in the case of Ecuador, 12 of its 14 ITs show more than 90% of their area under "very high" pressure indices.

Unlike the situation in PNAs, the ITs of almost all the Amazonian countries show "high" pressures, with Perú (20%) and Ecuador (18%) that show the greatest proportions under this index.

SYMPTOMS AND CONSEQUENCES OF HUMAN ACTIVITIES

Deforestation, burning and loss of carbon stocks are evidence of the large-scale transformations taking place in Amazonia.

DEFORESTATION

In Amazonia, accumulated deforestation reached 513,016 km² between 2000 and 2018. The triggers of this process, which vary in importance and type in each country, are associated with legal or illegal extractive activities (mining, hydrocarbons, wood, fauna and flora), agricultural activities, and infrastructure projects (roads, dams, among others). Forest loss varied throughout this period. In the first twelve years, the average annual deforestation was higher (30,854 km²/year) than for 2012-2018 (23,796 km²/year).

The peak was recorded in 2003, when more than 49,240 km² of forest was razed. From then on, rates of forest loss began to decline, in 2010 reaching just over 17,674 km², the lowest level for the whole period. However, since 2015 deforestation has begun to rise, and in 2018 more than 31,269 km² of forest were cut down, the equivalent of one third of Portugal, which puts that year in fifth place in terms of loss for the period studied.

Most of the deforestation (87.5%) took place outside PNAs and ITs, highlighting the role these areas play in protecting forests. However, 5.3% of forest loss occurred within ITs, and 7.5% within PNAs. In fact, the trend within ITs and PNAs goes against the regional trend. In this sense, the annual loss of forest in protected areas was 3,369 km² between 2000 and 2012, while between 2012 and 2018, this figure increased to 3,984 km², with high points in 2017 and 2018.

Between 2001 and 2018, Perú lost more than 22,848 km² of its Amazonian forests, according to the Ministry of the Environment (2019)[7] and the new RAISG analyses. This was mainly due to the expansion of areas for agricultural use, illegal mining, the proliferation of illegal crops, and the expansion of areas for livestock.

Upper image: Isolated Brazil-nut tree in an area cleared for agriculture, Sinop, Mato Grosso, Brasil. *André Villas-Bôas / ISA, 2015.*

7 Gobierno del Perú. (2020). GeoBosques http://geobosques.minam.gob.pe/geobosque/view/perdida.php

MAP 18. DEFORESTATION IN AMAZONIA

— RAISG BOUNDARY

LAND USE 2000-2018

- WOODED IN 2000
- NOT WOODED IN 2000

ANNUAL DEFORESTATION 2000-2018

2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018

Source: RAISG, 2020.

TABLE 8. DEFORESTATION IN AMAZONIA FROM 2000 TO 2018 (km²)

	2000 - 2012	2012 - 2018
Accumulated deforestation	370,243	142,773
Annual average (km²/year)	30,854	23,796

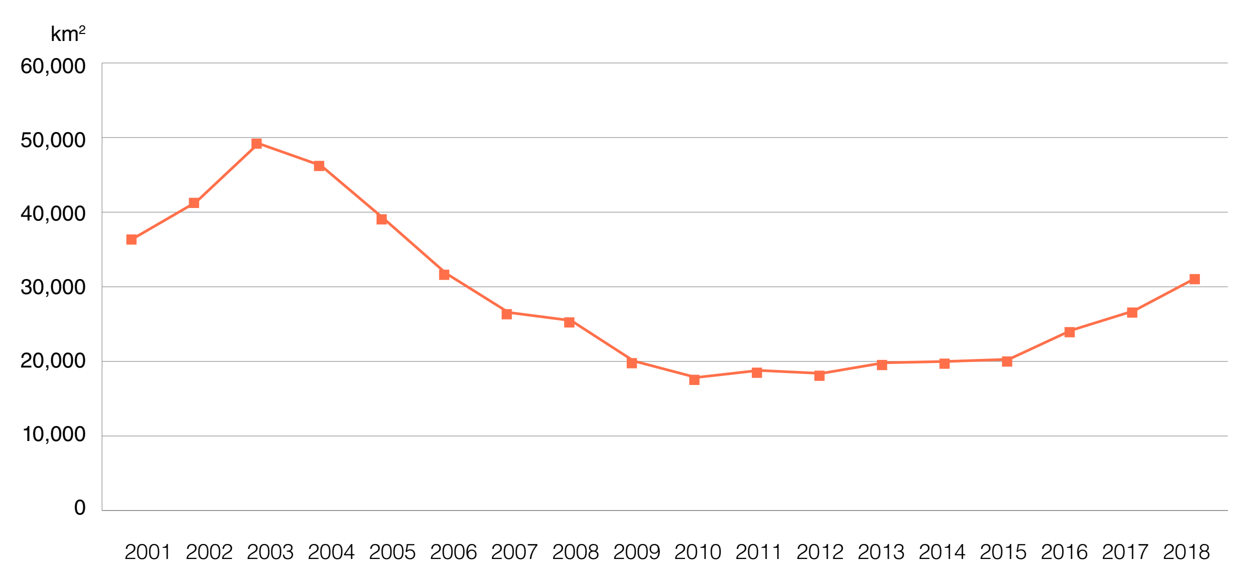


FIGURE 16. EVOLUTION OF ANNUAL DEFORESTATION IN AMAZONIA 2001-2018

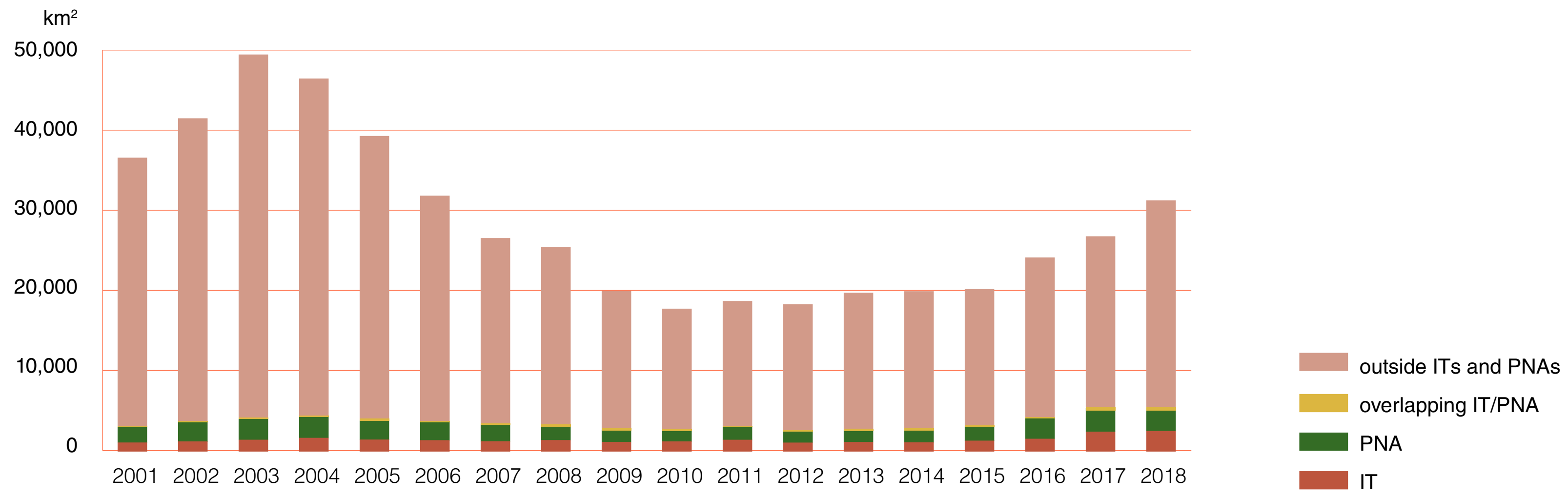


FIGURE 17. DISTRIBUTION OF DEFORESTATION 2001-2018

Although Perú has signed up to international initiatives to reduce deforestation, in practice one of the biggest challenges has been the lack of connection between national or regional policies, strategies and actions and those at the local level, which generate more immediate changes in land use.

For the first time since 1990, Ecuador witnessed an increase in its deforestation rate between 2017 and 2018, according to official data, a process that was already evident locally in its Amazon since 2015.

Between 2001 and 2018 the country lost 7,006 km² of forests in its Amazon region, the equivalent of almost 19 times the area of its capital, Quito. The alarms are sounding for the future due to the level of dependence that the country has on its extractive sector, oil and more recently mining, with various reserves in Amazonia. Although several dynamics operate to arrive at these figures, the direct cause of the largest proportion of deforestation is the expansion of agricultural areas.

In the period 2000-2018, Colombia saw between 600 and 1,400 km² of its Amazon forest transformed annually by the advance of agricultural activities (mainly for pasture), the expansion of road infrastructure, oil activity, and land grabbing, according to official figures from IDEAM's Forest and Carbon Monitoring System. These figures reveal a marked increase in the last two years of this period, partly explained by the peace process with the FARC, which eliminated the territorial control (and control over deforestation in particular) that this group exercised extra-legally in the so-called Arc of Deforestation.

In Brasil, the Amazon is suffering a rapid and intense process of deforestation. In almost 50 years, the country has lost 18.9% of its original forest (798,629.5 km², equivalent to almost twice the size of Germany). No other nation has felled so much in such a short time.

Between 2005 and 2011, the implementation of environmental policies in Brasil resulted in a reduction of the high rates of deforestation recorded in the previous period, marked by minimal government action. But between 2012, which was the year with the lowest level of deforestation (4,571 km²), and 2019 these efforts decreased drastically, and the trend was reversed. As a result, in this period deforestation increased 113.5%, according to official data.

In Bolivia, the data also show the speed with which deforestation is advancing in its Amazon region. A third (21,000 km²) of the 72,000 km² deforested in fifty years in the Bolivian Amazon was cleared between 2011 and 2018. In this period, deforestation occurred at an annual rate of 2,600 km², the worst figure in decades according to a study by the Fundación Amigos de la Naturaleza (FAN). This destruction is equivalent to clearing twice the area of the city of Rio de Janeiro every year for eight consecutive years. Agriculture and livestock are the main causes that drive the conversion of these forests.

In Venezuela, the absence of official figures makes inspection and control difficult. However, data from RAISG reveal that between 2000 and 2018 at least 4,000 km² of Amazonian forests were lost due to agricultural expansion and this, together with mining, mainly illegal and expanding uncontrollably, have caused important changes in the region over the past two decades.

BURNING

Fire, a tool used for centuries by indigenous peoples in Amazonia without noticeable landscape transformations, has been used on a large scale by other actors in recent decades, which has led to the conversion of vast areas of tropical forests into agricultural landscapes.

Between 2001 and 2019, 13% of Amazonia was affected by the advance of fire. This area, 1.1 million km², is equivalent to the entire territory of Bolivia. The annual average area affected by forest fires in the region is 169,000 km², which translates into burning practically the equivalent of the area of Uruguay every year, for almost two decades. Of the nine Amazonian countries, the one most affected by fire, in proportional terms, is Bolivia, with an impact that extends to 27% of its Amazonian territory. For Brasil this figure is 17%, for Venezuela 6% and for Colombia 5%.

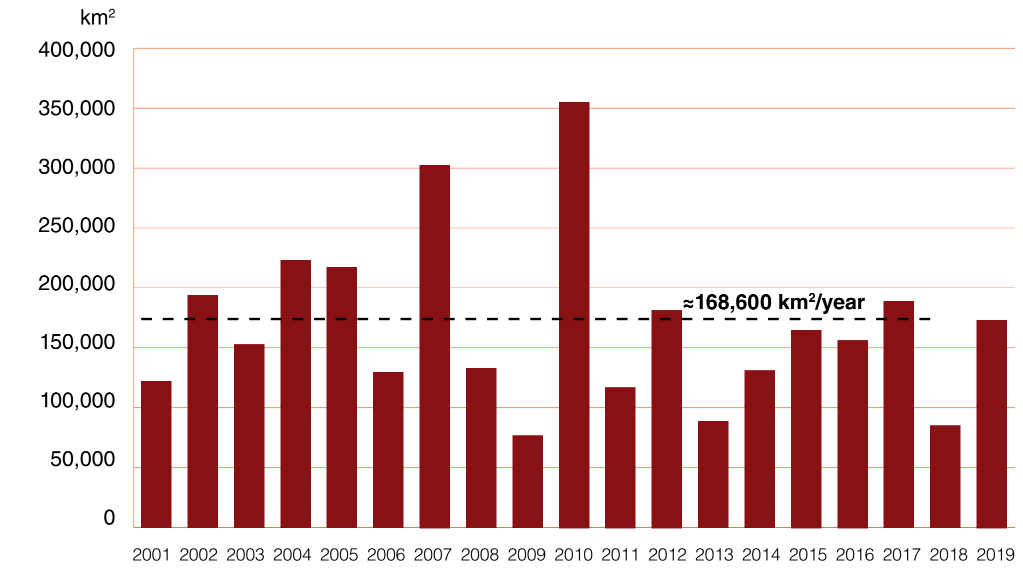


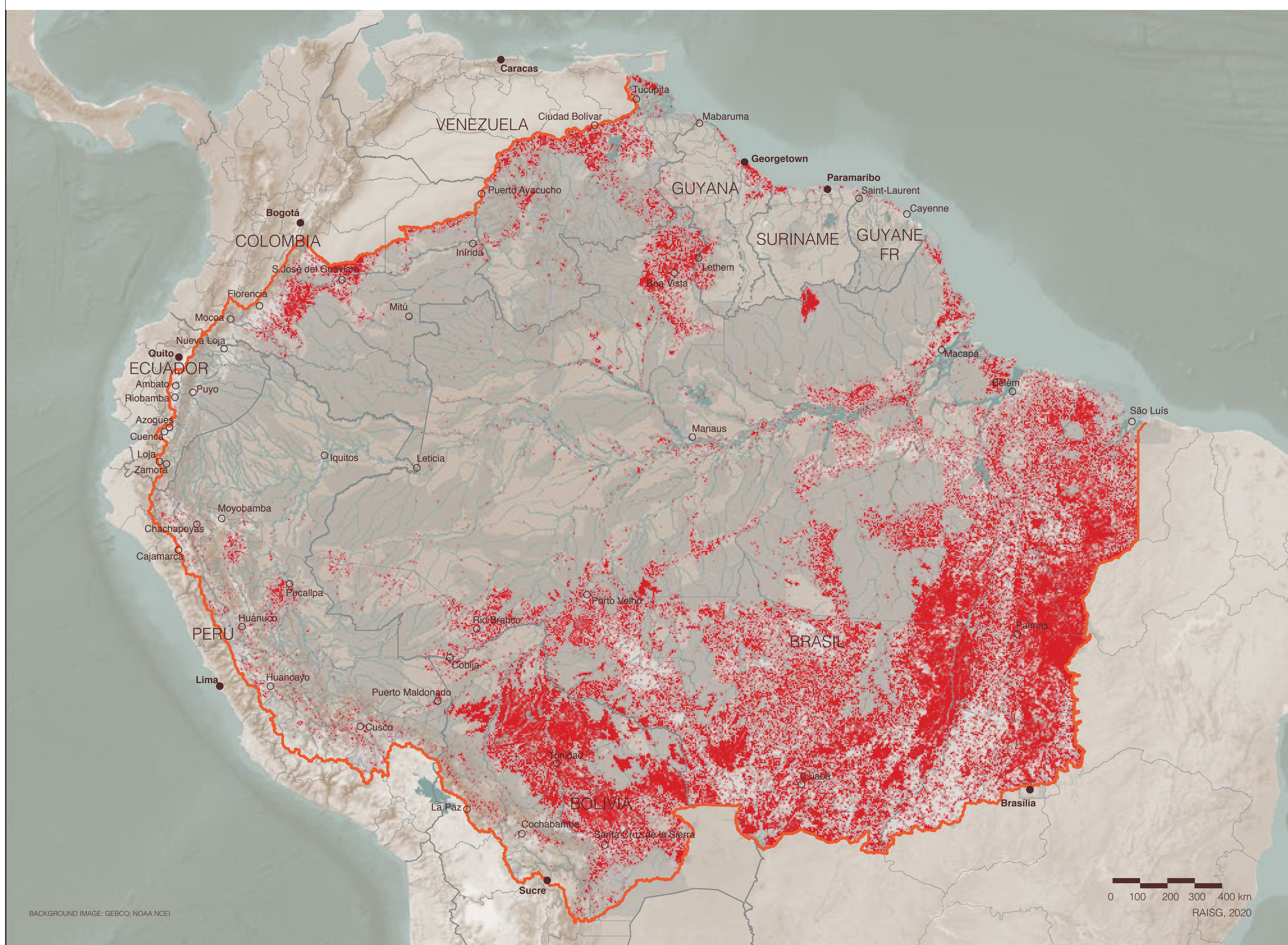
FIGURE 18. BURNING AND FOREST FIRES IN AMAZONIA, 2001-2019

MAP 19. AREAS BURNED IN AMAZONIA FROM 2001 TO 2019

IT OR PNA
FOREST OUTSIDE IT / PNA
RAISG BOUNDARY

AREAS BURNED (2001-2019)

Source: based on MODIS/ MCD64A1 (period 2001-2019, 500m resolution) and Sentinel-2 (20m) (see Analytical process, pg.05).



