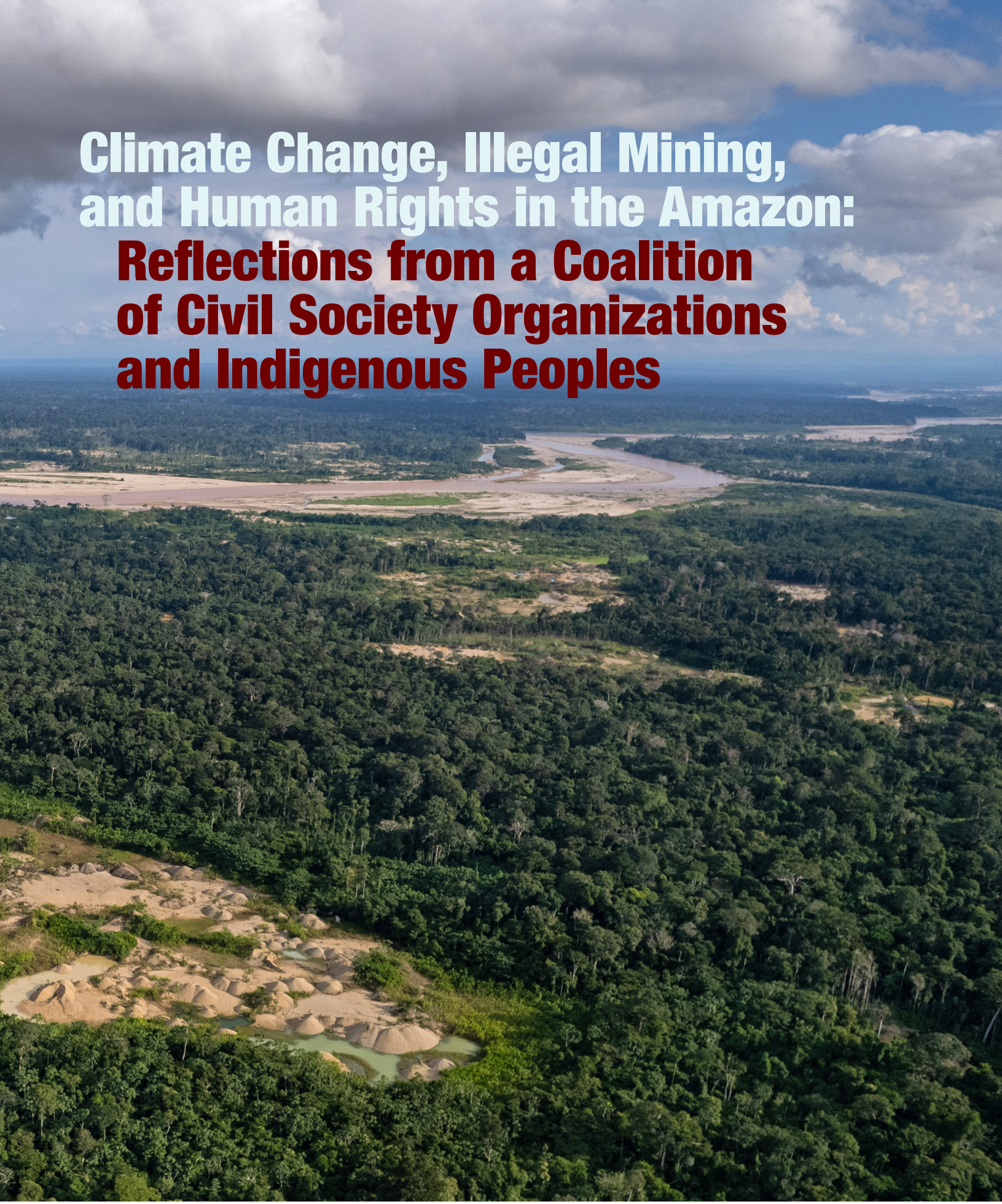

Climate Change, Illegal Mining, and Human Rights in the Amazon:

Reflections from a Coalition of Civil Society Organizations and Indigenous Peoples

Amazon Conservation Team
CEDIB Centro de Documentación e Información Bolivia
dpf Fundación para el Debido Proceso
Gaia Amazonas
HUTUKARA Associação Yanomami
People in Need
SPDA
SOS ORINOCO Salvando la Amazonía Venezolana
CMIA Coalición contra la Minería Ilegal en la Amazonia

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People in Need (PIN)

Sociedad Peruana de Derecho Ambiental (SPDA)

SOSOrinoco (Venezuela)

Coalición contra la Minería Ilegal en la Amazonía

Content

Content

Content

Executive Summary

The Amazon is at a tipping point: its degradation threatens global climate stability, biodiversity, and the human rights of millions of people. This report, prepared by a coalition of civil society organizations from Brazil, Bolivia, Colombia, Peru, Venezuela, and the Amazon Basin, examines the interrelationship between climate change, illegal mining, and human rights, with an eye toward strengthening international action coming out of COP30 in Belém.

The region is home to nearly 47 million people, including more than 400 indigenous peoples, 80 of whom live in isolation; their contribution to conservation and carbon sequestration is essential. However, advancing deforestation and fires have reduced the forest's resilience and brought it closer to a point of no return. Although national climate commitments have incorporated mitigation and adaptation goals, they lack a differentiated territorial approach and the full integration of indigenous peoples and their knowledge.

Illegal gold mining has become one of the main drivers of deforestation, soil degradation, and pollution, mainly from mercury, including within protected natural areas and indigenous reserves, which has had profound impacts on local communities' health, social cohesion, and culture. The expansion of illegal gold mining is linked to poverty, unemployment, corruption, institutional weakness, and lack of state control, which has enabled economic and criminal interests to become entrenched in the region. In spite of the commitments made under the Paris Agreement and other international instruments, implementation remains insufficient.

In this context, there is an urgent need to recognize and strengthen indigenous and local peoples as key actors in climate governance, establish effective regulatory frameworks to combat the illegal gold mining supply chain, enhance cross-border cooperation, and promote sustainable alternatives such as indigenous agroforestry practices and innovative financial mechanisms. Global climate action is inseparable from the defense of the Amazon and the protection of human rights, which is why COP30 in Belém is a historic opportunity for states to make coordinated and ambitious commitments that articulate climate justice, biodiversity, and the rights of indigenous peoples.

The Amazon merits every superlative thrown its way: unique, irreplaceable, mega-diverse, invaluable, and gravely endangered.

Jeffrey Sachs (2021)[1]

I would like the world to also assume its role in this fight.
Do not expect only the indigenous peoples to keep doing it.
We need you to fight with us to protect the Amazon.
If we all unite, we can change the future for our generations.

Nemonte Nenquimo,
Waorani indigenous leader.

[1] Preface to the Amazon Assessment Report 2021. PART I. Signed by J. Sachs in his capacity as convener of the Science Panel for the Amazon Convener. Scientific Panel for the Amazon. 2021. Amazon Assessment Report 2021. Nobre C, et al (Eds). United Nations Sustainable Development Solutions Network, New York, USA. Available at: www.laamazoniaquequeremos.org. DOI: 10.55161/RFFA7697

The Current Context of the Amazon and Climate Change

The Amazon region covers nearly 8 million square kilometers and extends across eight countries and one French overseas territory.[2] Generally, their geographical boundaries vary not only on the basis of the technical criteria used (hydrographic, biogeographical, ecological, altitudinal, and physiographic), but also based on other political-administrative criteria, which are usually dependent on different national interests, leading to significant changes in its size, population, ecological diversity, and interrelationships (natural or political, river basin, tropical rainforest, treaties, trade, borders). Although there is no unified conce pt of what the Amazon is, its size and boundaries, there is no denying its biological, hydrological, and climatic importance, both for the countries that share it and for the rest of the world.

No less important is its vast cultural diversity. Around 47 million people live in the region. Approximately 2.2 million of them are indigenous (4.6%), belonging to at least 410 different ethnic groups, 80 of which are in voluntary isolation or initial contact (RAISG, 2020; Athayde *et al.*, 2021). There are approximately 300 to 350 different languages spoken in the region, classified into 25 families, including around 20 isolated languages that do not appear to be genealogically related to any other known language (van der Voort, *et al*., 2021). This cultural richness is not only linguistic or social in nature; it is also expressed in the many ways in which indigenous peoples have successfully interacted with their environment, taming the Amazonian landscape by increasing the availability of food near their homes through practices that include (1) the removal of unwanted plants, (2) protecting useful trees during their development, (3) attracting seed-dispersing animals, (4) direct seed dispersal, (5) selecting specific phenotypes, (6) fire control, (7) cultivating useful plants, and (8) increasing soil fertility and structure, including the creation of anthropogenic soils and earthworks. (Neves *et al.*, 2021).

Furthermore, cultural variability adds immense complexity to the necessary efforts to achieve adequate regional governance that includes the perspectives, needs, and interests of Amazonian peoples in designing and implementing actions to address the challenges of climate change.

[2] https://www.sinchi.org.co/region-de-la-gran-amazonia

The current state of the Amazon Rainforest

Covering an area of around 600 million hectares,[3] the Amazon is the largest tropical rainforest on the planet, accounting for nearly 70% of this type of ecosystem globally. (Malhi *et al.,* 2008)

Far from being a homogeneous landscape, this rainforest is actually a gigantic mosaic of ecosystems that is home to exceptional biodiversity and provides a wide range of environmental services.

From a regional perspective, Sagobal (2018) indicates forest cover losses of around 0.28% per year, equivalent to nearly 1.6 million hectares per year between 2000 and 2015, with a slight reduction to 0.23% in the last year of the period –about one million hectares per year– representing a cumulative loss of approximately 24 million hectares over those fifteen years.