During the period analysed, the incidence of fire, mainly of human origin, varies according to the occurrence of more intense droughts and the effects of climate change.

The worst years for the region in terms of the area affected by fires were: 2010 (about 355,000 km^2), 2007 (302,000 km^2) and 2004 (223,000 km^2). However, a closer reading that considers the severity of the fires and how they impact ecosystems shows that the situation has worsened in recent years.

In map 20 it is evident that there are areas of recurrent burning, therefore the entire coverage does not represent new areas of burning.

In the last decade, occurring fires have been more difficult to control and extinguish, spreading more frequently towards woody formations (forest). Impacts on biodiversity have not been measured but are estimated to be considerable because much of the wildlife is trapped by the flames. In 2019 especially, the extent of the fires in the Amazon region generated an international wave of concern, calling for emergency action to contain the fires that, according to satellite calculations (20 m resolution, Sentinel 2), devastated more than 127,000 km^2 of Amazonia.

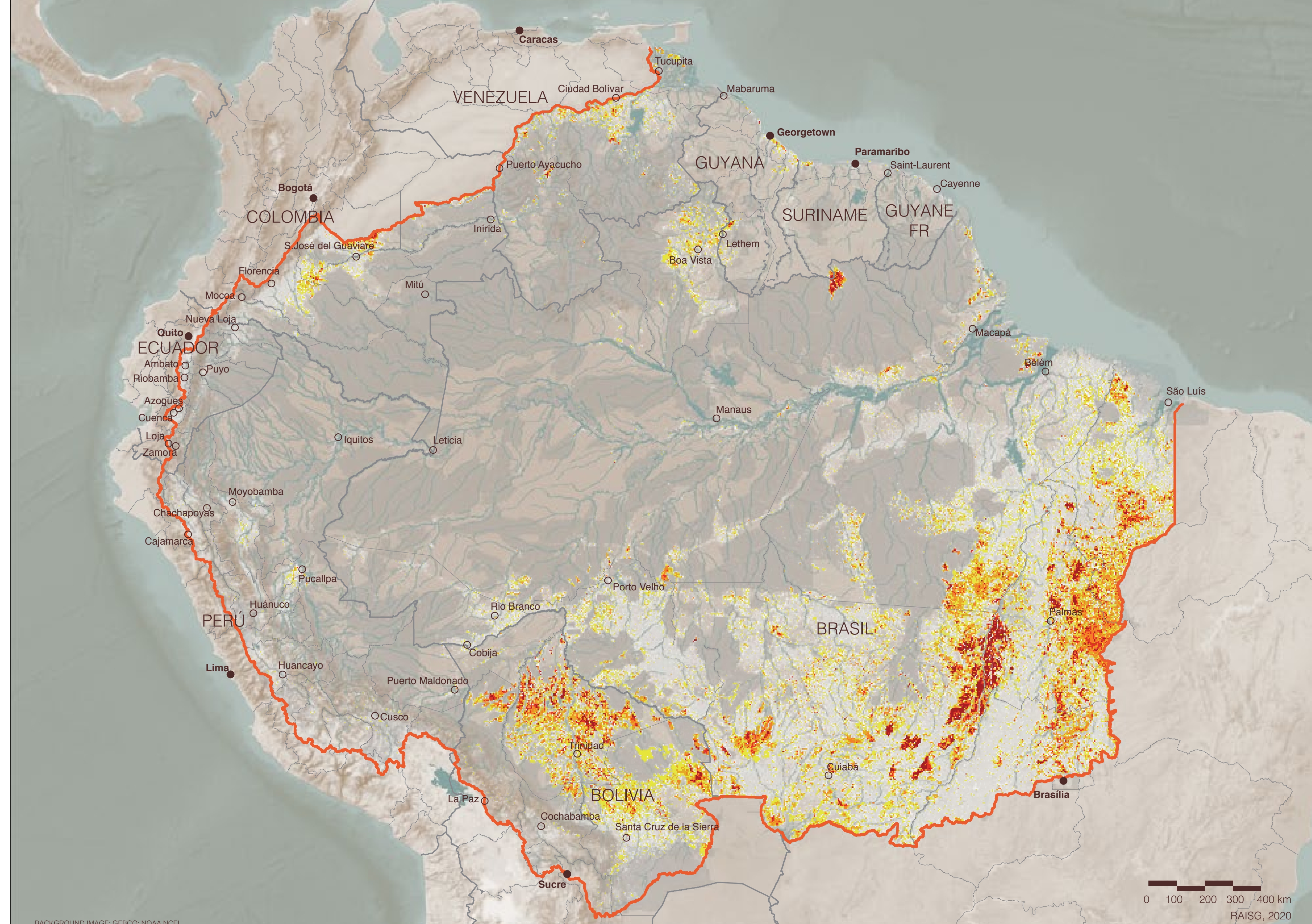
Another trend recorded between 2001 and 2019 was the advance of fire in PNAs and ITs. In this period, about 14% (152,697 km^2) of the area affected by burning corresponded to PNAs, while almost the same proportion (157,553 km^2) was inside ITs.

Despite the fact that PNAs and ITs are conservation areas and should be more protected, in the period 2001-2019 fire impacted annually, on average, 26,000 km^2 in PNAs (twice the area of Puerto Rico) and 35,000 km^2 in ITs (an area greater than Haiti). In 2019, fires exceeded the annual averages and affected 29,000 km^2 in PNAs and 40,000 km^2 in ITs, with predictable consequences on biodiversity and the indigenous peoples that inhabit these areas.

The use of fire is a traditional practice of indigenous communities, who regularly use it for tasks such as food production. But the techniques of indigenous peoples mimic natural processes of nutrient availability and circulation that protect species diversity and show a deep understanding of the forest. This includes the selection of areas based on the type of landscape, its vegetation cover, and soil characteristics. The burning period takes seasonality into account since the occurrence of burning in the dry or rainy season is an important factor in controlling fire.

The increase in deforestation is also related to the increase in burned areas and this, added to its impact on climate change, has negative consequences on the functioning of these cycles. Defining public environmental policies without considering the knowledge of indigenous peoples rings alarm bells about the frequency, extent and severity with which fires can spread in the Amazon region.

Burning in southern Amazonas state, Brasil. *Bruno Kelly / Amazônia Real, 2020.*



MAP 20. FREQUENCY OF FIRES IN AMAZONIA FROM 2001 TO 2019

- IT OR PNA
- FOREST OUTSIDE IT / PNA
- RAISG BOUNDARY
- 1 - 2 YEARS
- 3 - 4 YEARS
- 5 - 6 YEARS
- 7 - 8 YEARS
- 9 - 19 YEARS

Source: based on MODIS/ MCD64A1 (period 2001-2019, 500m resolution) and Sentinel-2 (20m) (see Analytical process, pg. 05).

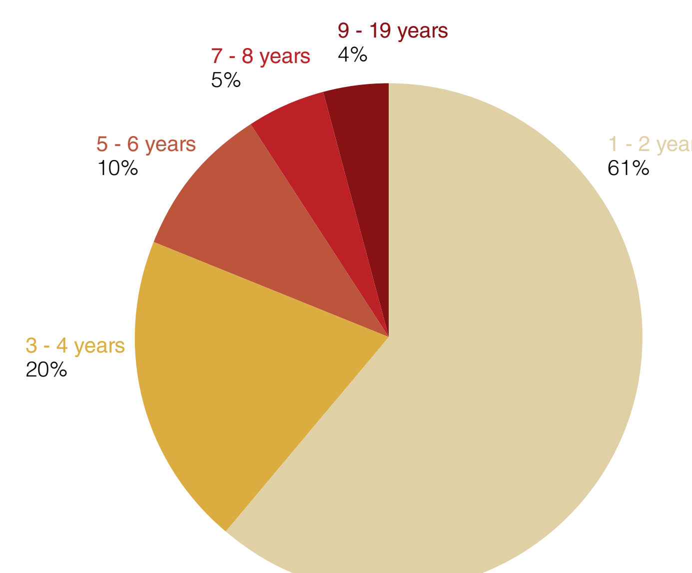


FIGURE 19. PROPORTION OF THE AREA AFFECTED BY FIRE IN AMAZONIA BY FREQUENCY AND TIME INTERVALS

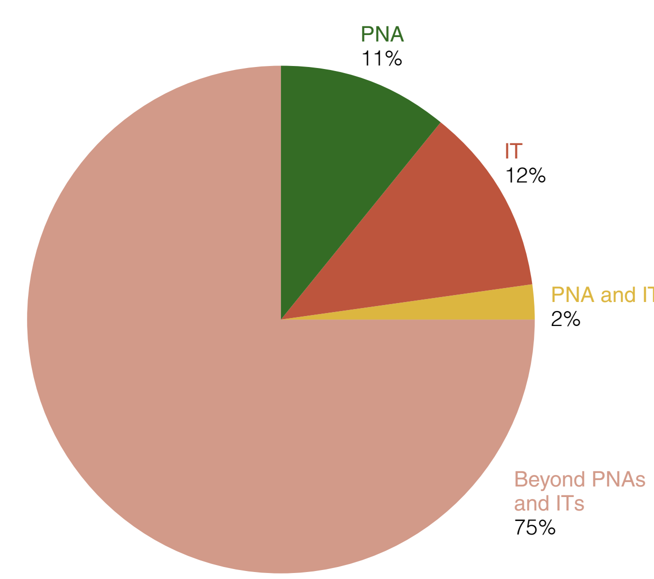


FIGURE 20. PROPORTION OF AREA AFFECTED BY FIRES INSIDE AND BEYOND PNAS AND ITS IN AMAZONIA, 2001-2019

CHANGES IN CARBON DENSITY

The measurement of forest cover to obtain estimates of changes in biomass and, as a consequence, carbon storage, has become a tool in the fight against climate change.

Although they contribute to the calculation of environmental damage, carbon emissions from the forest sector are not always adequately quantified in official figures by countries in the region, where reduction goals and policies focused on understanding and mitigating the causes are also lacking.

RAISG has been working with the Woods Hole Research Center (WHRC) since 2014 on various initiatives to conduct this type of monitoring. In 2017, WHRC scientists warned[8] that the net balance of gains and losses in forest biomass in pantropical forests between 2003 and 2014 was negative. In other words, they had stopped being a sink for carbon sequestration and had become a source of emissions.

The report argues that the gains in the region are due to forest growth and that the losses result from deforestation. In addition, forest degradation or disturbance caused in part by climate change, which even without destroying them affects the properties of forest cover, impacts their life cycles and reduces the environmental services provided.

The most recent analysis by RAISG and WHRC[9] suggests that during the period 2003-2016, the Amazon region was a net source of carbon emissions into the atmosphere, releasing around 1.29 billion tons of carbon (MtC), after calculating emissions and offsets.

This study considered the boundaries of the Amazon biome, an area of almost 7 million km^2 of Amazonian territory. Of this, 30% corresponds to ITs and 22% to PNAs.

ITs and areas of overlap (ITs/PNAs) registered the lowest net carbon loss between 2003 and 2016: -0.1% and -0.2% respectively. In PNAs, the net loss was -0.6% and, in contrast, was -3.6% in the "other lands".

Forest growth in ITs and PNAs represented a compensation (+826 MtC) for carbon loss (-956 MtC), meaning that the net loss in these areas was 124 MtC. This balance is almost nine times lower than the 1,029 MtC of losses in the "other lands".

These results reflect the effectiveness of ITs and PNAs in keeping the total carbon inventory intact and reinforce their fundamental role in protecting forests and fighting climate change.

Several studies have shown that these management areas act as buffers against external pressures associated with the expansion of the agricultural frontier, which is why clearly established land rights play an important role in reducing rates of deforestation and forest degradation.

8 Baccini, A. et al. (2019). Response to Comment on "Tropical forests are a net carbon source based on aboveground measurements of gain and loss." Science, 363(6423), 1–11.

9 Walker, W.S. et al. (2020). The role of forest conversion, degradation, and disturbance in the carbon dynamics of Amazon indigenous territories and protected areas. Proceedings of the National Academy of Sciences of the United States of America, 117(6), 3015–3025.

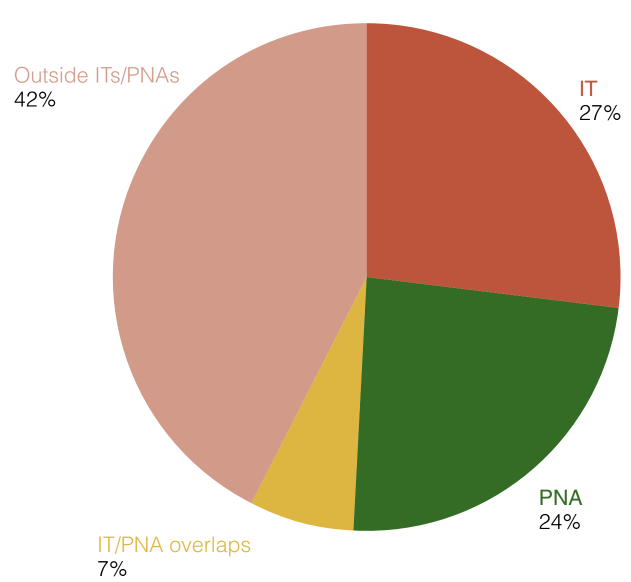


FIGURE 21. FOREST CARBON STOCKS IN AMAZONIA (2016)

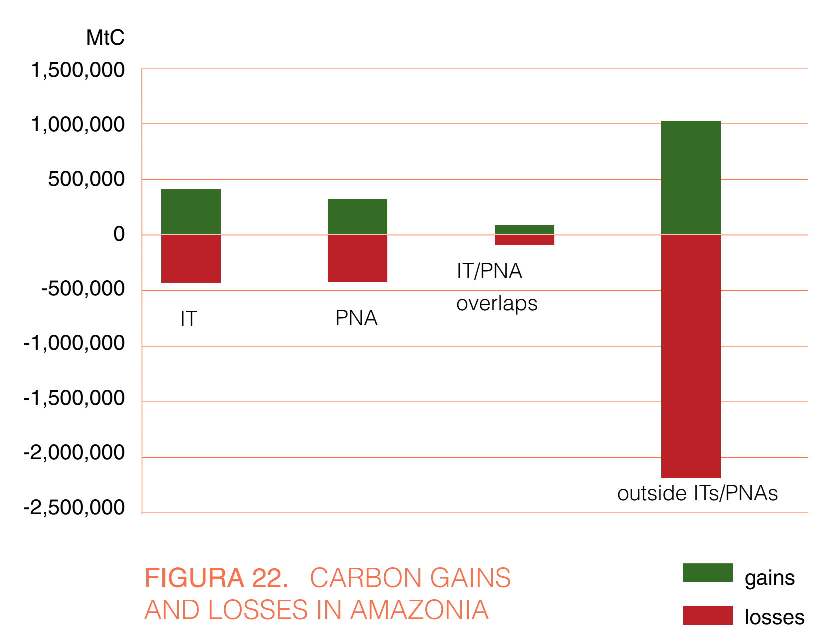
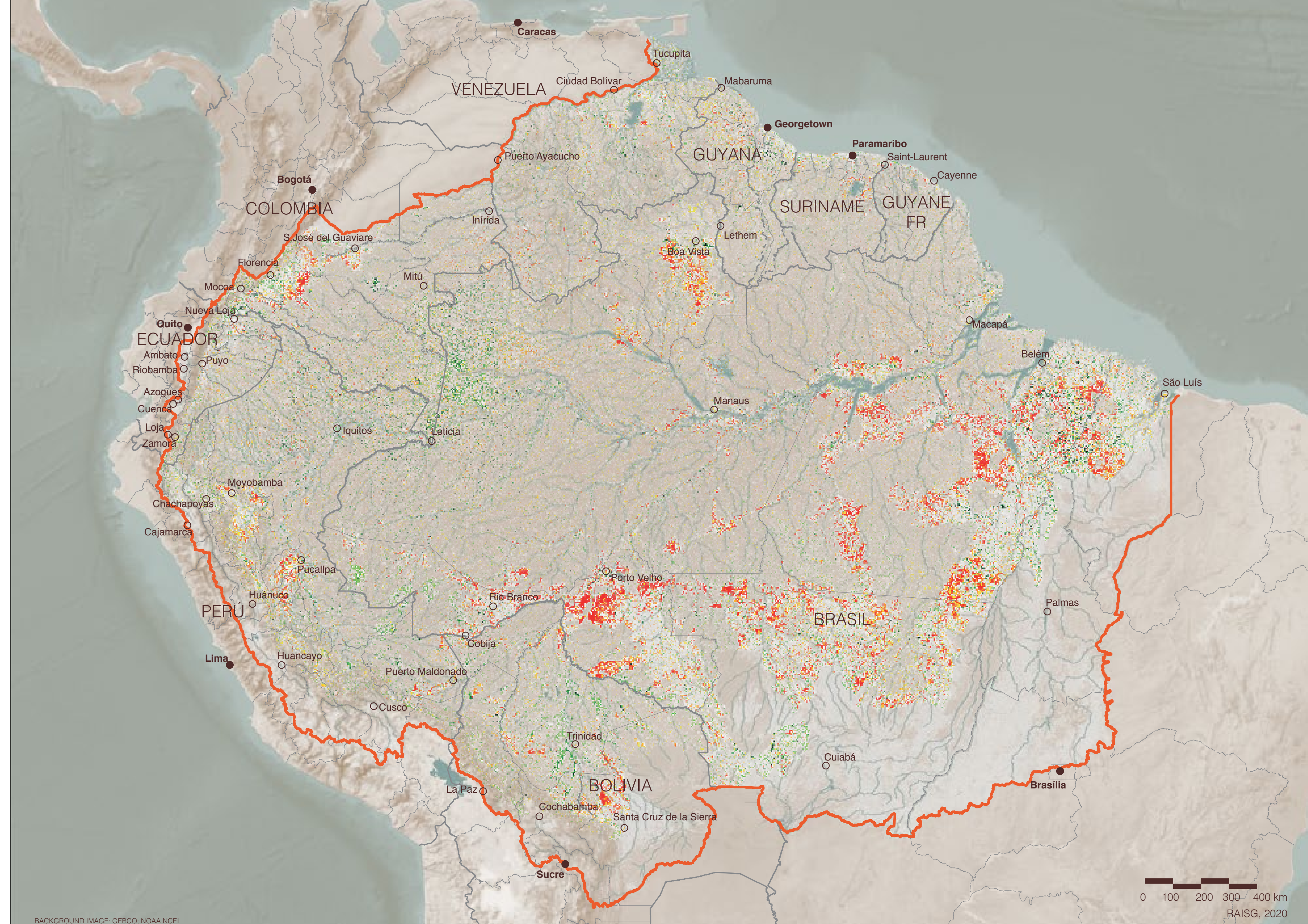


FIGURA 22. CARBON GAINS AND LOSSES IN AMAZONIA



MAP 21. CHANGES IN FOREST CARBON DENSITY IN AMAZONIA (2003-2016)

— RAISG BOUNDARY

≤-6 | 3 | 0 | 3 | ≥6 Mg C ha^{-1} y^{-1}

≤-80 | -40 | 0 | 40 | ≥80 Mg C ha^{-1}

LOSSES | GAINS

Source: Wayne S. Walker et al. (2020) (see pg. 67).

Rice and palm cultivation, Department of Meta, Colombia. *Wilfredo A. Garzón Paipilla, 2011.*

Upper image: Area of cleared and burned forest seen in the region of the Salomão feeder road, municipality of Apuí, Amazonas, Brasil. *Bruno Kelly / Amazônia Real, 2020.*

SYNTHESIS MAPS OF SYMPTOMS AND CONSEQUENCES

When analysing the spread of human activity in the Amazon region, we can see that more than half of Amazonia (52%) registers evidence of the symptoms and consequences of anthropogenic activity, both independently and in conjunction with carbon loss, areas burned, deforestation, or natural areas transformed.

All the countries of the region currently show some type of impact of human activity, with indices ranging from "very low" to "very high", as can be seen in map 22.

Although the symptoms and consequences were classified as "low" or "very low" in most of the affected units (UHA) (30%) in the whole of Amazonia, it is important to note that 4% of the region presents "very high" indices, 6% "high", and 11% "moderate", implying it experiences some level of degradation through one or more of the symptoms and consequences analysed.

The areas with high probability of degradation are found in the south-eastern portion in Brasil, the western region of Colombia, and central Bolivia, consistent with the processes of deforestation, land use changes, and burning, in particular. These three countries are the only ones with "very high" rates of symptoms and consequences of human activity.

Bolivia is the country with the largest proportion of its Amazon showing some type of symptoms and consequences (62%), followed by Brasil (56%) and Ecuador (54%). Bolivia and Brasil are the two most worrying cases, because the rates are not only higher but also more intense. Thus, in Brasil, 30% of units in its Amazonian territory are categorized as having "moderate" to "very high" symptoms and consequences. In the case of Bolivia, it is 20% and Colombia enters the list with 10% in this category.

At the other end of the spectrum, Guyane Française stands out for having 87% of its Amazonian territory unaffected by the human activities considered in the analysis. Together with Suriname, the country has only "very low" and "low" indices.

Venezuela, Guyana, Perú, and Ecuador have units affected by symptoms and consequences ranging from "moderate" to "very low". Perú and Guyana show 47% and 42% of their Amazonian territory, respectively, with mostly "very low" levels of impact.

Taking the variables into account, practically the whole of Amazonia shows signs of loss of stored carbon. Although in most units levels are "very low", Brasil, Colombia and Bolivia currently exhibit "moderate" rates. The situation is repeated with smaller areas but greater burning intensity, affecting especially the south of the region.

The areas of Amazonia that show deforestation rates follow a similar pattern, with the greatest intensity focused on the southeast portion of Amazonia in Brasil.

Symptoms and consequences related to deforestation can be seen in all the countries of Amazonia, although mostly corresponding to indices ranging from "very low" to "moderate".

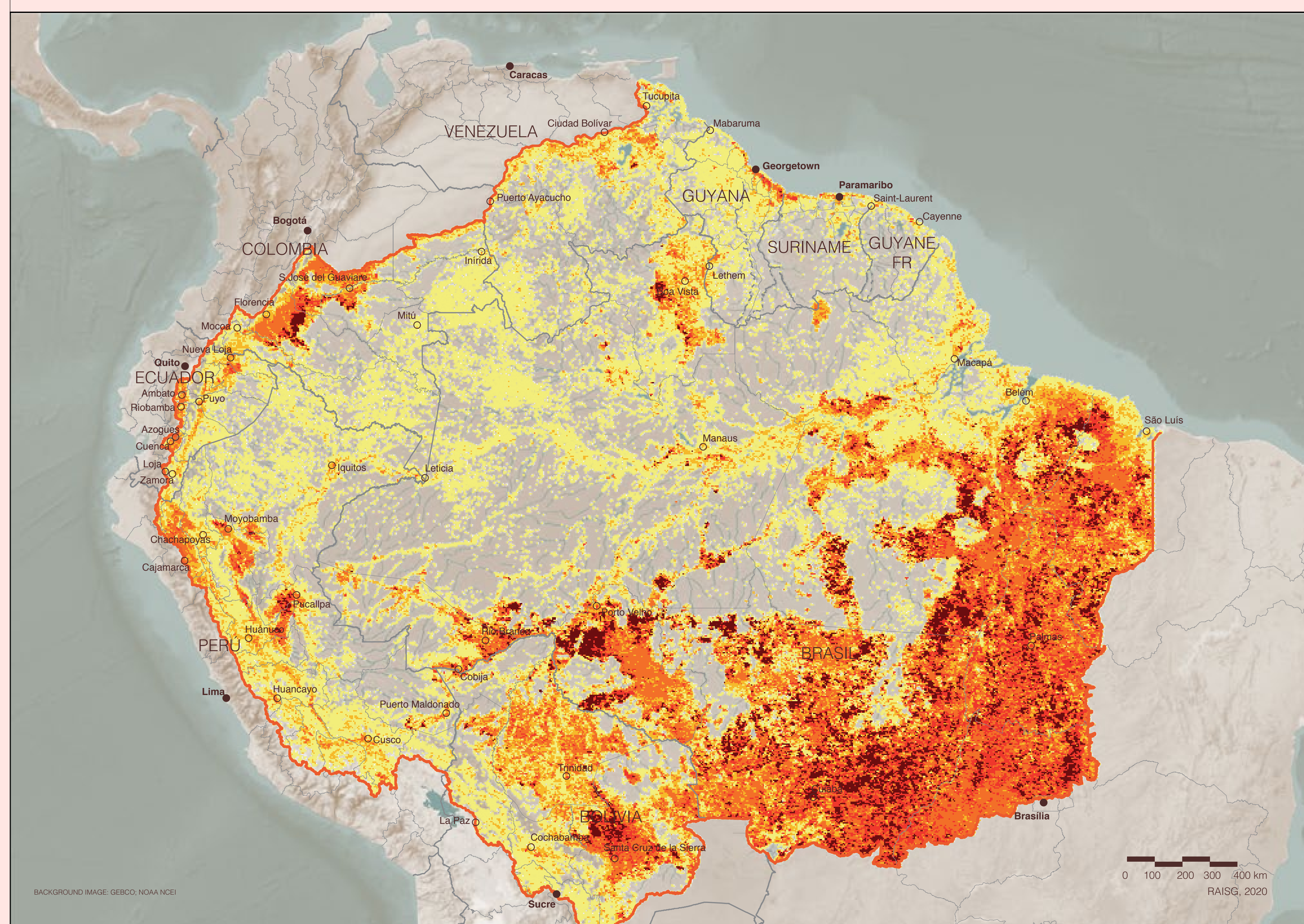
MAP 22. SYNTHESIS OF SYMPTOMS AND CONSEQUENCES IN AMAZONIA

RAISG BOUNDARY

INDEX OF SYMPTOMS AND CONSEQUENCES

- VERY LOW
- LOW
- MODERATE
- HIGH
- VERY HIGH

Source: developed by GAIA for RAISG, 2020 (see Analytical process, pg. 05).



A large fire in a cleared area seen alongside the BR-230 highway, municipality of Apuí, Amazonas, Brasil. *Bruno Kelly / Amazônia Real, 2020.*

Burning in southern Amazonas state, Brasil. *Lalo de Almeida, 2020.*

Cattle under a burnt Brazil nut tree on a tract of forest illegally cleared by farmers near the city of Novo Progresso, Pará, Brasil. *Lalo de Almeida, 2014.*

Burning in an area of intrusion in the Trincheira Bacajá Indigenous Land, Pará, Brasil. *Lalo de Almeida, 2019.*

Symptoms and consequences in ITs and PNAs

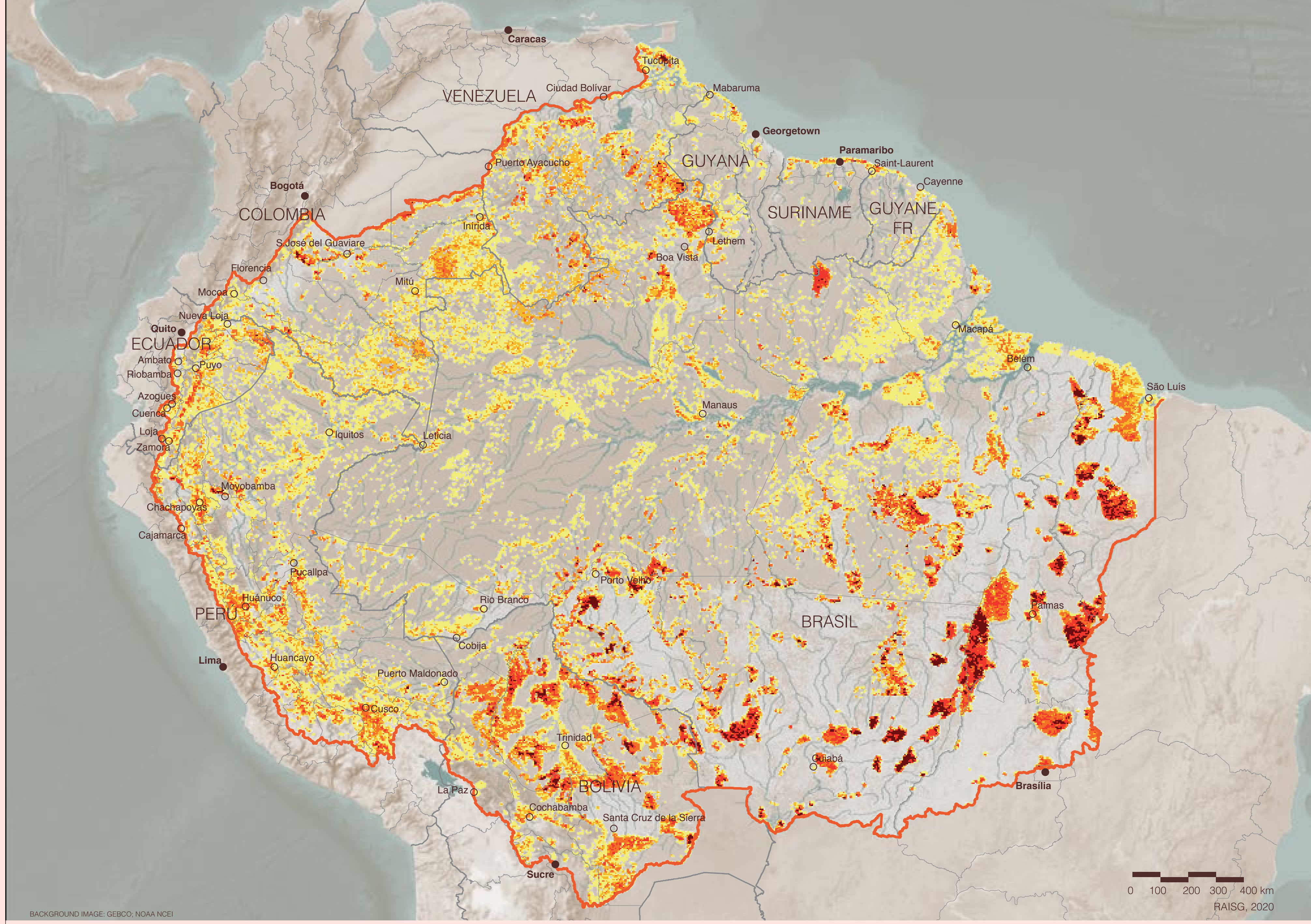
The analysis also considered the symptoms and consequences of environmental degradation caused by human activity in these protected areas, where degradation is marked by changes in natural cover and the loss of natural resources. Of the affected areas in Amazonia, 38% is found in the PNAs and ITs categories, but their role in conservation is shown by their hosting 72% of the areas free of these impacts in the region.

When analysing the levels of environmental degradation in protected areas of Amazonia (map 23), we can observe that 64% of PNAs and ITs in the region are free of symptoms and consequences caused by human activity. Most protected areas with signs of degradation show a "very low" rate (18%), the remainder being "low" (7%), "moderate" (6%), "high" (3%) and "very high" (1%).