Meanwhile, RAISG (2022) reports a loss of nearly 54.3 million hectares of forest in the Amazon between 2001 and 2020, more than double Sagobal's estimate. Although the starting points differ –RAISG estimates 623 million hectares of forest cover in 2000– the net reduction brought the forest area to 568 million hectares by 2020, or 8.2% less than the initial surface area.

Furthermore, deforestation rates are not uniform, with wide differences between countries during the period. The countries with the largest areas of forest loss were Brazil (44,003,100 hectares), Bolivia (3,923,900 hectares), Peru (2,980,600 hectares), Colombia (2,300,400 hectares), Ecuador (623,200 hectares), Venezuela (292,500 hectares), Suriname (68,900 hectares), Guyana (41,800 hectares), and French Guiana (23,700 hectares). The first four countries together account for 98% of the total deforestation in the region (RAISG, 2022).

[3] https://amazonia.mapbiomas.org/wp-content/uploads/sites/10/2024/09/MBI-Infografico-amazonia-6.0-ES-scaled.jpg

Photo: Diego Pérez/ SPDA

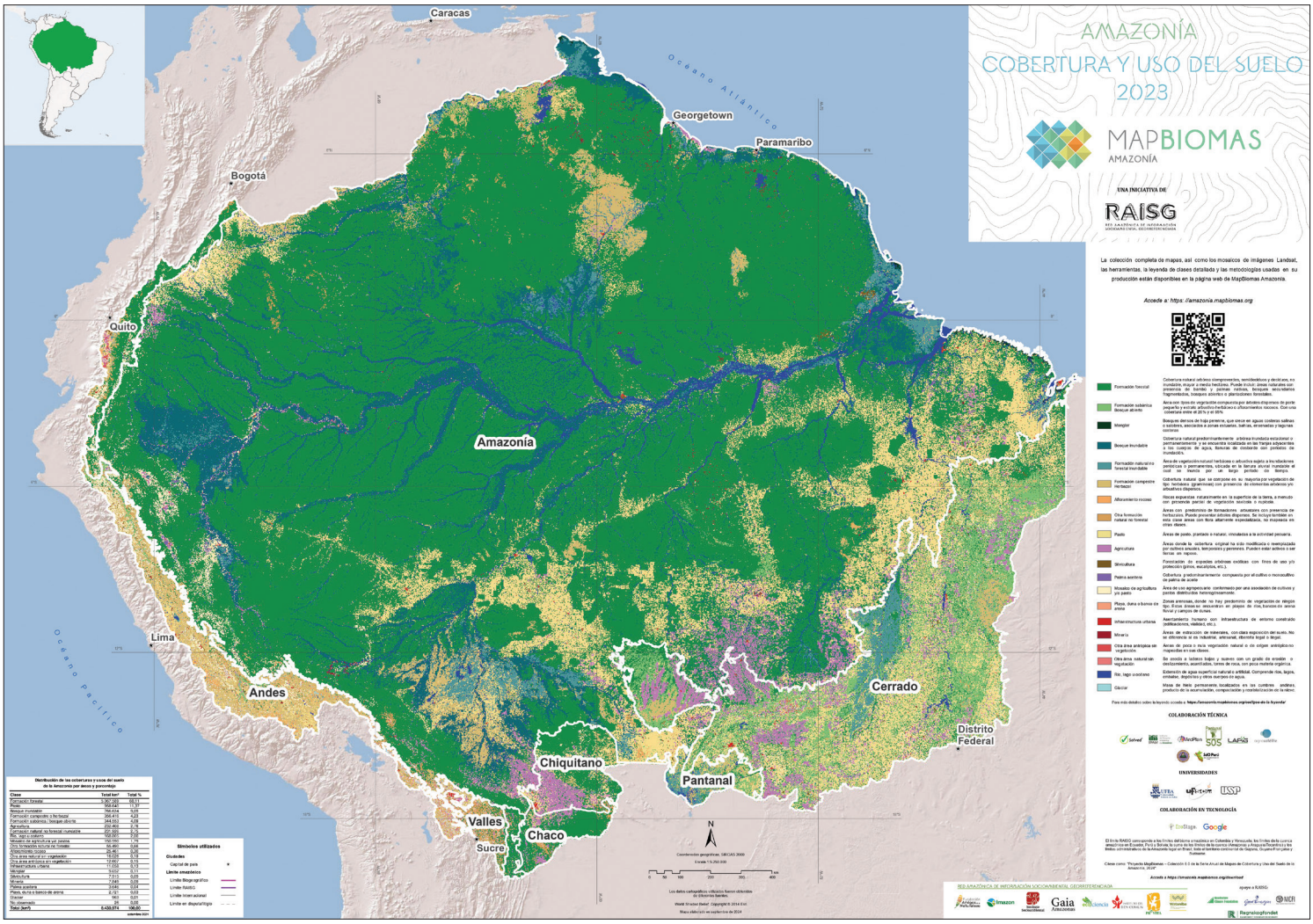

Figure 1. Cover and land use in the Amazon, estimates for the year 2023. Source: MapBiomas Amazonía and RAISG

The causes linked to these processes also vary in importance and type depending on the country, although they are strongly linked to both legal and illegal extractive activities. Among the most relevant are agriculture, cattle ranching, mining, and infrastructure construction (RAISG, 2020) (Figure 1).

These trends of increasing deforestation have seriously reduced biodiversity and forest cover in the Amazon. Each hectare lost further degrades the environment, weakening its capacity to sequester and store carbon reserves (RAISG, 2023), as well as the long-term sustainability of essential services such as water supply, climate regulation, hydroelectric power, agroforestry, and fisheries for all the countries in the region.

The Amazon as a critical component of the global climate system

Climate can be defined as the statistical expression of a set of atmospheric conditions (temperature, humidity, rainfall, wind) resulting from the constant and complex biophysical and biochemical interactions between the atmosphere, the geosphere, and the biosphere. It continuously feeds back into a kind of dynamic equilibrium, resembling a homeostatic system where the "regulatory" mechanisms are changes in forces and feedback mechanisms that trigger different conditions of global equilibrium (IPCC, 2021).

Given these premises, the Amazon's unique characteristics in terms of geographical location, size, topography, and vegetation cover, make it a region capable of significantly influencing the complex interactions that determine the functioning of the world's climate system.

Among the different ways through which the Amazon interacts decisively with the global climate system, its forests and soils stand out for their capacity to act as large reservoirs of atmospheric carbon, playing a very important role in the global carbon cycle, contributing to the regulation of CO_2 concentrations and, therefore, to the control of global temperature.

The Amazon also plays an essential role in the global hydrological cycle. Its tropical location surrounded by the Andes, its size, and its forest cover make it one of the most critical elements of the Earth's climate system. It is the largest and most intense convective center on Earth, exerting a strong influence on atmospheric dynamics and circulation patterns both inside and outside the tropics. It produces precipitation that results in the largest river flows on Earth, with 220,000 m3/s, which corresponds to between 16 and 22% of the world's total river flow (Costa, *et al.,* 2021).

At the same time, it absorbs and distributes water flow to the ground and riverbeds, while maintaining a constant exchange of water with the atmosphere through evapotranspiration, keeping the air humid, altering its temperature, and allowing orographic clouds to refill, and then fall "windward" in the form of rain. Through evapotranspiration, it recycles much of the rainfall it receives. Eltahir and Bras (1994) estimated that about 25% of the rainfall in the Amazon basin is due to evaporation. More recently, Mu *et al* (2023) have suggested that this value is closer to 50%, providing atmospheric moisture as far as western Brazil and other watersheds on the continent, such as those of the Plata and southeastern Brazil (Lovejoy & Nobre, 2018). In this way, the Amazon region is a huge carbon reservoir and a vital source of moisture for the world (Figure 2).

Forest loss disrupts this "moisture pump" and threatens spatial and seasonal rainfall patterns, affecting agriculture.