On a country basis, Bolivia and Ecuador rank as the most worrying countries, with only 46% and 50% of their protection areas free of symptoms and consequences of human activity.

Broken down by type of protected area, 67% of PNAs in Amazonia do not show symptoms or consequences of anthropogenic activity. Most (15%) of the area affected in this category of protected area registers "very low" indices, while 6% shows "low" intensity, a further 6% is "moderate" and 3% qualifies as "high" and 1% "very high".

Smoke from burning affects Yawalapiti indigenous village in the Xingu, Brasil. *Lalo de Almeida, 2016.*



MAP 23. SYMPTOMS AND CONSEQUENCES IN ITS AND PNAs

— RAISG BOUNDARY

INDEX OF SYMPTOMS AND CONSEQUENCES IN ITs AND PNAs

- VERY LOW
- LOW
- MODERATE
- HIGH
- VERY HIGH

Source: developed by GAIA for RAISG, 2020 (see Analytical process, pg. 05).

Bolivia has 46% of its PNAs showing some sign of degradation, most of them falling into the "moderate" index. Ecuador is the second most affected country, with 40% of its PNAs registering symptoms and consequences.

The analysis shows that 6% of the PNAss in the Amazon region show signs of degradation at "high" and "very high" rates over more than 50% of their area (almost all in Brasil), while only 29% of these protected areas have more than 7% of their areas free from signs of degradation.

On the other hand, although 67% of ITs do not show symptoms or consequences of human activity, 5% of these territories in Amazonia already show, in more than half their area, signs of degradation categorized as "very high" and "high". The main countries that show symptoms and consequences within their ITs in their Amazon region are Perú, Bolivia and Ecuador. Bolivia is the most affected country, where about 56% of its indigenous lands present some symptom or consequence of anthropogenic action.

IMPORTANCE OF ITS AND PNAS socio-environmental vision

Upper image: Brazil nuts, Rio Novo, Pará, Brasil *Lilo Clareto/ISA, 2019.*

Over the years, various studies, investigations, and reports have argued the importance of ITs and PNAs for environmental protection. These management units serve in Amazonia as conservation spaces, while deforestation continues to expand, putting pressure on huge areas of native forest in surrounding areas and sometimes even within their boundaries.

Previously, the prevailing view from governmental and social perspectives was that Amazonia was a region to be occupied and exploited, due to the enormous presence of natural resources. In that sense, indigenous populations were seen as obstacles to "development". This view has been partially overcome thanks to action, internationally, by groups favourable to environmental rights and indigenous rights, which have later been incorporated into national constitutions and laws.

The Amazon region has come to be recognized, at least partially, for its role in regulating the climate, for its availability of water, and as one of the places with the greatest biodiversity in the tropics. In addition, it is the habitat of multiple indigenous peoples that constitute enormous cultural diversity for the world.

Given their socio-environmental importance, PNAs and ITs are governed by specific protection rules and their protection and supervision falls to government agencies. However, there are failures in ensuring the protection of these areas, ignorance of their importance in environmental conservation, and delays in the recognition processes. Thus, making progress in policies for the establishment of indigenous territories and protected areas that meet the socio-environmental needs of Amazonia continues to be an unmet need.

The creation of an PNAs acts as an administrative tool for states to protect parts of their territories of high environmental value, but conservation of these areas has also proven to be crucial in combating climate problems at a global scale.

In ITs, some indigenous populations have taken local initiatives to confront the advance of illegal actors and to demand that their voice be heard by governments, both when claiming territories, as well as when deciding or authorizing infrastructure projects or the advance of the extractive sector in the region.

State deficiencies in advancing the demarcation and recognition of ITs and in clearly defending those that already exist favour the increased invasion of these territories and expose local communities and indigenous populations, the last defence of these areas of enormous biological and cultural diversity, to a state of greater vulnerability.

The effectiveness of a policy of delimitating PNAs and ITs is evidenced by contrasting them with the progress of the exploitation of the region legally or illegally.

Official figures show how the demarcation of ITs has a positive impact on reducing deforestation and degradation of native forests, which in turn guarantees the protection of carbon stocks, safeguards biodiversity, and conserves regional hydrological systems. All the above ensure the survival of cultural diversity in the region.

This happens because indigenous communities recognize the importance of the standing forest and use its resources in a sustainable way. The traditional practices of indigenous populations are strongly related to and in harmony with nature.

In this way, strengthening actions for the demarcation and defence of PNAs and ITs, as well as the inclusion of the voices of Amazonian populations in the definition of local governance and environmental management policies, are essential for the conservation of Amazonia.

COUNTRY CASES

Bolivia

There is a misfit between conservation and the vision of development. Under recent governments the protection of Mother Earth and Nature has been promoted, making this a subject of rights (Law No. 300); at the same time however, strong incentives have been directed towards agricultural production under arguments of food sovereignty and security.

In recent years, this approach has resulted in a period of stagnation for protected areas and the consolidation of indigenous territories. Historically, Bolivia moved ahead with the creation of protected areas following the Rio Summit in 1992. From 2006 to the present, only sub-national protected areas have been created.

The legal consolidation of ITs has been the result of a long process that began in the 1980s. By 2012, only 52% of the total ITs claimed were titled. From 2013 to the present, small areas have been titled and progress has been slow. Titling of indigenous territories has become a difficult goal to achieve, with land allocation preponderantly destined for migrant peasant communities from other regions, initiating a trend of demographically reconfiguring the lowlands.

In 2018, the National Institute of Agrarian Reform (INRA) reported that 80% of the national territory was healthy and had been titled in its 12 years of management (2006-2017). This important advance has resulted in greater pressure on conversion of Amazonia to agricultural use, because according to the INRA Law its Social Economic Function (FES) must be fulfilled and article 169 of the Political Constitution of the State is open to revocation if this obligation is not fulfilled.

On the other hand, ITs still must achieve recognition of their autonomous status so as to access State resources and act as autonomous entities as established by the State Political Constitution.

Brasil

In the first governments following re-democratization and the entry into force of the current Constitution at the end of the 1980s, 248 ITs in the Brazilian Amazon were legally registered. Between 2011 and 2018, under the administrations of Dilma Rousseff and her vice president Michel Temer, who assumed power in 2016 following her impeachment, there was a significant reduction. In these eight years only 21 ITs were approved (20 under Rousseff and 1 under Temer).

After President Jair Bolsonaro, who has repeatedly shown himself to be in favour of reducing the demarcation of indigenous territories, took office in January 2019, changes were made to the National Indian Foundation (Funai) which weaken the objectives of this state agency for indigenous affairs. The changes are intended not only to halt the process of demarcation but also to revise what has so far been done.

In terms of PNAs, the trend over the last eight years has been similar. Dilma Rousseff's government created the lowest number of conservation areas in this twenty year period and was notable for setbacks to forest legislation and for the continuation of policies supporting dependence on fossil fuels and infrastructure projects with high socio-environmental impact.

Colombia

Under the framework of Colombian policy for Amazonia and indigenous peoples, the state has in recent decades adopted the legal regime of "indigenous reservations", that is, the recognition of the collective ownership of the territory of the communities, which is inalienable, imprescriptible and cannot be encumbered.

Likewise, the Political Constitution of 1991 established conditions such that, in addition to the collective ownership of the land, communities enjoy the

Upper image: Uwottüja shaman in front of sacred stone, Uwottüja ancestral territory, as yet unrecognised officially, municipality of Autana, Amazonas state, Venezuela. *Wataniba /Jesús Chucho Sosa, 2013.*

political-administrative management of their territories in accordance with their traditions and customs, within the growing process of decentralization. Such a context entails adaptation of the organizational processes of indigenous peoples in their territories to those of the country and of external cooperation.

A recent measure taken by the national government, Decree 632 of 10 April 2018, opens the door for non-municipalized areas in the departments of Amazonas, Guainía and Vaupés, locations of the large indigenous reservations in the Colombian Amazon lowlands, to establish a gradual and progressive system for strengthening the autonomy of indigenous peoples in their territories, allowing indigenous communities and peoples to decide on the governance and management of resources, in accordance with their own systems of planning, administration and government.

Although in recent years there has been an expansion of areas and Amazonia has been declared a holder of rights, interests over areas in the national system of protected areas (SINAP) have not gone away and these areas are impacted by deforestation, legal and illegal mining, land grabbing within its jurisdiction, and illegal roads. Such are the cases of the Sierra de la Macarena, Tinigua, Nukak and Serranía de Chiribiquete national natural parks. For its part, the Colombian state has been weak in the face of these threats controlled by illegal economic forces and groups.

Ecuador
Its 2008 Constitution made Ecuador one of the first countries in the world to consider nature as a subject of law and this has, in some cases, enabled favourable legal decisions to uphold the rights of nature and of indigenous peoples against extractive industries.

The designation of protected areas dates back decades, but in the last decade eight new national protected areas and forty-six protected forests have been declared in the Amazon, reflecting a more systematic effort for biodiversity conservation.

Ecuador is recognized as a multicultural country and legislation has facilitated the recognition not only of communal lands, but also of ethnic groups as beneficiaries, allowing the legalization of territories claimed by ethnic groups or nationalities in a large part of the Amazon.

Perú
Perú recorded an increase in the number of ITs (3,471) because of the expanded RAISG boundaries of analysis, incorporating the headwaters of the basins. This has implied including in the database, in the high Andean areas, peasant communities, the other category recognized by the Peruvian state as an indigenous territory.

The country has progressed in the creation of new protected areas, especially in the category of Private Conservation Areas. However, the process of titling the lands of native and peasant communities has been almost frozen for two decades, with missing or incomplete dossiers. Although there have been several titling initiatives since 2012, progress is slow, even more so if the communities are located where investments and extractive and infrastructure projects are concentrated.

In Perú, the Kakataibo indigenous people have led a long struggle to demand official recognition by the state of their territories in the Unipacuyacu native community, as well as the protection of their forests against invasions by settlers and land traffickers for the development of agriculture and livestock, and against deforestation for the planting of illegal crops that, according to reports, also includes the installation of coca maceration ponds, confirming the presence of drug trafficking in the area.

Venezuela
In Venezuela, the main change since 2012 has been the creation of the Caura National Park in 2017, with 7.5 million hectares. In the process, the Jaua-Sarisariñama National Park and the Caura Forest Reserve were extinguished. Furthermore, the declaration of the park was given without prior, free, and informed consultation procedures involving the Ye'kwana and Sanëma peoples who live in the river basin and who for more than fifteen years have been demanding the recognition of their territories. Perhaps for this reason, the ordinance creating the park mentions indigenous rights.

On the other hand, there is overlap between the National Park and the Orinoco Mining Arc National Strategic Development Zone. This overlap does not appear in current maps in recent official documents, but a legal document sanctioning this change has not been found, so there are great doubts among environmentalists, civil society, and indigenous peoples themselves.

BOX 3 THE EMERGENCE OF BIOECONOMY

An environmental perspective and a concern for conservation have led to changes in the perceptions of consumers and have put the private sector under pressure for decision-making that involves more than simply ensuring the profit of its operations.

Driven by a market with new demands, investors are beginning to consider the socio-environmental impact, transparency, and traceability of their raw materials as relevant factors for their positioning in the global market.

The bioeconomy, a green and sustainable economy, is emerging as an innovative alternative for natural resource use, recognising and incorporating the knowledge of local communities and acknowledging the importance and value of keeping tropical forests standing, ceasing to see them as places of extraction.

According to data from the Organization for Economic Cooperation and Development (OECD), about 50 countries including the G7 have national strategies or policies consistent with the adoption of a green economy in the future, which acts as an alternative for addressing existing social problems. In the global market, the bioeconomy mobilizes about 2 billion euros and generates about 22 million jobs.[i]

There is an international consensus on the need to align economic growth with environmental policies. Multinational companies already promote and advocate using the resources of the Amazon region without degrading or deforesting native forests, ensuring their added value, social inclusion, jobs, and economic returns to local communities.

Alliances that recognize Amazonian populations and the value of biodiversity have proven to be lucrative, characterizing a means of overcoming the false dilemma of conservation or economic growth.

According to specialists, this is not just about positioning companies in the international market, but also benefits the economies of Amazonian countries by making use of their green potential with a view not only to the present, but also to the future.

It is not just about preserving, but about adopting policies to minimize and offset the environmental impact of its industrial processes, turning towards a circular economy.

After the first wave, adopted decades ago, which encouraged the demarcation of natural areas, and the second wave, which advocated a regional development model based on extractive activities, production of grains, and extensive cattle ranching, now climate pressures and advancing devastation in tropical forests require other economic alternatives.

The incorporation of technological innovation into industrial processes contributes to the establishment of a new model of inclusive economic development that capitalizes on the value of non-degraded tropical forests, i.e. those that can continuously produce, opening the door to the third Amazonian wave, which seeks to increase the profitability of companies by minimizing socio-environmental impacts on the region.

i OECD (2017). Green growth indicators. OECD Economic Surveys: Argentina 2017.

CONCLUSION

If we ask ourselves what are the main conclusions we wish to highlight in "Amazonia Under Pressure", there is no question but that we need to emphasise a fact common to the results presented in all the chapters: in the last decade there has been an accelerated rate of growth of Pressures and Threats, as well as their Consequences and Symptoms in Amazonia.

Here is some of the evidence that supports this conclusion:

- The synthesis map shows that 7% of the Amazon territory is under "very high" pressure and 26% under "high". The areas with the highest pressure are located in the peripheral areas of the biome, in areas of mountains and foothills to the west, especially in Ecuador, in northern Venezuela, and in the south of the region in Brasil

- Road density in Amazonia, calculated by road and territorial extent, is 18.7 km/1,000 km². The countries that are at the forefront of this expansion are Colombia, Perú and Venezuela.

- Hydroelectric plants, inside the boundaries of the Amazon biome in 2020, have increased by 4%, to a total of 177 hydroelectric plants. The increase was more prominent among UHEs, which increased by 47% compared to 2012, going from 51 to 75 in 2020.

- Between 2012 and 2019, the Amazon region recorded an increase in oil blocks. However, in the same period the land area occupied by this sector was reduced in all of its phases, though this does not necessarily translate into a decrease in these industries in Amazonia, but rather in changes to official databases.

- In a similar fashion to the oil sector, areas with mining interest increased from 52,974 in 2012 to 84,767 in 2020; however, there was a reduction of 11% (188,374 km²) of land occupied by this activity during the period analysed.

- Agricultural activity is responsible for 84% of deforestation in Amazonia, according to RAISG's analysis. Since 2015, deforestation in Amazonia has begun rising again. In 2018, more than 35,000 km² of forest were cut down, the equivalent of almost half Panama.

- In 2020 RAISG recorded 4,472 localities in Amazonia where illegal mining is practiced, 87% of them in the active phase of exploitation.

- Between 2001 and 2019, 13% of Amazonia was affected by fire. This is equivalent to an area of 1.1 million km² or a territory similar to that of Bolivia.

- RAISG analyses suggest that more than half the units of analysis in Amazonia (65.8%) are subject to some type of permanent or ongoing pressure, while more than half (52%) register symptoms and consequences of anthropogenic activity, independently or together with loss of carbon, areas burned, deforestation or converted natural areas. These impacts are lower within PNAs and ITs, demonstrating their key role in conservation in the region.

All these indicators show that Amazonia, its biodiversity, and its indigenous peoples are experiencing a critical moment, a rate of degradation unprecedented in its history.

During the preparation of "Amazonia under Pressure" we learned that a group of eminent researchers had created an Amazonian Scientific Panel, a multidisciplinary group that seeks to inform society about the critical moment in the region. This group starts from the premise that the forest is approaching a point of no return.

The pioneering studies of Carlos Nobre, a Brazilian scientist who for years worked at the National Institute for Space Research (INPE), later supported by the Met Office, the UK meteorological service, pointed out the possibility that as a result of deforestation and climate change, Amazonia is reaching another point of disequilibrium with less rain and more fires.

With this urgent premise, the purpose of the Panel is to inform society that we need to change the concept of development as it is applied in Amazonia. It emphasises the importance this giant has for the survival not only of the indigenous peoples who inhabit it, but also of the wider society, as it is, as we have seen, a large-scale regulator of the global climate.