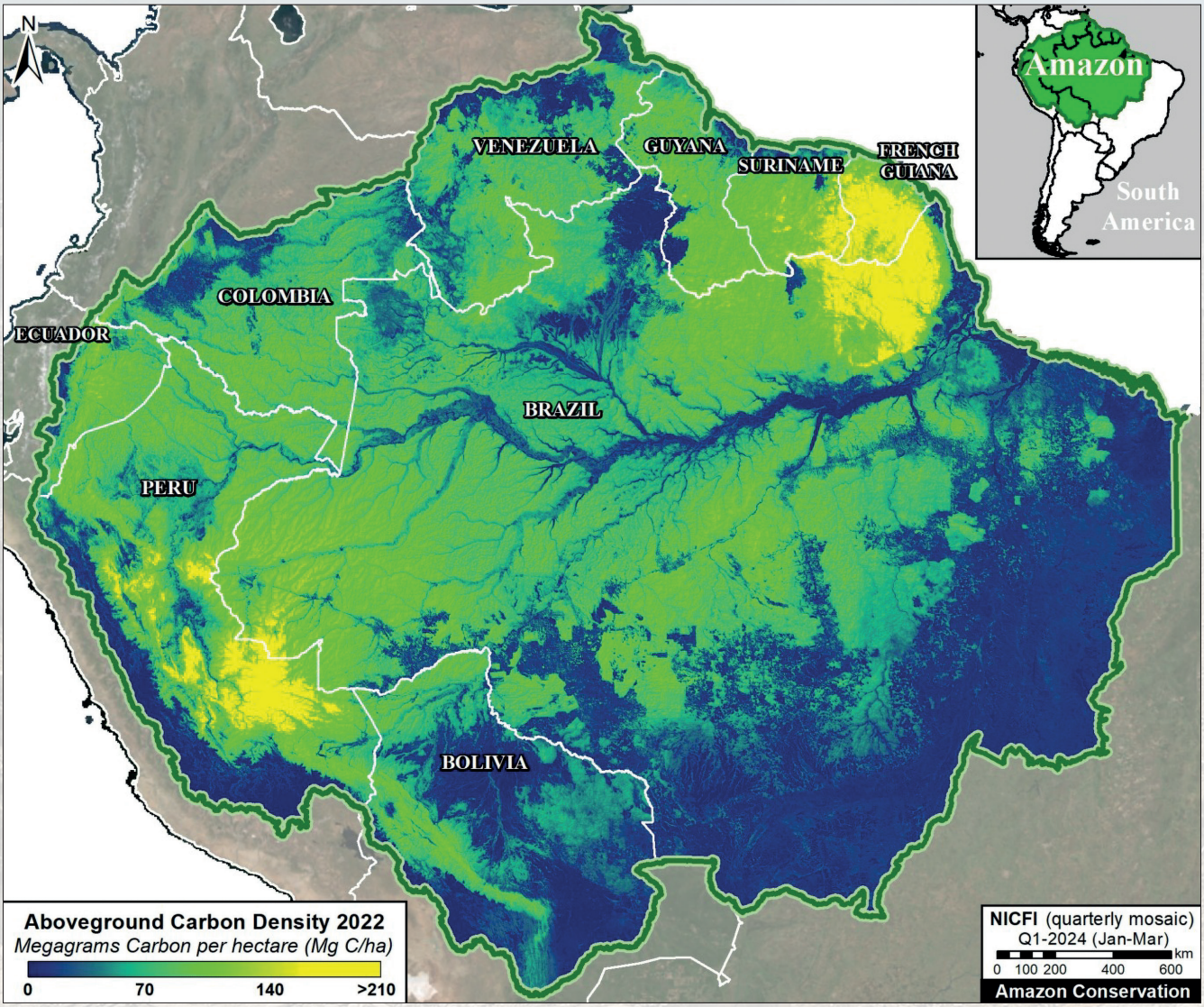

Figure 2. Estimated aboveground carbon density in the Amazon for the year 2022. Source: Finer M, Mamani N, Anderson C, Rosenthal A (2024) Unprecedented Look at Carbon across the Amazon (Part 1). MAAP #215.

Current trends in deterioration and loss of resilience

Between 1985 and 2023, more than 88 million hectares of forest cover were lost –12.5% of the original biomass– not only affecting its ability to control the region's hydrological cycle, but also, as mentioned above, significantly reducing its role as a carbon sequester and sink (Malhi *et al.*, 2021, RAISG & MapBiomas, 2023) (Figure 3).

These losses are not isolated incidents, nor are they the result of random catastrophes. Rather, they are indicative of a general trend resulting from various initiatives, usually the product of ill-advised, ignorant development policies that ignore the natural context in which they are implemented.

For example, in Brazil, government incentives promoted forest conversion and human migration to the Amazon, as forests were considered barriers to economic growth. This resulted in the transformation of around 17% of the Amazon rainforest, nearly 60 million hectares of land –an area equivalent to the size of France– which are now used for other purposes, mainly soybean cultivation and large expanses of low-yield pastureland for the cattle industry. However, all this transformation does not seem to have resulted in solid development, employment opportunities, better income distribution for the local population, or environmental benefits for the region. Currently, around 45 percent of the population lives below the poverty line (Azevedo-Ramos, 2008).

There have been similar cases in Bolivia, where extractive activities and weak institutions have led to uncontrolled deforestation, placing the country in second place in terms of forest loss in the region. Large agricultural corporations have been reported to benefit from large-scale burns, which then allow the land to be put to use. These lands, usually in protected areas or indigenous territories, increase in "value" once the forest has disappeared and the lands can be used for monoculture farming (Espino Cruz, 2024; Müller *et al.*, 2012).

Fires and droughts have exacerbated this situation, especially in 2005, 2010, 2019, and 2024. These conditions affect not only the climate but also biodiversity. Forest fragmentation prevents species dispersal and gene flow, causing a 23% loss in the ecological connectivity of the biome (RAISG & ANA, 2023; Pinho *et al.*, 2024).

Climate models indicate that exceeding between 20–25% deforestation could transform the rainforest into a savanna-like ecosystem, especially in the southeastern Amazon. A 4°C increase in global temperature would accelerate this change, bringing vast areas to the point of no return (Lovejoy & Nobre, 2018).

Bottino *et al.* (2024) use integrated climate models to analyze the combined effects of land use changes and global warming on the Amazon, which have resulted in a 44% reduction in average annual precipitation and a 69% increase in the duration of the dry season. Additionally, this analysis showed that savannization is one of the main factors explaining reduced moisture transport inland, resulting in a spike of up to 14°C in daily temperatures, a clear decrease in soil moisture and surface run-off, which suggests negative cascading effects on agricultural production and hydroelectric power generation in the future.

If forest degradation continues, the Amazon will cease to act as a carbon sink. Forests degraded by human activity and fires store less carbon, as large, mature trees are replaced by small, fast-growing species (Mongabay, 2025). Gatti *et al*

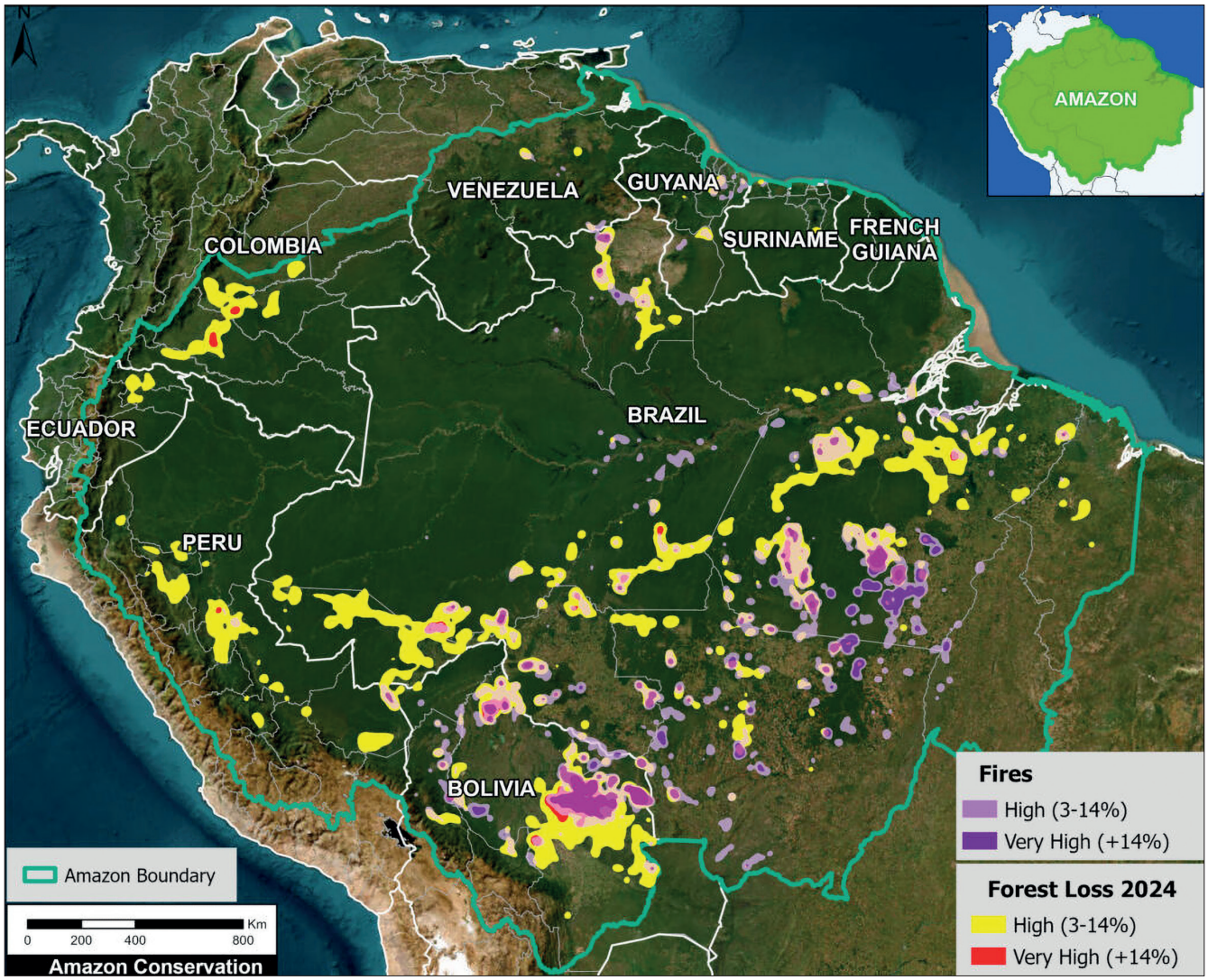

Figure 3. Amazon deforestation and fire hotspots in 2024 based on data from UMD/GLAD, Amazon Conservation/MAAP. Source: Finer M, Ariñez A, Mamani N, Cohen M, Santana A (2025) Amazon Deforestation and Fire Hotspots 2024. MAAP: 229.

(2021), studying the carbon budget in the Brazilian Amazon between 2010 and 2018, found that total carbon emissions were higher in the eastern Amazon than in the western Amazon, mainly due to the effect of fires, noting that the southeastern Amazon acts as a net source of carbon. This situation is related to increased deforestation, greater warming, and increased hydrological stress. Emissions are increasing rapidly, from 0.24 ± 0.19 PgC y^{-1} in the period from 2010 to 2018 to 0.44 ± 0.22 in 2019 and 0.52 ± 0.22 PgC y^{-1} in 2020. This increase is related to rising deforestation and forest fires (Gatti *et al.*, 2021b).

Indigenous peoples as land defenders and community mechanisms for adapting to climate change

Protected areas (Figure 4) and indigenous territories comprise a large percentage of the Amazon biome, although their legal recognition and governance vary from country to country. More than 3,000 units of indigenous lands and territories have been recognized throughout the Amazon under various tenure systems which, when added to formally recognized protected areas, represent almost 45% of the region and protect almost half of the remaining forests (RAISG, 2020; FAO and FILAC, 2021).

More than 80% of the area occupied by indigenous peoples in the Amazon is covered by forests, and 35% of all remaining intact forests in Latin America are inhabited by indigenous peoples (Garnett *et al.,* 2018). These statistics are a clear indication of the inextricable link between cultural and biological diversity in the Amazon and highlight Indigenous Peoples and Local Communities (IPLCs) as crucial partners for the continued conservation of biodiversity, as well as for forest management and ecological restoration (IPBES, 2019). In general, indigenous peoples are among the populations most vulnerable to the effects of climate change. At the same time, they hold knowledge that is invaluable for identifying solutions for adaptation, mitigation, and ecosystem conservation, making them agents of change (European Commission, 2021).

Currently, indigenous peoples and local communities in the Amazon are responsible for nearly half of the rainforest (Figure 5) and maintain lower deforestation rates within their territories (MapBiomas, 2022). This suggests that their knowledge, forms of governance, and sustainable practices are key to conservation and climate adaptation (RAISG & ANA, 2023). Therefore, in order to avoid reaching the point of no return, there is a clear need to understand and apply the knowledge and practices that can guide appropriate policies for the comprehensive development of the Amazon and its inhabitants.

This involves not only formalizing the territorial rights of indigenous peoples as full citizens of their respective nations, but also strengthening their autonomy, governance, the transfer of sustainable technologies, and support for their health and training needs, enabling them to play a more active role in the global fight against climate change. There is a need for a regional response that combines science and local, national, and regional leadership in order to achieve coordinated policy actions to protect the Amazon and its inhabitants, with the hope of restoring the region's global ecological role.

Figure 4. Map of Amazonian National Protected Areas. Source: prepared by the authors using data from the RAISG database.

Figure 5. Map of Amazonian indigenous territories. Source: prepared by the authors using data from the RAISG database.

Amazon border (RAISG's data base)

National protected areas (RAISG's data base, 2023)

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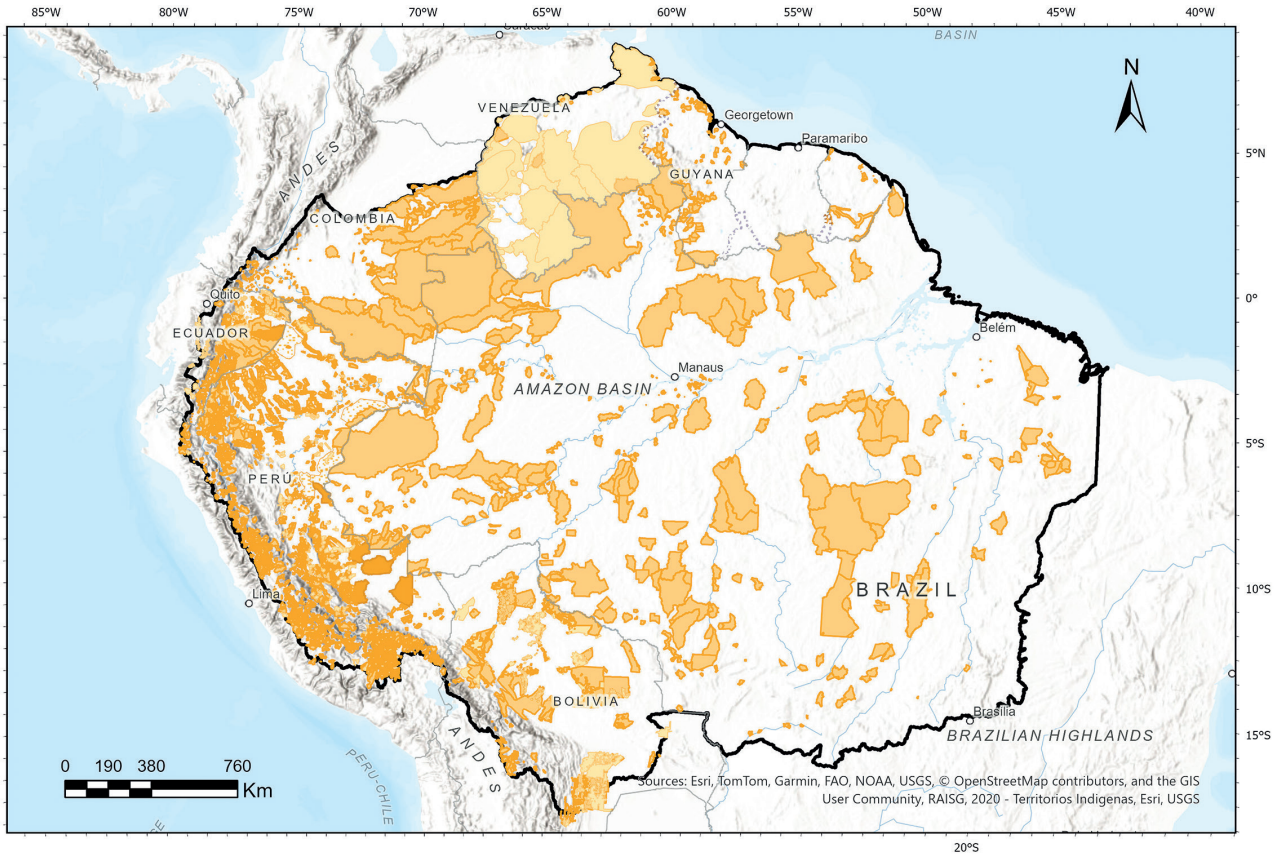

Amazon border (RAISG's data base)

Proposed indigenous reserves

Indigenous Reserve or Intangible Zone

officially recognized IT

IT without official recognition

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How have countries incorporated sustainable management of the Amazon into climate change adaptation and mitigation goals in nationally determined contributions?

In general, Amazonian countries have included their Amazonian territories in their climate goals in one way or another. Countries such as Brazil and Colombia have included Amazon-related targets in their NDC under the Paris Agreement. Brazil intends to halt illegal deforestation by 2028 and restore 12 million hectares by 2030. Colombia is committed to reducing greenhouse gas emissions by 51% by 2030. Peru has also included the protection of primary forests, but faces implementation constraints. A short description of each country is provided below.

Brazil

Brazil has incorporated sustainable management of the Amazon as a central pillar in its climate change mitigation and adaptation goals, establishing a direct link between the preservation of the Amazon biome and the fulfillment of its nationally determined contribution (NDC). This approach is based on a legal framework, a national strategy, and the implementation of specific plans. The Brazilian strategy starts at the highest regulatory level, as the 1988 Federal Constitution (Brazil, 1988. Art. 225) defines the Amazon rainforest as a national heritage site and stipulates that the Amazon's use must ensure environmental preservation (Art. 225). This legal mandate serves as the basis for aligning the protection of the Amazon with the country's climate goals.

Brazil's current NDC[4] are ambitious: reduce greenhouse gas emissions by 53% by 2030 and achieve carbon neutrality by 2050.[5] The NDC text explicitly recognizes that meeting these goals depends on the role of forests in carbon sequestration, positioning the Amazon not only as an ecosystem to be protected, but also as an active tool for climate change mitigation. To translate these objectives into action, Brazil uses the National Climate Change Plan (Climate Plan) as its main coordinating instrument (UFAM/PPGCASA, 2025). Within this plan, the forest and land use sector receives priority attention, with a dual focus on protection and restoration. The key instruments for managing the Amazon are the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm), which is the main tool for combatting illegal deforestation. Its effectiveness is reflected in the consolidated reduction of deforestation by 45.7% between 2022 and 2024, the best performance since 2015.

Another relevant instrument is the National Native Vegetation Recovery Plan (Planaveg), which focuses on ecosystem restoration, a key measure for climate adaptation and increased carbon capture. In addition, the Arc of Restoration in the Amazon (Veríssimo *et al.*, 2024), an initiative announced at COP28, seeks to transform the "Arc of

[4] https://www.gov.br/mma/pt-br/assuntos/noticias/brasil-entrega-a-onu-nova-ndc-alinhada-ao-acordo-de-paris/ndc-versao-em-portugues.pdf/

[5] https://www.gov.br/mma/pt-br/composicao/smc/plano-clima/ndc-ambicao-climatica-do-brasil

Deforestation" –the most vulnerable area– into a restored ecological corridor, combining mitigation (CO_2 capture) and adaptation (increasing ecosystem resilience) efforts. These actions are made possible through climate finance instruments, such as payments for environmental services and carbon credits, which provide economic incentives for conservation.[6]

In summary, Brazil integrates management of the Amazon into its NDC by constitutionally recognizing its value, linking its carbon capture capacity to emission reduction targets, and implementing specific and measurable plans (such as the PPCDAm and the Arc of Restoration) that combat deforestation and promote forest recovery as key mitigation and adaptation strategies.