The main agenda of the group is consistent with the conclusions reached by RAISG after months of studies: to avoid the collapse of environmental services in Amazonia, it is necessary to stop deforestation immediately and to initiate restoration processes that reverse the impacts it has endured for decades.

Advancing understanding of continent-wide connections and climate regulation makes this need even more pressing. Society and its elected officials need to understand that not only environmental damage, but also social and economic damage, is taking place.

Among the most recent RAISG studies is the scientific article on carbon stocks in Amazonia. More than 50% of the carbon is found in indigenous lands and protected natural areas, so much so that the greatest number of emissions has been produced on "other lands".

In other words, thanks to indigenous peoples, social leaders, some political leaders and the pioneering spirit of scientists, we now have conserved forests, often sustainably managed. These are essential for their inhabitants and provide vital services for those who live in cities near and far. This is not the time to throw away this achievement.

Upper image: Iténez Natural Integrated Management Area Departental Park, Beni, Bolivia. *Marcelo Arze / FAN, 2014.*

SOURCES OF INFORMATION

NATIONAL DATABASES COMPILED AND COMPATIBILIZED BY RAISG INTO A SINGLE DATABASE:

	Boundaries	Amazonia	PNA	IT	Roads	Hydroelectric	Oil	Mining
Bolivia	Instituto Nacional de Estadísticas (INE), 2013	Viceministerio de Recursos Hídricos y Riego (VRHR), 2010	Servicio Nacional de Áreas Protegidas (SERNAP), 2015	Instituto Nacional de Reforma Agraria (INRA), 2018	Administradora Boliviana de Carreteras (ABC), 2020	Empresa Nacional de Electricidad (ENDE), 2018	Viceministerio de Exploración y Explotación de Hidrocarburos (VMEEH), 2017	Servicio Nacional de Geología y Técnico de Minas (SERGETECMIN), 2013
Brasil	Malha Digital IBGE, 2017	Boundaries of the Brazilian Legal Amazon established under Law 5.173/66 and the biogeographical boundaries of the Amazon Biome according to the Map of Biomes of Brazil, 1st Approximation, IBGE, 2004	ISA, 2020, based on official documents	ISA, 2020, based on official documents	Database of federal highways, DNIT, 2017	ANEEL, September 2019	Production database, BDEP, ANP, 2019	DNPM,2020
Colombia	Integrated Digital Map 2019, Instituto Geográfico Agustín Codazzi (IGAC)		Digital Map of National Natural Parks by category, Scale 1:100.000. República de Colombia. Parques Nacionales Naturales de Colombia 2019	Digital Map of Indigenous Territories. República de Colombia. Agencia Nacional de Tierras 2019	Digital Cartographic Base Map. Scale 1:25.000. Instituto Geográfico Agustín Codazzi. 2017.	n/a	Digital Map of Areas. Agencia Nacional de Hidrocarburos 2019.	Digital mining cadastre of the Republic of Colombia. Agencia Nacional de Minería
Ecuador	Comite Nacional de Límites Internos (CONALI, 2019)	Drawn up by EcoCiencia 2019	Ministerio de Ambiente y Agua del Ecuador (MAAE, 2020)	Capa de EcoCiencia, 2019	Instituto Geográfico Militar, 2019	Ministerio de Energías y Recursos no Renovables del Ecuador, 2019	Ministerio de Energías y Recursos no Renovables del Ecuador, 2019	Agencia de Regulación y Control Minero, (ARCOM, 2019)
Guyana	Digital Chart of the World (DCW)	Digital Chart of the World (DCW)	DCW	Ministry of Amerindian Affairs, 2009	Digital Chart of the World (DCW)	n/a	n/a	n/a
Guyane Française	Digital Chart of the World (DCW)	Digital Chart of the World (DCW)	DEAL, 2007	DEAL, 2007	DEAL, 2007	n/a	n/a	n/a
Perú	Referential political boundaries: Instituto Nacional de Estadística e Informática (INEI), 2017	Ministerio de Agricultura y Riego (MINAGRI) - Autoridad Nacional del Agua (ANA), 2010	Ministerio del Ambiente (MINAM)-Servicio Nacional de Áreas Naturales Protegidas por el Estado (SERNANP), 2019	Native communities: IBC-SICNA 2019 Peasant communities: SICCAM-IBC/CEPES Indigenous reserves (existing and proposed): Ministerio de Cultura, 2019	Ministerio de Transportes y Comunicaciones - MTC, 2018	Organismo Supervisor de la Inversión en Energía y Minería - OSINERGMIN, 2018	PerúPetro/ Ministerio de Energía y Minas - MINEM, 2019	Instituto Geológico, Minero y Metalúrgico - INGEMMET, 2019
Suriname			World Database of Protected Areas (WDPA), 2006	n/a	DCW	n/a	n/a	n/a
Venezuela	Instituto Geográfico de Venezuela Simón Bolívar (IGVSB), 2016.	Instituto Geográfico de Venezuela Simón Bolívar (IGVSB), 2016.	Provita, 2020, from official gazettes.	- Freire, G., Tillet, A. 2007. Salud Indígena en Venezuela. Mapa general. Ediciones de la Dirección de Salud Indígena, Caracas, Venezuela. - MPP Ambiente y MPP Pueblos Indígenas 2014. Mapa Tierras Indígenas. Dir. Gen. POT / Sec. Tec. Com. Nac. Demarcación del Hábitat y Tierra de los Pueblos y Comunidades Indígenas. Caracas, Venezuela. - Wataniba 2019 (in collaboration with the indigenous organizations Oipus, HOY, Kuyunu, Kuyukani, Kuyujani originario, Kubawy)	Provita, 2020, updated using OpenStreetMaps. See: https://www.openstreetmap.org/copyright	Camacho Gabriel y Carrillo Augusto, 2000. EDELCA, 2004. Herrera Karina, 2007. Ministerio del Poder Popular para la Energía Eléctrica, 2013. Grupo Orinoco Energía y Ambiente, 2015.	Ministerio de Energía y Petróleo, 2017.	Ministerio de Energía y Minas, 2017.

Regional databases:

Fires: produced globally using MODIS (Moderate Resolution Imaging Spectroradiometer) MCD64A1, at 500 metre spatial resolution using the Google Earth Engine (GEE) platform.

Areas of Agriculture and Livestock Utilization: drawn from Collection 2.0 of annual maps of land cover, land use and land use changes between 2001 to 2018 in the Pan-Amazon produced by the MapBiomas Amazonia, an initiative led by RAISG. Data available for download at https://amazonia.mapbiomas.org/

Carbon: Wayne S. Walker, Seth R. Gorelik, Alessandro Baccini, Jose Luis Aragon-Osejo, Carmen Josse, Chris Meyer, Marcia N. Macedo, Cicero Augusto, Sandra Rios, Tuntiak Katan, Alana Almeida de Souza, Saul Cuellar, Andres Llanos, Irene Zager, Gregorio Díaz Mirabal, et al. (2020). The role of forest conversion, degradation, and disturbance in the carbon dynamics of Amazon indigenous territories and protected areas. Proceedings of the Natural Academy of Science. www.pnas.org/cgi/doi/10.1073/pnas.1913321117

Vegetation: taken with modifications from Comer PJ, Hak JC, Josse C, Smyth R (2020) Long-term loss in extent and current protection of terrestrial ecosystem diversity in the temperate and tropical Americas. PLoS ONE 15(6): e0234960. https://doi.org/10.1371/journal.pone.0234960

Deforestation: set of annual deforestation maps produced by RAISG, 2020 using land cover, land use and land use changes maps of MapBiomas Amazonia.

Basin headwaters and Seasonal flooding: Spickenbom, J., Quintanilla, M. (2020) Análisis de Cabeceras de Cuenca y Estacionalidad de las Inundaciones de la Pan-Amazonia, Santa Cruz, Bolivia. Specially prepared by Fundación Amigos de la Naturaleza for the present publication.

INDIGENOUS PEOPLES IN AMAZONIA 2020

Bolivia
Brasil
Colombia
Ecuador
Guyana
Guyane Française
Perú
Suriname
Venezuela

• Achuar • Aikanã • Aikewara • Akawaio • Akuntsu • Amahuaca • Amanayé • Amarakaeri
• Amondawa • Anambé • Andoa • Andoque • Aparai • Apiaká • Apinayé • Apurinã • Arabela
• Araona • Arapaso • Arapium • Arara • Arara da Volta Grande do Xingu • Arara do Rio Amônia
• Arara do Rio Branco • Arara Shawãdawa • Arautaní • Arawak Oriental • Araweté • Arazaire • Arekuna
• Arikapú • Aruá • Ashaninka • Asháninka • Ashéninka • Asurini do Tocantins • Asurini do Xingu
• Atorad • Avá-Canoeiro • Awa • Awajún • Aweti • Aymara • Ayoreo • Bakairi • Banawá • Baniwa
• Bará • Barasana • Baré • Baure • Bora • Borari • Bororo • Cabiyarí • Cacataibo • Candoshi
• Canela Apanyekrá • Canela Ramkokamekrá • Canichana • Capanahua • Caquinte • Carapana • Carijona
• Cashinahua • Cavineño • Cayubaba • Chacobo • Chamicuro • Chimán • Chintonahua • Chiquitano
• Cinta Larga • Cocama • Cocama-Cocamilla • Cofán • Coreguaje • Cubeo • Cuiba • Culina
• Curripaco • Deni • Desana • Djeoromitxí • Dow • Enawenê-nawê • Eñepa • Ese Eja
• Galibi do Oiapoque • Galibi-Marworno • Gavião Akrãtikatêjê • Gavião Kykatejê • Gavião Parkatêjê
• Gavião Pykopjê • Gente Dia • Guajá • Guajajara • Guanano • Guarasugwe • Guarayo
• Guató • Guayabero • Harakmbut • Hitnü • Hixkaryana • Huachipaire • Huitoto • Huni Kuin • Hupda
• Ikolen • Ikpeng • Iñapari • Inga • Ingarikó • Iny Karajá • Iquito • Iranxe Manoki • Isconahua
• Itano • Itonama • Jamamadi • Jaraqui • Jarawara • Javaé • Jiahui • Jivi • Jodï • Jujüpda
• Juma • Ka'apor • Kaixana • Kalapalo • Kali'na • Kallawaya • Kamaiurá • Kamentsá • Kanamari
• Kanoê • Karajá do Norte • Kariña • Karinya • Karipuna de Rondônia • Karipuna do Amapá
• Karitiana • Karo • Kassupá • Katuenayana • Katukina do Rio Biá • Katukina Pano • Katxuyana
• Kawaiwete • Kaxarari • Kisêdjê • Kokama • Korubo • Kotiria • Krahô • Krahô-Kanela
• Krikatí • Kuikuro • Kujubim • Kulina Pano • Kuruaya • Kwazá • Lecos • Letuama
• Lokono • Machiguenga • Machineri • Makaguaje • Makuna • Macushi • Mai Juna • Mako • Makuna
• Makurap • Mapoyo • Marinahua • Maropa • Marubo • Mashco-Piro • Mastanahua • Matapí
• Matipu • Matis • Matsés • Mebêngôkre Kayapó • Mehinako • Menky Manoki • Mestizo
• Miranha • Mirity-tapuya • Misak • Mitiwa • Moré • Morunahua • Moseten • Movima
• Moxeño-Ignaciano • Moxeño-Trinitario • Muinane • Munduruku • Mura • Muruy • Nadob • Nahua
• Nahukuá • Nambikwara • Ñamepaco • Nanti • Naruvotu • Nasa • Nheengatu • Nomatsiguenga
• Nukak • Nukini • Ocaina • Omagua • Oro Win • Pacahuara • Palikur • Panará • Parakanã
• Paresí • Parintintin • Passé • Patamona • Paumari • Pemón • Piapoco • Pirahã • Pira-tapuya
• Pisamira • Puinave • Pukirieri • Puyanawa • Quechua • Quechua Lamas • Quechua Napo
• Quechua Pastaza • Quijos • Resígaro • Rikbaktsa • Sakurabiat • Sanëma • Sapananawa Sapé
• Sapiteri • Sateré Mawé • Secoya • Shanenawa • Shapra • Sharanahua • Shawi • Shipibo-Conibo
• Shirian • Shiwiar • Shiwilu • Shuar • Sikuani • Siona • Siriana • Siriano • Sirionó • Surui Paiter
• Suruwaha • Tacana • Taiwano • Tanimuka • Tapajó • Tapayuna • Tapirapé • Tapuia • Tariana
• Taruma • Tatuyo • Taurepang • Taushiro • Teko • Tembé • Tenharim • Terena • Ticuna • Tiriyó
• Torá • Toromona • Toyoeri • Trío • Trumai • Tsohom-dyapa • Tucano • Tujupda • Tumaco
• Tunayana • Tupari • Turiwara • Tuyuka • Umutina • Urarina • Uru-Eu-Wau-Wau • Uwottüja
• Wai Wai • Waimiri Atroari • Wajãpi • Wajuru • Wampis • Waorani • Wapichana • Warao
• Warekana • Wari' • Wauja • Wayana • Xavante • Xerente • Xikrin • Xipaya • Yabarana • Yagua
• Yaminahua • Yánesha • Yanomami • Yauna • Yavitero • Yawalapti • Yawanawá • Ye'kwana • Yeral
• Yine • Yudja • Yuhup • Yuhupde • Yukuna • Yuqui • Yuracare • Yuri • Yurutí • Zápara • Zo'é
• Zoró

PAPER PÓLEN BOLD 90g/m²
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RIOS VOADORES

Amazônia Sob Pressão 2020

Encarte especial

RAISG
REDE AMAZÔNICA DE INFORMAÇÃO SOCIOAMBIENTAL GEORREFERENCIADA

O fotógrafo Sebastião Salgado, entre os anos 2013 e 2019, realizou diversas viagens na Amazônia brasileira para registrar comunidades indígenas e paisagens da região para seu novo livro e exposição. Um dos focos deste trabalho, ele conta, foi visualizar, através da fotografia, o clima amazônico e sua importância para a América do Sul e o planeta. Aqui seu depoimento:

"Há vários anos, eu venho trabalhando na Amazônia não somente com as comunidades indígenas. Eu tenho trabalhado também no meio físico da Amazônia. Eu tenho fotografado esta vista generosa da Amazônia, essa dimensão incrível através de fotos aéreas. Fiz uma série incrível de viagens aéreas. Eu pude observar de uma maneira muito especial o sistema de evaporação da Amazônia. Esses rios aéreos incríveis que começam muito cedinho pela manhã. Normalmente, as noites são úmidas na Amazônia, nós temos muita precipitação, e as manhãs começam a ter um grande grupo de pequenas nuvens chamado 'aru'. Os 'arus' vão se formando, são micro nuvens e aos poucos eles vão se juntando, horas depois já são nuvens de tamanhos consideráveis e no início da tarde se transformam em cumulonimbus, nuvens de grande altitude, com uma carga incrível de umidade, de energia, de ventos no interior e que provocam uma segunda precipitação. Mas esta nuvens continuam andando, a gente vai vendo, quando se voa bastante na Amazônia, a formação destes rios aéreos. É uma coisa impressionante. Então a finalidade do meu trabalho na Amazônia, além das comunidades indígenas, além da parte humana, foi mostrar esse sistema de águas. Não só o sistema de rios, não só as florestas de igapó, que são florestas inundadas por extensões imensas, mas mostrar também esses outros aspectos da grande evaporação, do grande acúmulo de umidade e a necessidade desta umidade ser distribuída no planeta inteiro, principalmente na América do Sul. Fiz estas fotografias com a intenção de captar essa ideia da umidade maior, do transporte desta umidade através dos ventos."

Imagem acima à esquerda: Território Yanomami, entre Auaris e Surucucus, Roraima, Brasil. *Sebastião SALGADO*, 2018.

Imagem abaixo à esquerda: Território Yanomami, Auaris, Roraima, Brasil. *Sebastião SALGADO*, 2018.