Bolivia

In the case of Bolivia, the NDC set out in the Paris Agreement (COP21, 2015) reference water, energy, forestry, and agriculture[7] (Ministerio de Medio Ambiente y Agua y Autoridad Plurinacional de la Madre Tierra, 2022).[8] The goals are detailed below, with those most directly related to the Bolivian Amazon highlighted in bold and those indirectly related in italics:

A Bolivian Forestry Research Institute (IBIF) assessment of the initial targets set in 2016 for the forestry sector (Gomez Cerveró, 2021) shows that illegal deforestation, which was supposed to reach zero by 2020, increased to 270,497 hectares in 2019 (58% of total deforestation). Reforestation, which was supposed to reach 4.5 million hectares by 2030, had barely reached 124,000 hectares by 2018. And community forest management, which was supposed to increase by 16.9 million hectares by 2030, had barely reached 5.47 million hectares by 2018. A Bolivian government report on progress towards the new targets for the 2021-2022 period shows the following progress for the indicators we identified as directly related to the Amazon:

As can be seen in the table, in many cases, the indicators defined by the government do not take cumulative changes into account, only annual rates. This completely undermines the purpose of the targets. Despite this definition, which attempts to hide the real progress or lack thereof toward the targets, the indicators that relate specifically to forests show worrying results up to 2022. In 2024, fires were much more severe than in previous years, allowing us to assume that progress toward the targets has not improved, but rather worsened.

Colombia

The indigenous peoples of the Colombian Amazon, through their local and regional organizations, have succeeded in positioning themselves in various national and international forums that address the environmental management of the biome. For example, a differential approach was implemented in the recent process of updating the Biodiversity Action Plan to align it with the Kunming-Montreal Global Biodiversity Framework, within the Convention on Biological Diversity, with extensive participation of the National Organization of Indigenous Peoples of the Colombian Amazon (OPIAC) and the Amazon Regional Roundtable (MRA).

[6] https://www.gov.br/mma/pt-br/assuntos/mudanca-do-clima/financiamento

[7] Specifically: multipurpose hydroelectric projects to increase water storage capacity and irrigation coverage as a measure for strengthening climate change adaptation capacities; conservation of forests for the environmental benefits they provide, strengthening food and housing sovereignty for local and national populations; promotion of agricultural production with the participation of small landowners and communities; and increased access to hydroelectric and alternative energy.

[8] Initially presented in 2016, the NDC was updated in 2022 to reflect the lack of funding, means of implementation, and "current national circumstances."

Table 1. Bolivia's Nationally Determined Contribution Targets (2022)

2022 NDC Targets	Connection to the Bolivian Amazon
Water Sector	
- 100% drinking water coverage will be achieved with resilient service delivery systems by 2030. - 1.3 million hectares under efficient irrigation will be reached by 2030. - 12 million hectares will be achieved with Integrated Watershed Management (MIC) by 2030.	The targets set for this sector are national in scope and mostly related to water and basic sanitation services, as well as irrigation projects. Approximately 14.9% of Bolivia's population lives in the Amazon region, where coverage rates for these services are relatively low in both rural and urban areas. Most irrigation systems are located in the upper Amazon and La Plata basins (valleys). Drinking water services and irrigation systems in Bolivia both depend to a large extent on water sources that are part of the Amazon basin. Therefore, a significant portion of watershed management (MIC) is linked to the Amazon basin. As mentioned above, the Bolivian Amazon is home to five RAMSAR sites, covering a total area of 7,594,939 hectares.
Forestry Sector	
- By 2030, reduce deforestation to 80% compared to the baseline. - Reduce deforestation in National Protected Areas by 100% by 2030. - Reduce the area with forest fires by 60% compared to the baseline by 2030. - Double the areas under integrated and sustainable forest management by 2030. - Increase forest cover gain by one million hectares by 2030. - Double authorized timber production compared to the 2016-2020 average by 2030. - Double the production of non-timber forest products compared to the 2016-2020 average by 2030.	Most of the targets refer to deforestation, forest fires, and forests. Since the forests in the Amazon basin in Bolivia are subject to burning and deforestation, we believe that all the targets in this sector are related to the Amazon.
Energy Sector	
- By 2030, 79% of the energy consumed will come from renewable energy plants (50% of installed capacity). - By 2030, 19% of the energy consumed will come from power plants based on alternative energies (13.25% of installed capacity). - By 2030, the installed capacity of the interconnected electricity system will reach 5,028 MW.	In the energy sector, the target related to renewable energy sources is directly linked to the Amazon, since six of the seven hydroelectric plants in operation are located in the Amazon basin in Bolivia, and at least half of the hydroelectric projects in different stages of development are also located in the Amazon basin. The increase in capacity is related to these projects. Alternative energies that use biomass are also relevant to the Amazon region. This is because they use biomass from existing industrial-scale crops, like sugarcane, or planned crops, like African palm.
Agricultural Sector	
- Production will have increased by 70% of strategic crops at the national level by 2030.	The agricultural sector's target of increasing strategic crops is directly related to the Amazon, as these crops include oilseeds and industrial crops. The most significant of these crops is soy, which is the leading driver of agricultural expansion through deforestation in the Amazon basin.

The experience accumulated has allowed OPIAC to be involved in the process of updating Colombia's NDC in 2025. Two strategic approaches are being promoted: on the one hand, the recognition of indigenous territories, collective land titling, legal security, and the exercise of indigenous governance as a key action for climate action; and on the other hand, the need to protect their territories from the threats posed by mineral extraction related to the energy transition.

Colombia has included the Amazon region in its NDC as a strategic focus point for climate change mitigation and adaptation. In its updated NDC for 2020, the country committed to reducing

Table 2. Progress Toward Bolivia's 2022 NDC Targets Related to the Amazon

Target	Indicator	Baseline (2020)	Planned (2030)	Reported Value (2022)	% Progress (2022)
Water Sector					
1.4 billion m^3 of water storage capacity will be reached by 2030.	Storage capacity	919.00 million m^3	1,400.00 million m^3	944.00 million m^3	5.20%
16 million ha of wetlands designated as Ramsar Sites will have been maintained and conserved by 2030.	Area of wetlands designated as RAMSAR sites	16 million ha	16 million ha	NA	NA
Forestry Sector					
By 2030, reduce deforestation to 80% compared to the baseline.	Percentage of deforestation	262,178 ha/year	209,742 ha/year	309,553 ha/year	0%
Reduce deforestation in National Protected Areas by 100% by 2030.	Percentage of deforestation in Protected Areas	0.5% loss	0%	0.51% (6.728,33 ha)	0%
Reduce the area with forest fires by 60% compared to the baseline by 2030.	Area affected by forest fires	1,447,070 ha/year	578,828 ha/year	1,253,945 ha/year	22.24%
Double the areas under integrated and sustainable forest management by 2030.	Areas under integrated and sustainable forest management	10.8 million ha under integrated and sustainable forest management	21.6 M ha	11.37 M ha	5.32%
Increase forest cover gain by one million hectares by 2030.	Forest cover	86,800 ha	1,000,000 ha	90,476.96 ha	0.40%
Double authorized timber production compared to the 2016-2020 average by 2030.	Average authorized timber production	1,371,223 m^3/year	2,742,446 m^3/year	1,699,915 m^3/year	24.0%
Double the production of non-timber forest products compared to the 2016-2020 average by 2030.	Average production of non-timber forest products	103,732 tons/year	207,464 tons/year	133,085 tons/year	28.3%
Energy Sector					
By 2030, 79% of the energy consumed will come from renewable energy plants (50% of installed capacity).	Percentage of renewable energy consumed	37% in energy	79%	37.02%	0.05%
	Percentage of installed capacity	27% in capacity	50%	32%	21.74%
Agricultural Sector					
Production will have increased by 70% of strategic crops at the national level by 2030.	Production volume of strategic crops	20.196.561 tM	34.334.153 tM	NA	NA

Source: Prepared by the authors using information from the Plurinational Authority for Mother Earth, 2024.

its net greenhouse gas emissions by 51% by 2030. One of the priority actions is to reduce deforestation, especially in the Amazon region.

Within the National Climate Change Policy (PNCC), several instruments have been developed, such as the Comprehensive Climate Change Management Plan for the Amazon Region (PIGCC-Amazon), which seeks to promote territorialized adaptation actions based on both scientific knowledge and the indigenous peoples' own knowledge systems. Likewise, intersectoral programs such as *Visión Amazonía* have contributed to the implementation of concrete measures against forest loss and the promotion of sustainable development.

However, the targets set out in the NDC –especially those related to deforestation and the agriculture, forestry, and other land use (AFOLU) sector– are not differentiated by territory. Although the Amazon region accounts for a substantial portion of the country's natural forests, a significant portion of stored carbon, and a significant proportion of deforestation, there are no differentiated targets for this region. This limits the effectiveness of climate action, as it does not respond to the ecological, social, and cultural conditions specific to the Amazon region.

For the Amazon to fulfill its strategic role in climate change mitigation and adaptation, it is necessary to move toward climate planning with a territorial approach, which allows for the territories and indigenous governments themselves to co-create targets, indicators, and actions, respecting their knowledge systems and their own forms of governance.

Peru

As part of the commitments it made by signing the Paris Agreement, Peru passed Law No. 30754, the Climate Change Framework Law (LMCC), in 2018, and its regulations through Supreme Decree 013-2019-MINAM in 2019. Based on these regulations, Peru has implemented various instruments, including the following: i) the National Strategy on Forests and Climate Change (ENBCC); ii) the National Strategy on Climate Change to 2050 (ENCC); iii) the NDC Update Report for the period 2021-2030; iv) the Catalogue of Adaptation Measures; and v) the Catalogue of Mitigation Measures.

Likewise, according to the Progress Report on the Fulfillment of Adaptation and Mitigation Targets for the period from July 2023 to December 2024, progress toward fulfillment is as follows:

a. National GHG emissions: National GHG emissions: According to the latest national inventory available for 2021, 194,895.53 kt CO_2EQ were emitted in total. The leading sector in terms of emissions is LULUCF (84,791.69 kt CO_2EQ), accounting for 43.51% of total emissions, the main source of which is the conversion of forest and grassland to cropland (MINAM, 2025c: 46).

b. Adaptation measures: Six of the twelve measures related to forests are being implemented, amounting to 50% progress. To comply with these measures, 10,087,240.46 hectares are being monitored and controlled in ANPs, with indigenous community participation; ancestral knowledge and practices for ecosystem conservation have been recuperated (MINAM, 2025c: 37, 42).

c. Mitigation measures: Three of the ten measures related to UTCUS have been implemented, amounting to 30% progress. To comply with these measures, 6,637.97 hectares of forest concessions have been granted, with the aim of encouraging the managed use of forestry products. Indigenous communities were granted 2,186.11 hectares in titles. 274 communities have signed conservation agreements under the mechanism known as Conditional Direct Transfers, which provides indigenous communities with economic incentives for forest management (9 MINAM, 2025c: 49-50).

Venezuela

In terms of updating and fulfilling its NDC targets, Venezuela's pattern reveals a significant gap between the international commitments it has made and its implementation of climate policies. While the country has submitted its updates to the United Nations Framework Convention on

Table 3. Summary table of Instruments and Measures to Address Climate Change Focused on the Peruvian Amazon

Instrument	Measures related to the Amazon
ENBCC	Strategic Action 2.16 * Implementation of the Amazon Indigenous REDD+ initiative, "an initiative that recognizes the value of the environmental services provided by indigenous forests and territories" (1 MINAM, 2016: 101, 126).
ENCC	Priority Objective 4: Reduction of GHG emissions from land use. Priority Objective 4 Guidelines: i) Strengthening conservation mechanisms, increasing the allocation of usage rights in Amazonian forests, and optimizing the implementation of REDD+ for the benefit of indigenous peoples (2 MINAM, 2024: 103).
NDC Update Report for the 2021-2030 Period	Target – Mitigation Measures By 2030, limit Peru's GHG emissions: - To a maximum level of 208.8 $MtCO_2EQ$ (unconditional target) - To a level of 179.0 $MtCO_2EQ$ (target conditional on the availability of international financing) (3 MINAM, 2020: 11). Target – Adaptation Measures Reduce damages and losses caused by climate change and take advantage of the opportunities for sustainable development. - Second priority issue: Forests. (4 MINAM, 2020: 13,15).
Catalogue of Adaptation Measures	Of the 84 measures developed, 12 relate to forests, including the following: · Recuperation of ancestral practices for ecosystem use (BOS1) · Implementation of a surveillance system in Protected Natural Areas (PNA) (BOS5) · Implementation of strategic production chains in rural and indigenous communities (BOS12) (5 MINAM, 2025a:11)
Catalogue of Mitigation Measures	Of the 66 measures developed, 10 relate to land use, land-use change, and forestry (LULUCF), including the following: - Forest conservation mechanisms in indigenous communities (LULUCF3) - Management and conservation of PNAs (LUCUF4) and Amazonian peat bogs (LUCUF10) - Allocation of land rights in unclassified lands in the Amazon (LULUCFS5) (6 MINAM, 2025b:11)

* Strategic Action 2.16, which corresponds to Strategic Action 2 of the ENBCC, seeks to increase the value of forests through Sustainable Forest Management, including community management and other activities, making it more competitive compared to activities that cause deforestation and degradation.

Source: Prepared by the authors based on the ENCC, ENBCC, NDC Update Report for the 2021-2030 Period, and the Catalogues of Adaptation and Mitigation Measures.

Climate Change, the emissions reductions observed over the last decade are mainly due to economic contraction and a decline in industrial activity, rather than a deliberate mitigation strategy. The absence of specific sectoral and territorial plans, together with a nascent climate institutional framework and limited participation by private and subnational actors, has hampered the government's ability to translate commitments into concrete and sustainable actions. This situation is exacerbated by the lack of an updated national emissions inventory, which makes it difficult to set realistic and ambitious targets for the period from 2020 to 2030 (ACFIMAN, 2022).

In this context, the lack of reliable data and robust monitoring systems poses one of the main obstacles to climate management in Venezuela. The absence of a National Greenhouse

Gas Emissions Inventory System (SINGEI) and a National Climate Change Information System (SNCC) prevents adequate policy monitoring and impact assessment. Furthermore, there is insufficient data collection disaggregated by sector, gender, ethnic group, and territory, limiting the possibility of identifying vulnerabilities and designing effective adaptation responses. The development of risk and vulnerability indicators, as well as the implementation of real-time monitoring networks and early warning systems, are urgent measures to strengthen transparency, accountability, and evidence-based decision-making (ACFIMAN, 2022).

Forests play a central role in Venezuela's climate strategy, in terms of both climate change mitigation and adaptation. Reduced deforestation and ecological restoration are priority goals, recognized not only for their contribution to carbon sequestration, but also for their role in protecting biodiversity and ecosystem services.

Photo: Diego Pérez/ SPDA

Table 4. Venezuela's Nationally Determined Contribution Targets (2020)

Policy	Action	Observations
Promote actions at the national and international levels to protect, conserve, and sustainably manage strategic areas, such as freshwater sources and reservoirs (surface and groundwater), watersheds, biological diversity, seas, oceans, and forests. (Plan for the Homeland 2019–2025–2030).	1.- National Integrated Forest Information System (SINIB), with expected results of 4,465,909 ha of forest ecosystems monitored and evaluated. 2.- Capacity building and innovative tools for sustainable and participatory forest management covering 166,634 ha of forests. 3.- Restoration and regeneration of 3,000 ha of forests through sustainable forest management strategies for the sequestration of 0.2 million tons of CO2EQ.	The considerations mention that local actors from the Imataca Forest Reserve (Bolívar State, part of the Amazon rainforest) will receive support, but do not specify whether all efforts will be undertaken there. However, considering that over the last 24 years more than 820,000 hectares of forest have been lost south of the Orinoco River and that 40% of this loss has occurred since 2015 at a rate of more than 75,000 hectares deforested per year, one would expect that part of the efforts would focus on monitoring and restoring the Venezuelan Amazon.
Promote actions at the national and international levels to protect, conserve, and sustainably manage strategic areas, such as freshwater sources and reservoirs (surface and groundwater), watersheds, biological diversity, seas, oceans, and forests. (Plan for the Homeland 2019–2025–2030).	The forest cover exchange rate is expected to remain at 0.20%, equivalent to 90,000 hectares/year, by 2030, promoting and implementing measures for forestry and environmental control.	The policy scope mentions that it is a national-level action aimed at conservation. However, in the latest analysis of land cover changes south of the Orinoco River, SOSOrinoco recorded a forest loss of at least 100,000 hectares per year for the period 2020-2024.
Produce 8,797,255 native forestry, fruit, medicinal, and ornamental plant species, promoting the use of agroecological practices (Plan for the Homeland 2019–2025–2030 and the National Production Plan 2021).	A total of 55 institutional nurseries and 240 community nurseries are expected to be set up for plant production over a period of five years.	There is no mention as to whether nurseries will specifically target different geographical areas and ecosystems. These nurseries are expected to prioritize working with local species and ensure that they meet planting requirements to guarantee the highest probability of survival. Furthermore, it would be ideal to start with watershed headwaters and riparian forests affected by mining extraction.
Restore national forest cover, prioritizing watersheds and degraded areas in national parks and natural monuments. (Plan for the Homeland 2019–2025–2030 and the National Reforestation Strategy 2021).	1.- Establish 88 fruit forests and 127 polychromatic forests covering an area of 480 hectares to beautify plazas, avenues, and communities, planting 300,000 ornamental plants with the aim of creating urban green spaces to capture CO2. 2.- The plan is to plant 4,800,000 trees in 4,000 reforestation days, with the aim of establishing core green areas for CO2 capture.	These types of policies and actions need to be evaluated and improved because they lack an objective-subject relationship and do not reflect a technical plan focused on national priorities, much less those of the Amazon region.
Mining sector	1.–An estimated 1,575 affected hectares will be remediated by planting 48,375 native trees in areas affected by mining. 2.–The emissions generated by mining activities from 2020 to 2030 will be estimated. 3.–Annual carbon capture through reforestation of mature forests will be measured. 4.–Minimize the environmental impact of mining activities, undertake remediation of environmental damages, prioritize the development and use of low-impact technologies, and assess the environmental burden.	In the states of Amazonas and Bolívar alone, SOSOrinoco has estimated that mining has impacted more than 68,000 hectares in the Amazon, while major rivers such as the Caroní, Caura, Yuruaní, Yuruari, Orinoco, and Cuyuní are affected by sedimentation processes in areas where mining occurs along riverbanks or through riverbed dredging.

Source: Prepared by the authors based on the 2021-2030 NDC Update Report and the catalogues of adaptation and mitigation measures for Venezuela.

Illegal Mining and Its Incompatibility with Climate Change Mitigation and Adaptation

Illegal mining in the Amazon has undergone sustained and alarming growth in the last several decades, establishing itself as one of the main drivers of change in the Amazon biome. This section presents a comprehensive analysis of the socio-environmental impacts of illegal mining, with an emphasis on its incompatibility with climate change mitigation and adaptation goals. It addresses the effects of illegal mining on deforestation, soil degradation, greenhouse gas emissions, impacts on protected areas and indigenous communities, and mercury contamination.