Imagem abaixo: Fortes ventos do Oceano Atlântico entram no continente e cruzam a Amazônia passando pela região do Monte Roraima, no extremo norte do Brasil. O vento concentra as nuvens, também enriquecidas pela evaporação recente, e deixa visível o "rio voador" que levará a umidade a milhares de quilômetros de distância. Terra Indígena Yanomami, Roraima, Brasil. *Sebastião SALGADO*, 2018.

Nas últimas décadas, com o avanço das pesquisas científicas sobre interações entre a biosfera e a atmosfera na Amazônia, consolidaram-se os conhecimentos sobre o papel de seus ecossistemas no equilíbrio climático regional, assim como na disponibilidade de água para o consumo e a produção agrícola.

Hoje sabemos que a segurança e o bem-estar das populações que vivem nessa área e nas regiões vizinhas dependem desse equilíbrio. Seja para a produção de alimentos, a geração de energia ou a mitigação das mudanças climáticas, a Amazônia provê água para as cidades, a agricultura e as mais diversas formas de vida nesse bioma.

A bacia do Amazonas, a maior do mundo, e sua floresta tropical formam um grande sistema de reciclagem de água. Desde 1970, estudos científicos argumentam que aproximadamente metade da água precipitada na bacia volta para a atmosfera através da evapotranspiração.

O pesquisador Enéas Salati e seus colaboradores foram os pioneiros na busca da assinatura química da reciclagem de água na Amazônia. Em artigo publicado na revista Science, em 1979[1], Salati demonstrou que a água reciclada por transpiração contém mais moléculas de um certo elemento (o isótopo pesado oxigênio-18) que a água evaporada do oceano. Dessa maneira, o pesquisador pôde provar que parte das precipitações na Amazônia vem da transpiração da própria floresta; um sistema em equilíbrio, como ele mesmo definiu em outro artigo, em 1984[2].

De acordo com estudos realizados pelo projeto LBA (Large Biosphere Atmosphere), em um dia são evaporados em média 3,6 litros por metro quadrado. Cobrindo uma superfície de 5,5 milhões de quilômetro quadrados de área florestal, estima-se que a cada dia são enviados à atmosfera 20 trilhões de litros de água, ou seja, mais que o volume despejado pelo Oceano Atlântico no rio Amazonas[3].

Assim, ao invés de ser o pulmão do mundo, a floresta tropical é o "ar-condicionado" global, graças à preservação da umidade e da temperatura regional. Além disso, contribui para a absorção e conservação do carbono.

Podemos pensar a Amazônia também como o coração que bombeia água para outras regiões. Uma das melhores imagens usadas para descrever a importância da preservação da Amazônia é a dos rios voadores.

Depois da demonstração de que a floresta tropical pode gerar chuva por si mesma, outros estudos descreveram como essa umidade circula no continente. Os experimentos do pesquisador José Marengo e seus colaboradores mostraram aquilo que se convencionou chamar "jato de baixa altitude sul-americano". Resumidamente, trata-se de correntes atmosféricas, ventos, responsáveis por levar vapor d'água da Amazônia para as montanhas andinas e também para a bacia do Rio da Prata[4]. Esses são os famosos "rios voadores".

Assim, podemos afirmar que a América Latina está conectada pela Amazônia. E a ligação é exatamente a bacia e seu bioma, que funcionam como reguladores climáticos, especialmente no regime de chuvas.

Segundo estudo publicado em 2014 no Journal of Climate, por J. Alejandro Martínez e Francina Domínguez, é possível atribuir às chuvas procedentes da Amazônia até 20% das precipitações que ocorrem na bacia do Rio da Prata, a qual se estende por parte do Brasil, Argentina, Paraguai, Bolivia e Uruguai, representando o segundo maior sistema fluvial da América do Sul[5].

Diante de tais evidências, torna-se urgente o debate sobre as mudanças no uso do solo para a preservação dessas funções ambientais. A última geração de estudos já mostra que a ocorrência de eventos extremos, como as secas e mesmo a redução das precipitações nas regiões de produção agrícola, está cada vez mais acentuada por conta do ritmo acelerado do desmatamento.

Investigações comandadas por pesquisadores como Marcos Costa, da Universidade Federal de Viçosa, em Minas Gerais, apontaram os efeitos concretos do desmatamento no regime de chuvas da Amazônia. "A mudança climática, incluindo a retroalimentação entre as mudanças no uso da terra e o clima local, está diminuindo a duração da histórica temporada de chuvas ao sul da Amazônia, aumentando o risco de que sejam produzidas condições ambientais prejudiciais no futuro e representando uma ameaça para agricultura intensiva", afirmam Costa e colaboradores em artigo publicado em novembro de 2019, na Frontiers in Ecology and the Environment[6].

A preocupação é de que a Amazônia esteja sendo empurrada em direção à ruptura de seu equilíbrio. Assim, o desmatamento está criando um clima cada vez mais seco, que resulta em uma floresta cada vez mais suscetível às queimadas.

Em 2014, o pesquisador Antonio Nobre, em sua publicação *O futuro climático da Amazônia*, comparou as árvores com gêiseres, capazes de extrair água de extratos subterrâneos e bombardear a atmosfera. Estima-se que uma árvore grande poderia enviar até mil litros de água para o ar. Nobre lembra que 90% da umidade da atmosfera chegou ali por meio das plantas.

Para ele, entender o sistema hidrológico da Amazônia é também um esforço para entender a Amazônia de maneira holística, como um bioma que contribui para o equilíbrio ambiental e econômico, não só do continente sul-americano, mas de todo o planeta.

1 Salati, E. et al. (1979). Recycling of water in the Amazon Basin: An isotopic study. Water Resources Research, 15(5), 1250–1258.

2 Salati, E. & Vose, P.B. (1984). Amazon Basin: A System in Equilibrium. Science 225(4658), 129–138.

3 Nobre, A.D. (2014). O Futuro Climático da Amazônia. Relatório de Avaliação Científica. Patrocinado por ARA, CCST-INPE, e INPA. São José dos Campos, Brasil, 42p.

4 Vera, C. et al. (2006). The South American low-level jet experiment. Bulletin of the American Meteorological Society, 87(1), 63–77.

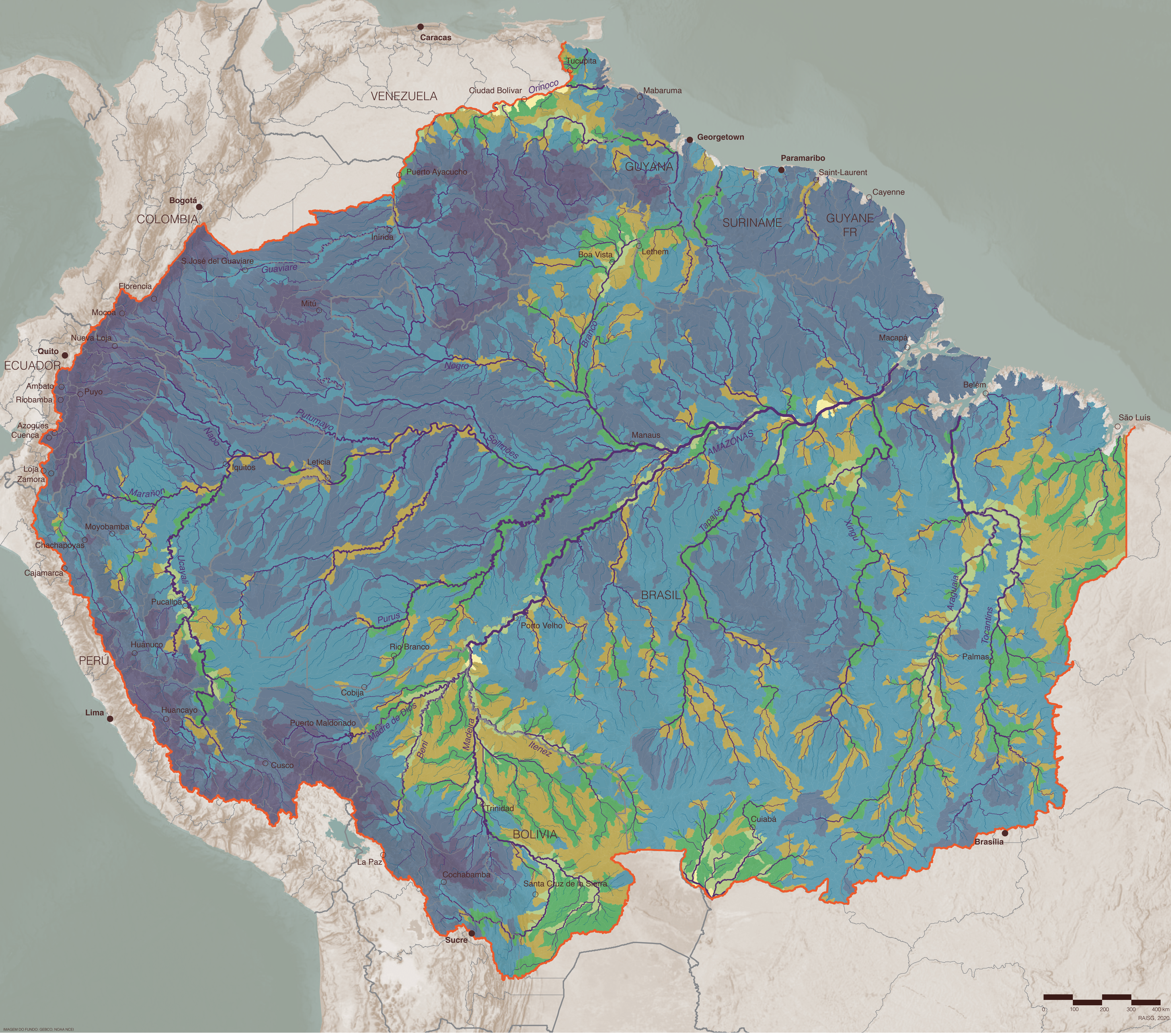
5 Martinez, J.A. & Dominguez, F. (2014). Sources of atmospheric moisture for the La Plata River Basin. Journal of Climate, 27(17), 6737–6753.

6 Costa, M.H. et al. (2019). Climate risks to Amazon agriculture suggest a rationale to conserve local ecosystems. Frontiers in Ecology and the Environment, 17(10), 584–590.

ÁGUA AMAZÔNIA

Amazônia Sob Pressão 2020
Pôster

RAISG



MAPA 1. PRODUTIVIDADE HÍDRICA POR CLASSE DE BACIA

— LIMITE RAISG

- MUITO ALTA PRODUTIVIDADE
- ALTA PRODUTIVIDADE
- ZONA PRODUTORA
- CONECTIVIDADE HIDROLÓGICA
- MÉDIA ACUMULAÇÃO
- ALTA ACUMULAÇÃO
- MUITO ALTA ACUMULAÇÃO

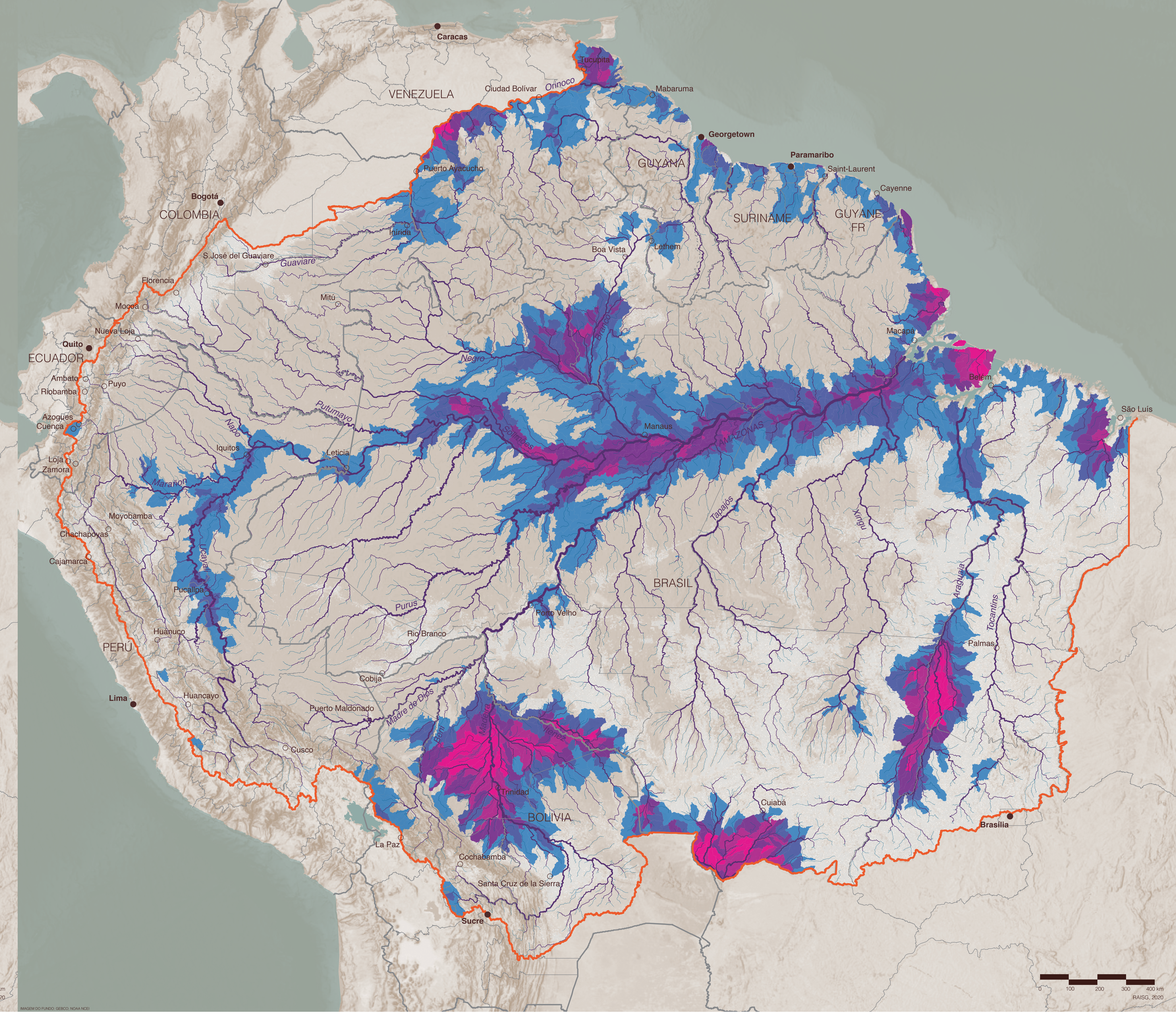
CLASSIFICAÇÃO DE DRENAGENS STRAHLER

- ORDEM 1
- ORDEM 2
- ORDEM 3
- ORDEM 4
- ORDEM 5
- ORDEM 6
- ORDEM 7

Fonte: elaborado pro FAN para RAISG, 2020 (v. Amazonía bajo presión 2020, pág. 05)

CABECEIRAS DE BACIA

Com mais de 8,4 milhões de quilômetros quadrados (km²), a Amazônia é o maior reservatório de água doce do mundo. Nascidos nos Andes e nas montanhas, muitos cursos d'água formam um conjunto heterogêneo em altitude; surgem ali e correm para alimentar os rios principais até desaguarem no rio Amazonas, o mais longo (6.762 km de comprimento) e caudaloso do planeta. Ele nasce a 5.150 metros de altitude, na Quebrada Apacheta, aos pés da montanha Quehuisha, em Arequipa, no Perú. Ao longo de seu trajeto através da planície amazônica, sua profundidade varia entre 20 metros e 100 metros em regiões muito caudalosas. A largura do rio varia entre alguns poucos metros até 50 quilômetros em regiões baixas e planícies inundadas durante a temporada úmida. Além disso, na região norte da Amazônia, encontra-se a bacia do rio Orinoco, que praticamente se une ou conecta ao Amazonas através do rio Casiquiare, na Venezuela. Ao sul, no Brasil, está a bacia Araguaia-Tocantins, cujas águas correm desde o planalto central, em direção ao norte, até o canal sul do Amazonas.