The most relevant data estimates that illegal mining has transformed more than 5.5 million hectares of Amazonian forest, releasing more than 330 million tons of CO_2 and affecting more than 2.3 million people due to mercury exposure. Patterns of territorial expansion, technological advances in operations, and displacement to areas of high ecological and sociocultural sensitivity, such as protected areas and indigenous territories, have also been identified. Alluvial gold mining, in particular, stands out as the most widespread and destructive form of mining, with cumulative impacts on biodiversity, the water cycle, and public health.

Figure 6 illustrates the evolution over time of the area transformed by mining in the Amazon biome between 1985 and 2023, showing a sustained upward trend, with an exponential increase since the 2000s. This pattern reflects the intensification of illegal extractive activities, driven by factors such as global demand for gold, institutional weakness, and the implementation of extractivist policies in several Amazonian countries. The graph allows us to gauge the magnitude of the phenomenon and contextualize the analyses presented in the following sections.

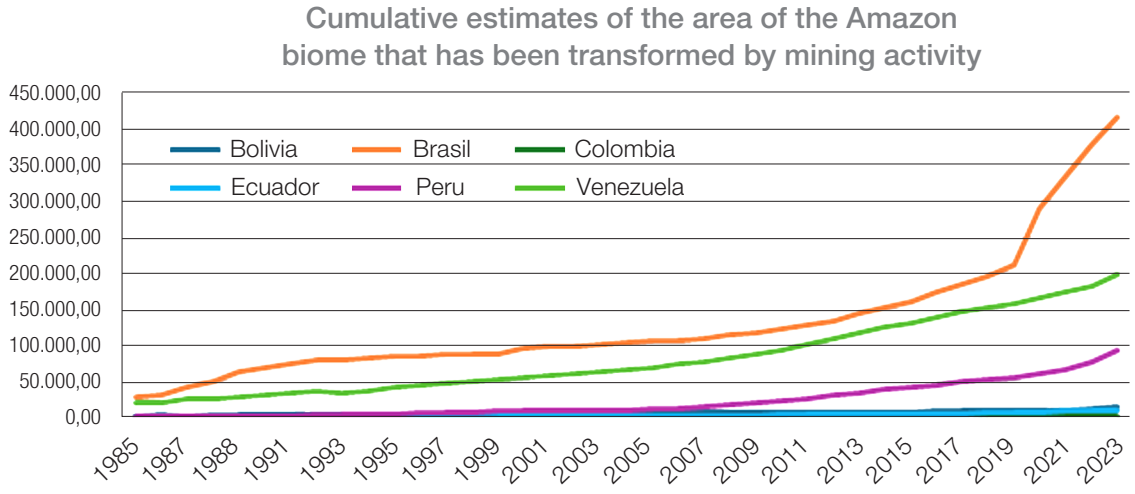


Figure 6. Cumulative estimates of the area of the Amazon biome that has been transformed by mining activity. Source: Prepared by the authors based on the RAISG database.

Deforestation and soil degradation

For the purposes of this publication, the Amazon is defined as a vast, continuous expanse of forest covering the Amazon River basin, much of the Orinoco River basin, and the forested areas of the Guiana Shield. Deforestation and soil degradation are complex and multifaceted problems within the Amazon, driven primarily by agriculture and cattle ranching, as well as illegal mining and other extractive activities.

Deforestation and soil degradation in the Amazon are complex and multifaceted problems, with illegal gold mining being one of the main drivers. Not only does it cause the direct destruction of the forest, but it also triggers a cascade of negative impacts that include mercury contamination, biodiversity loss, and the breakdown of communities, particularly affecting indigenous peoples, *quilombolas*, and traditional communities.

Brazilian Amazon

Illegal mining in the Brazilian Amazon is a key driver of carbon emissions in the atmosphere, directly impacting the global climate crisis. This activity is now one of the main causes of environmental degradation in the region, causing accelerated forest cover loss, especially in indigenous territories (Silva-Junior, *et al*., 2023). Starting in 2019, this process intensified dramatically, with an approximate 195% increase in the deterioration of these territories compared to previous years, demonstrating an alarming intensification of unauthorized extractive activities (Mataveli *et al*., 2022).

The consequences of this deterioration are clear to see, as demonstrated by the events of 2024, when the Kayapó Indigenous Territory led the region in the number of hotspots recorded. With 3,246 fire outbreaks between January and September, satellite images confirmed that many of these fires were directly linked to recently opened illegal mining areas, demonstrating how illegal miners use fire to clear new areas for extraction (Siqueira-Gay, J., Dondé, R. F., & Sanchez, L. E., 2023). Located in the state of Pará, which will host COP30 in 2025, the Kayapó Indigenous Territory is home to more than 6,000 people from the uncontacted indigenous peoples of Rio Fresco and Mebengôkre, highlighting that the impact of mining is not only environmental but also deeply social.

Bolivian Amazon

While most of the Amazon is located in Brazilian territory, Bolivia is the country with the highest percentage (65%) of its territory covered by the Amazon (714,000 km²) after the Guianas (Gudynas, 2024: 32). According to Latindadd (2024), the Bolivian National Institute of Statistics projected that by 2022, 1,790,201 inhabitants (15.8%) would live in the Bolivian Amazon region, which comprises a total of 88 municipalities in five departments (Beni, Pando, Santa Cruz, La Paz, and Cochabamba). This immense area is home to different biomes: the Amazonian (67%), Andean (4%), Chaquense (8%), Chiquitano (14%), Tucumano-Boliviano (2%), and Valles (5%) (MAPBIOMAS, 2024:6).

According to Global Forest Watch (2025), the Bolivian Amazon absorbed an average of 178 $MtCO_2e$/year from 2001 to 2024, with total carbon storage of 9.91 Gt (3.11 Gt of carbon in soil, 5.43 on the surface, and 1.37 underground). However, there are also average emissions of 158 $MtCO_2e$/

year, leaving a balance of only 20.0 $MtCO_2e$/year. For the aforementioned period (2001-2024), an average of 158 Mt of GHGs were emitted due to the loss of tree cover, for a total of 3.78 $GtCO_2e$ of emissions. Estimates indicate that mining activities and extractive processes are responsible for 336 $ktCO_2e$ of GHG emissions and 17.1 kHa of deforestation.

Seven of Bolivia's 22 nationally protected areas are located in the Bolivian Amazon, in the departments of Pando, north of La Paz, Beni, and the northeast of Santa Cruz. These include Carrasco National Park, Beni Biological Station Biosphere Reserve, Manuripi Amazonian Wildlife National Reserve, Noel Kempff Mercado National Park, Amboro National Park and Integrated Management Natural Area, Madidi National Park, Pilon Lajas Biosphere Reserve and Community Land of Origin. In addition, there are five RAMSAR sites located there: Bañados de Izozog and the Parapetí River, Laguna Concepción, Río Blanco, Río Matos, and Río Yata.

Protected areas in the Bolivian Amazon are essential for maintaining the water cycle, as they protect ecosystems that regulate humidity through evapotranspiration, a process whereby forests release water vapor into the atmosphere. This mechanism allows between 30% and 70% of the rainfall in the Amazon basin to come from the forest itself, ensuring constant precipitation not only in the region, but also in other areas of Bolivia and the southeast of the continent. The Bolivian Amazon generates 6.2% of the 9.1 trillion m^3 of water produced annually throughout the Amazon, which is equivalent to about 564 billion m^3. Of this, more than 70% is recycled as rain thanks to vegetation, which contributes to regional water flow (CSF, 2021). According to the same source, Carrasco National Park, along with Apolobamba (which does not form part of the Amazon basin), generates 70% of Bolivia's hydroelectric power. Four protected areas (Carrasco, Madidi, Rhukanrhuka, and Bajo Madidi) –out of a total of 81 national, departmental, and municipal protected areas– account for 50% of the water in watersheds related to irrigation projects.

Bolivia ranked as the second most deforested country in the world in 2024, with a loss of 1.8 million hectares of forest, of which 1.5 million were primary forest. This figure represents a 200% increase in tree loss and a threefold increase in primary forest loss compared to 2023. Between 2001 and 2024, Bolivia lost more than 9.7 million hectares of tree cover (one-third of which was destroyed by forest fires), which is equivalent to 15% of its tree cover area in 2000 and contributed 3.78 gigatons (Gt) of CO_2 emissions. In 2024 alone, fire consumed 1.07 million hectares, accounting for 59% of all tree loss in that year. This figure makes 2024 the most devastating year for fires in more than two decades (Global Forest Watch, 2025).

Bolivia faces environmental deterioration caused by the interaction of multiple extractive pressures: the expansion of agriculture and cattle farming, which accounts for the majority of deforestation due to soybean cultivation and grazing; illegal gold mining, which contaminates rivers with mercury and affects aquatic life and indigenous communities; and oil and gas exploration, which encroaches on protected areas and indigenous territories with activities such as trail clearing and seismic detonations. These activities, backed by government policies that promote an extractivist model, reinforce one another, generating a cumulative impact that includes deforestation, environmental degradation, and social conflicts, especially with indigenous communities. The lack of integrated environmental governance and the prioritization of short-term benefits exacerbate

the vulnerability of the Amazon, threatening its sustainability and causing potentially irreversible damage.

In the case of Bolivia, Tejada *et al.* (2016) developed deforestation scenarios for lowlands –including the Amazon basin and parts of the La Plata basin lower than 3,000 meters above sea level– considering variables such as the existence and condition of roads, variables related to export markets, the status of protected areas and indigenous territories, and the rate of deforestation. These projections suggest deforestation of between 25 and 37 million hectares by 2050 (Tejada *et al.*, 2016: 57), multiplying the cumulative deforestation between 2001 and 2024 by 2.5 to 3.7 times, affecting between 24% and 38% of priority biodiversity conservation areas. Another study (Maillard *et al.*, 2020) presents scenarios of natural cover loss specifically for the department of Santa Cruz, projecting an increase in the area of human use of up to 55%, with a natural cover loss of 14.1 million hectares and a decrease in forest cover of up to 34.9%.