MAPA 2. SAZONALIDADE DE INUNDAÇÕES POR CLASSE DE BACIA

— LIMITE RAISG

- MUITO BAIXA
- BAIXA
- MÉDIA
- ALTA
- MUITO ALTA

CLASSIFICAÇÃO DE DRENAGENS STRAHLER

- ORDEM 1
- ORDEM 2
- ORDEM 3
- ORDEM 4
- ORDEM 5
- ORDEM 6
- ORDEM 7

Fonte: elaborado pro FAN para RAISG, 2020 (v. Amazonía bajo presión 2020, pág. 05)

SAZONALIDADE DE INUNDAÇÕES

Aproximadamente 25% da Amazônia se transforma em ecossistemas completamente aquáticos por conta da dinâmica de inundações. São processos naturais que ocorrem há milhões de anos, enriquecendo o solo por meio do carreamento de sedimentos nas diferentes bacias, desde os Andes até as terras baixas. Esse processo também influencia a cultura dos povos indígenas. Além disso, as inundações produzem uma alta diversidade e riqueza de espécies aquáticas, em sua maioria peixes. As aves migram de zonas muito remotas para chegar aos locais das inundações devido à concentração de espécies aquáticas, consolidando a dinâmica de inundação como um elo-chave para a cadeia alimentar que sustenta a biodiversidade e para a manutenção dos meios de vida dos povos indígenas e comunidades.

Durante a época de chuvas são gerados pulsos de inundação que formam imensos espelhos d'água, que desaparecem quase completamente durante as épocas de seca. Ou seja, os ecossistemas se transformam em ecossistemas aquáticos e terrestres segundo as condições climáticas, formando um mosaico heterogêneo dependente das abundantes precipitações e da água armazenada especialmente nas cabeceiras de bacias.

Por conta das inundações, a Amazônia abriga as áreas úmidas mais importantes do mundo, muitas delas categorizadas como sítios Ramsar (convenção da ONU para a proteção das zonas úmidas).

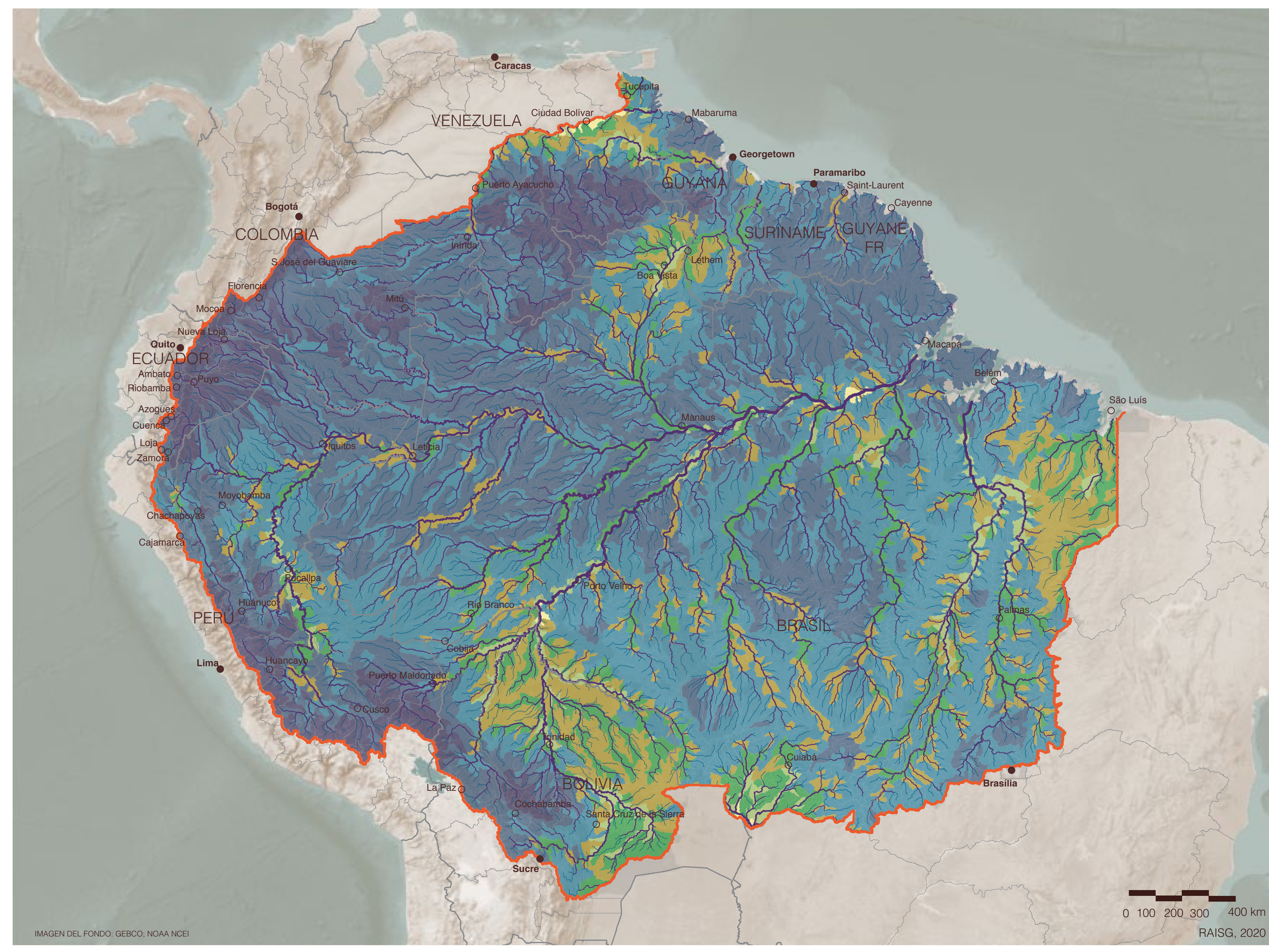
PRODUTIVIDADE HÍDRICA DA AMAZÔNIA

Em relação às análises realizadas sobre a produtividade hídrica da Amazônia, cerca de 6.465.732 km², equivalentes a 77% de sua extensão, são cabeceiras de bacia com alta ou muito alta produtividade de água, além de serem zonas produtoras que contribuem para o abastecimento e armazenamento de água. Os territórios indígenas (TIs) e as áreas naturais protegidas (ANPs) guardam em seus territórios mais de 51% (3.314.323 km²) da produtividade hídrica da Amazônia. As áreas de inundação, localizadas em sua maioria em regiões de conexão hidrológica e de acumulação hídrica, são fundamentais para o equilíbrio da água na Amazônia.

A sazonalidade das inundações demarca uma área de 2.078.650 km² (25% da Amazônia), sendo que 40% dessa extensão está localizada dentro de ANPs e TIs, que abrigam desde sempre recursos aquáticos diversos, os quais influenciam formas de vida e cultura. Na planície de Moxos, na Bolívia; no Pantanal, no Araguaia-Tocantins e no rio Amazonas, no Brasil; e no rio Orinoco, na Venezuela, são grandes os espelhos d'água e áreas alagadas que se destacam pela sazonalidade das inundações – sua particular capacidade de transformação de ecossistema aquático a terrestre, que dá vida a espécies únicas no planeta.

QUADRO 1. ÁREAS DE PRODUTIVIDADE HÍDRICA EM TIs E ANPs DA AMAZÔNIA

Tipo de bacia	Produtividade hídrica	Superfície (km²)					Proporção (%)
		ANP	TI	Áreas de sobreposição entre ANP/TI	Fora de ANP e TI	TOTAL	
Cabeceira de bacia	Muito alta produtividade	102.604	176.023	131.019	167.588	577.234	7%
	Alta produtividade	650.197	751.739	138.858	1.095.839	2.636.633	31%
	Zona produtora	584.973	683.981	94.928	1.887.983	3.251.865	39%
Conexão hidrológica	Conexão hídrica	126.998	164.810	30.401	629.206	951.414	11%
Acumulação hídrica	Acumulação média	140.004	126.356	19.669	453.053	739.082	9%
	Alta acumulação	29.747	40.038	5.913	150.429	226.126	3%
	Muito alta acumulação	1.742	2.141	0	11.299	15.182	0,2%
	TOTAL GERAL	**1.636.265**	**1.945.088**	**420.787**	**4.395.395**	**8.397.535**	**100%**

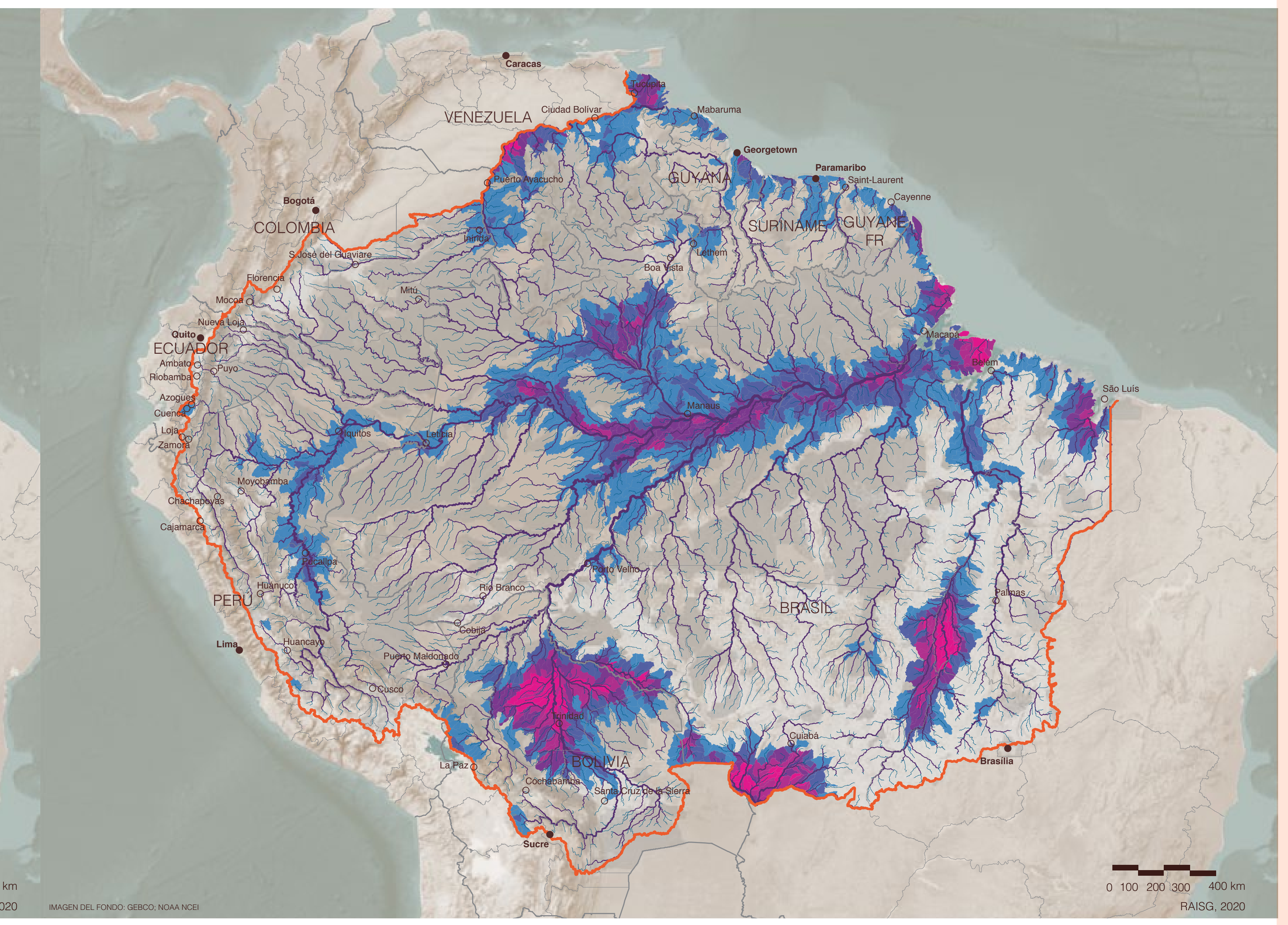


MAPA 1. PRODUTIVIDADE HÍDRICA POR CLASSE DE BACIA

MUITO ALTA PRODUTIVIDADE · ALTA PRODUTIVIDADE · ZONA PRODUTORA · CONECTIVIDADE HIDROLÓGICA · MÉDIA ACUMULAÇÃO · ALTA ACUMULAÇÃO · MUITO ALTA ACUMULAÇÃO

CLASSIFICAÇÃO DE DRENAGENS STRAHLER — ORDEM 1 — ORDEM 2 — ORDEM 3 — ORDEM 4 — ORDEM 5 — ORDEM 6 — ORDEM 7

Fonte: elaborado pro FAN para RAISG, 2020 (v. Amazonia bajo presión 2020, pág. 05)



MAPA 2. SAZONALIDADE DE INUNDAÇÕES POR CLASSE DE BACIA

MUITO BAIXA · BAIXA · MÉDIA · ALTA · MUITO ALTA

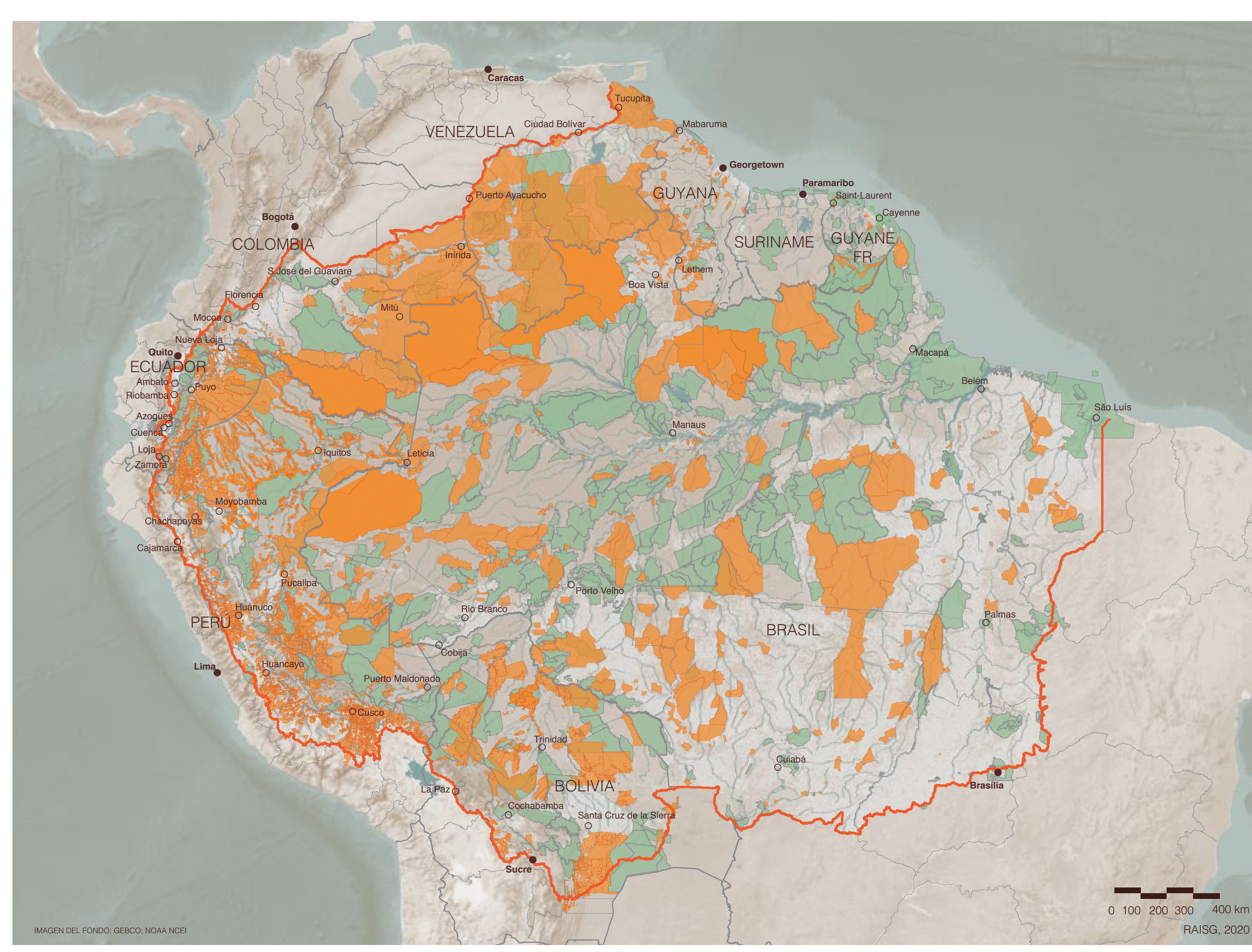
CLASSIFICAÇÃO DE DRENAGENS STRAHLER — ORDEM 1 — ORDEM 2 — ORDEM 3 — ORDEM 4 — ORDEM 5 — ORDEM 6 — ORDEM 7

Fonte: elaborado pro FAN para RAISG, 2020 (v. Amazonia bajo presión 2020, pág. 05)

SINTOMAS E CONSEQUÊNCIAS NAS BACIAS HIDROGRÁFICAS

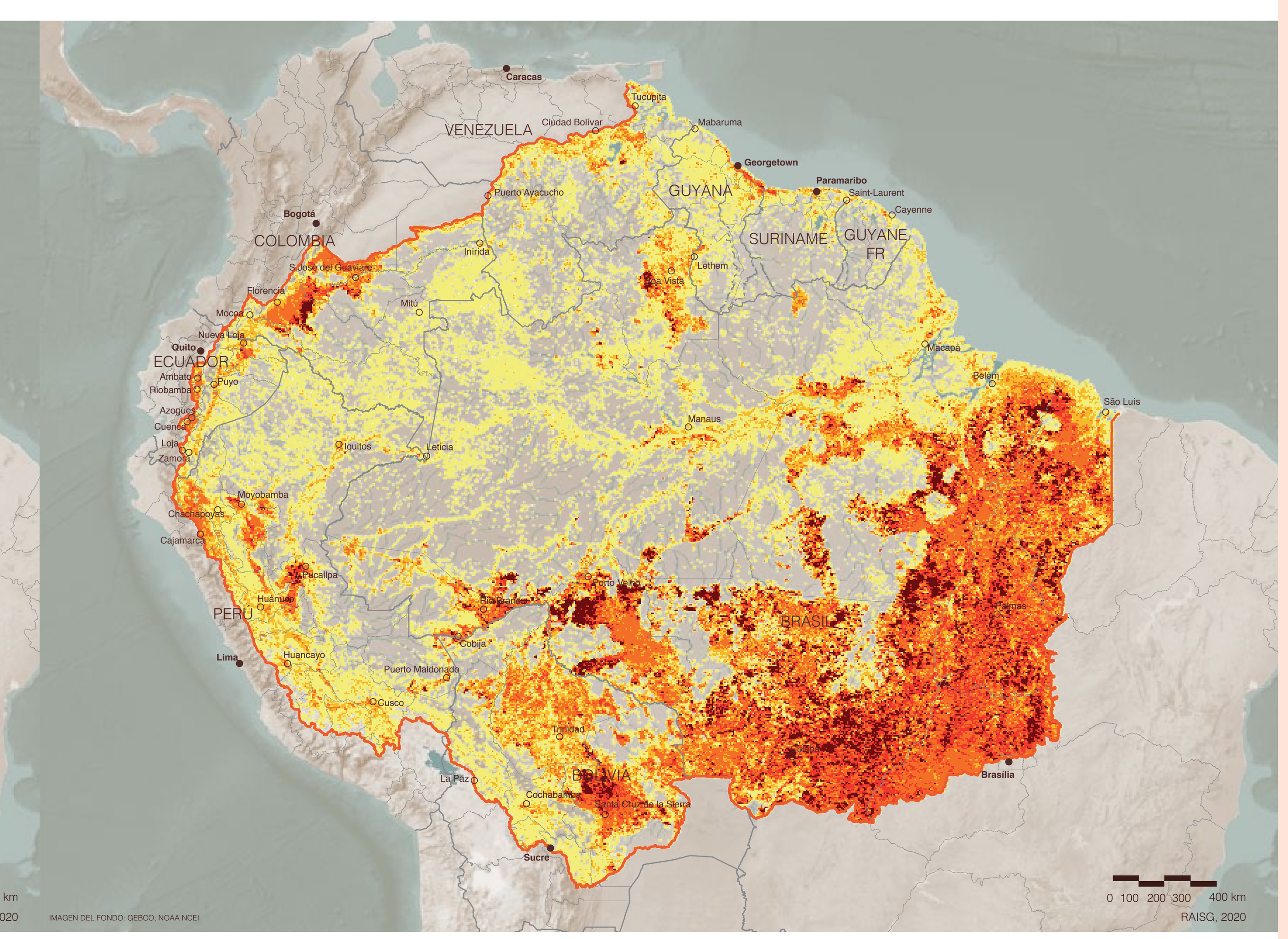
Os sistemas hidrológicos da Amazônia apresentam hoje algum grau e magnitude de sintomas e consequências da atividade humana. As bacias mais impactadas (com graus de sintomas e consequências "moderado", "alto" e "muito alto") são as de conexão hídrica, com uma taxa de 36%, seguidas pelas de alta acumulação (34%) e acumulação média (33%). As cabeceiras de bacia apresentam menor impacto (com graus nulo, muito baixo e baixo) e produtividade hídrica alta e muito alta; apenas 4% e 7% de sua área, respectivamente, apresentam algum tipo de sintoma ou consequência. Sem dúvida, os números são alentadores para impulsionar a conservação das cabeceiras de bacias, considerando que assim se protegem as reservas de água da Amazônia, além da biodiversidade e os povos indígenas.

No entanto, a maior preocupação reside nas zonas de inundação, onde os sintomas e consequências alcançam 36%, em grau "moderado", "alto" e "muito alto". Muitos desses locais, tiveram sua paisagem natural transformada e, com isso, estariam alterando a dinâmica das inundações, que são fundamentais para o equilíbrio hídrico da Amazônia.



MAPA 3. TERRITÓRIOS INDÍGENAS E ÁREAS NATURAIS PROTEGIDAS NA AMAZÔNIA

— LIMITE RAISG · FLORESTA FORA DE TI/ANP · TERRITÓRIOS INDÍGENAS · ÁREAS NATURAIS PROTEGIDAS



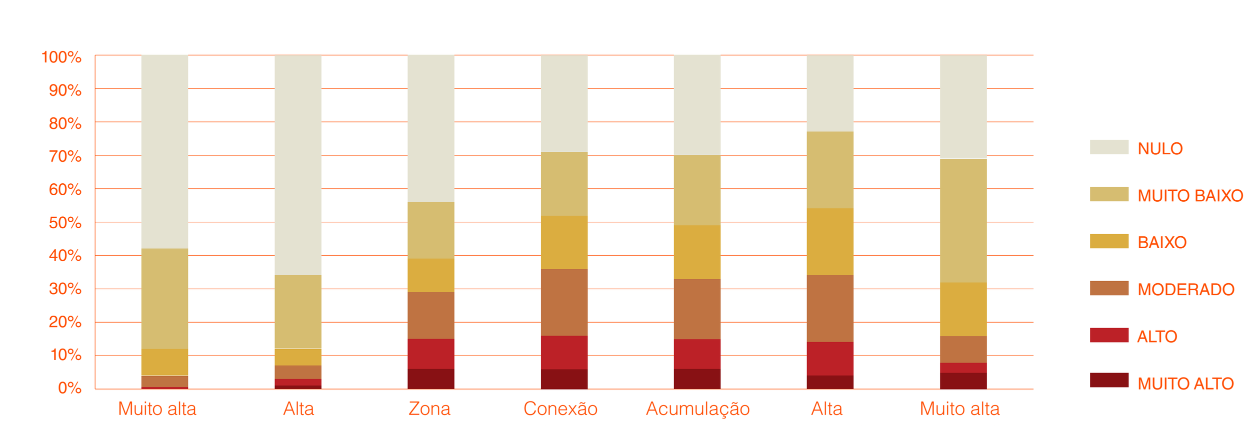
MAPA 4. SÍNTESE DOS SINTOMAS E CONSEQUÊNCIAS NA AMAZÔNIA

— LIMITE RAISG

ÍNDICE DE SINTOMAS E CONSEQUÊNCIAS: MUITO BAIXO · BAIXO · MODERADO · ALTO · MUITO ALTO

Fonte: elaborado por GAIA Amazonas para RAISG, 2020

FIGURA 1. ÍNDICE DE SINTOMAS E CONSEQUÊNCIAS DA ATIVIDADE HUMANA POR CATEGORIA DE BACIA



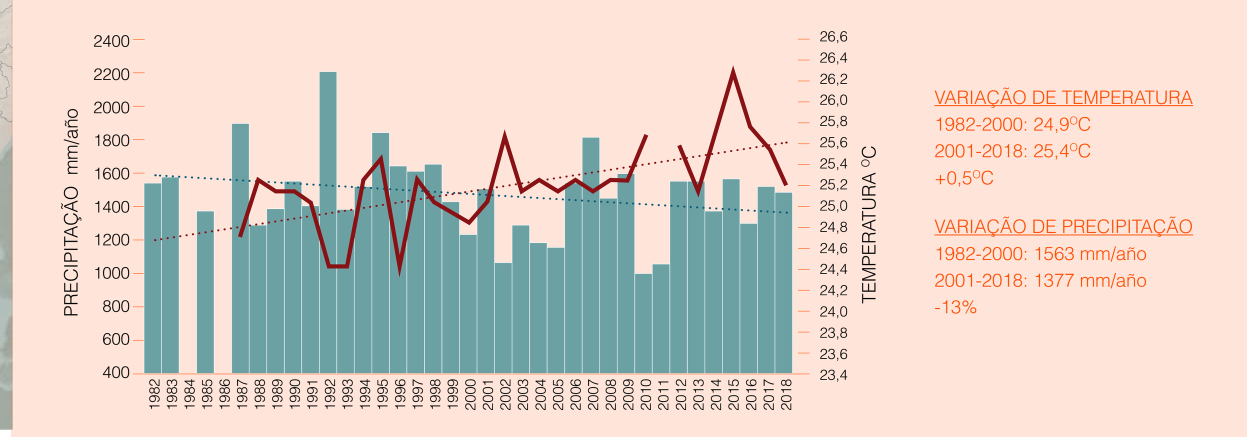
Mudanças climáticas, uma realidade na Amazônia

A situação hidroclimática está mudando na Amazônia. Um exemplo disso pode ser observado em Ascensión de Guarayos, um município da Amazônia boliviana onde, entre 1982 e 2018, as precipitações anuais diminuíram 13% e a temperatura aumentou 0,5ºC, segundo análise comparativa entre os períodos de 1982-2000 e 2011-2018. Nos meses de agosto e setembro as mudanças são mais intensas; as chuvas diminuem até 64% e 57%, respectivamente.

Segundo os dados desses 37 anos, o comportamento linear do clima parece confirmar a teoria (projeções) através da realidade (dados medidos na estação Ascensión de Guarayos). A temperatura média cresceu progressivamente (de 23ºC a 26ºC); enquanto a precipitação diminuiu (de 1563 para 1377 mm/ano). Essa alteração climática pode ser atribuída em parte à mudança no uso do solo no município; nesse período, o desmatamento cresceu de 6 mil para 171 mil hectares (23 vezes mais), impactando e modificando o clima local.

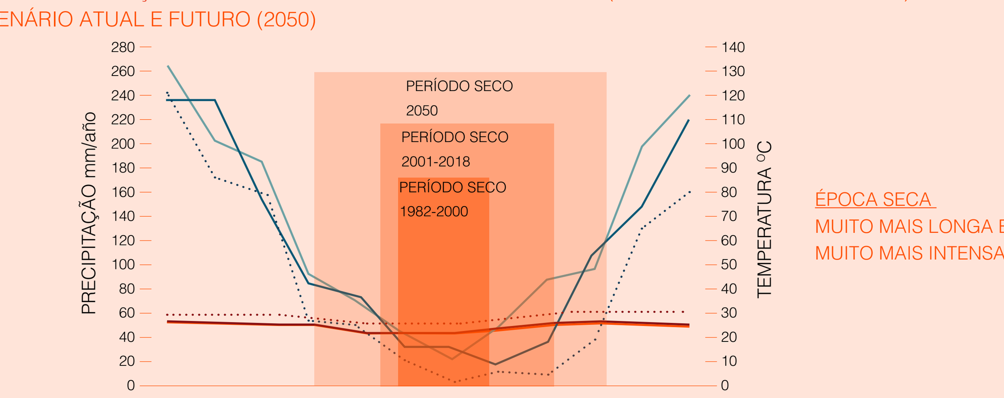
De acordo com projeções para as mudanças climáticas (RCP8.5), no ano 2050 Ascensión de Guarayos terá aumentado sua temperatura média anual em 3,4ºC e sua precipitação anual terá caído 34%. Isso gerará impactos mais graves no ciclo da água; estão previstas mais secas para a Amazônia, um bioma úmido, o que provocará maior desequilíbrio por conta do aumento na evapotranspiração, ao passo em que as chuvas diminuirão. A produção agropecuária com certeza ficará inviabilizada, pois a demanda por água crescerá e, com isso, também os conflitos.

FIGURA 2. . TENDÊNCIA DE PRECIPITAÇÃO E TEMPERATURA ANUAL NA ESTAÇÃO DE ASCENSIÓN DE GUARAYOS, BOLIVIA



PRECIPITAÇÃO SOMA ANUAL
TENDÊNCIA DE PRECIPITAÇÃO (SOMA MÉDIA ANUAL)
TEMPERATURA MÉDIA ANUAL
TENDÊNCIA DE TEMPERATURA (SOMA MÉDIA ANUAL)

FIGURA 3. MUDANÇAS NA SAZONALIDADE DO PERÍODO DE SECA (CLIMOGRAMA WALTER-LIETH) NO CENÁRIO ATUAL E FUTURO (2050)



		JAN	FEV	MAR	ABR	MAI	JUN	JUL	AGO	SET	OUT	NOV	DEC
Precipitação (mm/año)	1982-2000	264	203	187	92	72	44	23	51	89	100	198	240
	2001-2018	237	238	151	86	73	33	29	19	37	107	147	220
	2050	241	172	159	54	50	21	3	12	9	37	129	161
Temperatura (ºC)	1982-2000	26,5	26,1	26,0	25,1	23,1	21,8	21,5	23,3	24,9	26,8	26,7	26,6
	2001-2018	26,8	26,4	26,4	25,5	23,1	22,3	22,3	24,2	26,0	27,3	27,2	26,9
	2050	29,9	29,9	29,2	28,1	26,3	25,0	25,1	27,0	29,5	31,0	31,1	30,4

A tendência atual mostra que o clima local sofre modificações tão intensas quanto as projetadas para o ano de 2050. O maior impacto reside na alteração do calendário agrícola; os climogramas Walter-Lieth (Figura 3) indicam que o período de seca já aumentou de 2,5 meses para 4 meses nos últimos 18 anos, e estima-se que em 2050 chegará a 6,5 meses (de meados de abril até o final de outubro).

O equilíbrio da água na Amazônia, atual e futuro, está em perigo por causa das alterações no clima, produto da mudança no uso do solo. A temperatura superficial sofre graves alterações resultantes do desmatamento na região. Nos locais onde se derruba a floresta, a temperatura aumenta imediatamente de 8,7ºC a 13,6ºC ao serem transformados em plantação ou em solo nu. Entretanto, os processos hídricos também se modificam (infiltração, percolação, escoamento, evapotranspiração etc.), diminuindo rapidamente a capacidade de armazenamento de água e umidade nos solos.

A longo prazo, a disponibilidade de água depende da captação hídrica na época chuvosa e do armazenamento de água em áreas úmidas. Ambos processos estão sofrendo alterações por conta da maior extensão do período de seca, prolongada e mais intensa, e do fato do período de chuvas ser mais curto e intenso. As zonas de balanço hídrico positivo estão cada vez mais reduzidas e o déficit hídrico tem se intensificado e expandido para as regiões que sofreram mais mudanças no uso do solo. No futuro (2050), em Ascensión de Guarayos, a disponibilidade hídrica sofrerá uma diminuição de -117% (de 847 mm/ano para 390 mm/ano); a preservação das florestas e áreas úmidas parecem ser o passaporte para nossa adaptação às mudanças climáticas.

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