Colombian Amazon

The Colombian Amazon covers approximately 48 million hectares, representing about 42% of the national territory and around 6.2% of the entire continental Amazon (RAISG, 2023). This territory is home to a rich variety of ecosystems, including tropical rainforests, natural savannas, floodplain forests, swamps, and aquatic systems such as rivers and streams. The Amazon area is made up of nine hydrographic zones: Caquetá (29.23%), Putumayo (16.94%), Apaporis (15.65%), Vaupés (11.02%), Yarí (10.86%), Guainía (9.15%), Caguán (6.07%), Amazonas (0.96%), and Napo (0.13%).

According to MapBiomas Colombia (2024), 85.6% of the Colombian Amazon is still covered by natural vegetation. This coverage provides vital ecosystem services such as water regulation, biodiversity, traditional agroforestry, and hydroelectric power generation. Protected areas cover more than 11.1 million hectares (23%), and indigenous reserves cover 57%, with a high degree of overlap between the two.

Over the last decade, the Colombian Amazon has experienced intensified ecological deterioration. According to MapBiomas Colombia (2024), between 2001 and 2023, more than 1.2 million hectares of forest cover have been lost, equivalent to 2.5% of the national Amazonian area. The highest peaks of deforestation occurred in 2017 and 2020, linked to the expansion of the agricultural frontier, illegal mining, and the weakening of territorial governance. This is in addition to critical events such as the forest fires of 2016 and 2023, as well as the severe droughts recorded in 2010 and 2016, which directly impacted the ecological resilience of the region.

According to the Ombudsman's Office of Colombia (2025), in the second half of 2024, the Amazon River reached its lowest level in 122 years, reaching a depth of just five meters in large sections of the country. In addition, river transport came to a near standstill, with serious consequences for society and food security. On the Leticia-Tarapacá route, a ten-year high of 176 fires was recorded.

Climate models indicate that if between 20% and 25% of the original forest cover is lost, the Amazonian system's capacity to recycle moisture could collapse.

Although the cumulative percentage of forest loss in Colombia has not yet reached the critical threshold for savannization, the spatial concentration patterns of deforestation –especially in areas that are key to ecological connectivity– could accelerate large-scale fragmentation and degradation processes, compromising the structural

resilience of the ecosystem. A clear example of this process can be seen in the Amazonian foothills, where progressive disconnections have historically occurred. More recently, this fragmentation has intensified between the protected areas of the Macarena Special Management Area (including the Picachos, Tinigua, and Sierra de la Macarena National Natural Parks) and the Serranía de Chiribiquete National Natural Park, which in turn affects biogeographic connectivity between the Andes and the Colombian Amazon.

The Amazon has historically functioned as an important carbon sink, capturing more CO_2 than it emits. However, cumulative processes of deforestation and degradation are upsetting this balance. In the Colombian Amazon, an estimated 349 million tons of carbon were lost between 2001 and 2020, equivalent to 1.28 billion tons of CO_2, or about 7% of the carbon lost in the entire Amazon basin during that period (Walker *et al.*, 2022).

While we still do not have specific data to estimate the current net carbon balance at the subnational level, trends point to a progressive reduction in carbon sequestration capacity, especially in areas subject to recurring disturbances. Local and inter-institutional scientific research on the Colombian Amazon carbon cycle needs to be strengthened in order to better understand these processes and guide effective mitigation measures.

In the face of climate change, various indigenous communities of the Amazon have promoted autonomous adaptation strategies such as the recovery of native seeds, participatory environmental monitoring, and strengthened territorial governance with a cultural focus. In the eastern Colombian Amazon, this process has been consolidated with the progressive formalization of indigenous governments as Indigenous Territorial Entities (ETIs), in a coordinated effort between the organizations themselves and the Gaia Amazonas Foundation.

This model enhances the capacity for planning, protection, and sustainable use of the territory, reaffirming the role of indigenous knowledge systems in climate adaptation. Nonetheless, these community responses have been implemented in the clear absence of public policies designed for the Amazonian context, especially the sociocultural diversity of the eastern Amazon. The limited availability of systematic information and weak coordination between different levels of government have limited the effectiveness of local adaptation initiatives in the Amazon (SINCHI, 2022; Gaia Amazonas, 2023).

In this scenario, Decree 1275 of 2024 (Ministry of Environment and Sustainable Development, 2024), which recognizes indigenous authorities as environmental authorities within the National Environmental System, represents a crucial opportunity. This regulatory framework opens the way for indigenous governments to play a role in land use planning, environmental management, and the application of their own justice system, which could allow for a more contextualized, culturally relevant, and self-governance-based adaptation to climate change. However, its implementation will require institutional will, sustained investment, and, above all, a process of intercultural dialogue that translates this legal recognition into practical and concrete transformations in the territory.

Venezuelan Amazon

In Venezuela, the Amazon region as discussed in this report refers to the Guayana region, as defined by Huber (1995), which includes the states of Amazonas, Bolívar, and Delta Amacuro, excluding the Essequibo Territory. The report uses the Hylea area as a criterion for defining the Venezuelan

Amazon, covering part of the Venezuelan Orinoco and Guayana regions.

This region represents 50.5% (453,915 km²) of Venezuela's surface area (916,445 km², excluding the Essequibo) and borders Colombia and Brazil. This immense region includes the Venezuelan portion of the Amazon basin (approximately 41,956 km²) (Rojas and Castaño, 1990), more than half (58%) of the Venezuelan Orinoco basin (Lasso *et al.*, 2010), and around 45% of the surface area of the Guiana Shield (Huber, 1995). This vast area features an extremely wide variety of ecosystems, with different types of forests, savannas, grasslands, shrublands, and rock-dwelling vegetation that support the region's rich biodiversity, some of which are unique to the country (Riina and Huber, 2003). However, the predominant ecosystem is the forest, covering an area of more than 37.6 million hectares in 2020, which represents about 81% of Guyana's land area and 72% of the country's tree cover (University of Maryland and World Resources Institute, 2025). A total of thirty protected areas (nine national parks, 19 natural monuments, and two biosphere reserves) have been established. Although the boundaries of some of these areas overlap, the total surface area protected, without overlap, reaches more than 221,708 km² (22 Mha), or about 49% of the region, providing legal protection for most of the existing forest area (Bevilacqua *et al.*, 2006; SOSOrinoco, 2025).

In general, the ecosystems of Venezuelan Guayana provide a myriad of environmental services in the four categories described by Figueroa (2009): provision (food, water, fuel, fibers, medicines, raw materials, etc.); regulation (climate, hydrology, biological pest control, etc.); cultural (mythical-religious value, solace, recreation, etc.); and basic or support (erosion control, sediment retention, nutrient storage and cycling, shelter, etc.).

From an economic standpoint, water is clearly important as a source of energy, a means of communication for transport and trade, areas for tourism and recreation, the basis of the continental fishing industry, or simply as a vital resource for subsistence (drinking water). In addition, these ecosystems contribute to the protection of soil and water resources, biodiversity conservation, support for agricultural productivity and sustainability, carbon sequestration and mitigation of global warming, the fight against desertification and resource degradation in arid and semi-arid areas, the provision of shade, fun, and recreation, and the protection of coastal areas and coastal fisheries (ACFIMAN-SACC, 2018).

Venezuela's climate is strongly influenced by its geographical location. Located in the intertropical zone, north of the equator, Venezuela has warm waters to the north and northeast (the Caribbean Sea and the Atlantic Ocean), an extensive tropical rainforest to the south, and a massive mountain range to the west (the Andes), as well as major mountain ranges to the north near the coast and significant formations to the south (highland areas of the Guiana Shield). Together, these factors combine in a complex interaction of meteorological and geographical factors to produce a series of climate -related effects. In general, the intertropical convergence zone and the high pressure and anticyclonic ridge have a wide-ranging seasonal influence on the country.

On the other hand, the ecosystems of the Venezuelan Guayana, very important actors in biosphere-atmosphere relations, also play a unique role in regulating the regional climate. While their role in capturing and storing atmospheric carbon stands out, other lesser-known but highly important factors, such as their role in the hydrological cycle and in mitigating changes in the albedo, have a decisive influence on surface temperatures (Jia *et al.*, 2019).

They play a complex role in maintaining the water cycle and water distribution in the region. On the one hand, they buffer and "manage" the flow of water into the soil and river channels, which protects the soil. On the other hand, they maintain a constant exchange of water with the atmosphere due to evapotranspiration, which maintains air humidity, modifies temperatures, and allows for the recharge of orographic clouds that then fall "windward" in the form of rain. Unfortunately, no simulation studies have been conducted to establish with any degree of certainty the impact that soil moisture has on the magnitude and spatio-temporal distribution of rainfall in the region. However, we can assume that it is very important, given the results of the simulations carried out by Llopart *et al.* (2014), which indicate a high relative influence of local soil moisture feedbacks on the remote effects of regional sea surface temperature (such as ENSO) in the Amazon basin. As early as 1994, Eltahir and Bras had estimated that about 25% of the rainfall in the Amazon basin is due to evaporation, reinforcing evidence from previous studies which include a differentiation between forest evapotranspiration's degree of contribution, which increases from east to west, probably due to the influence of prevailing wind patterns.

Although Venezuelan Guayana accounts for nearly half of Venezuela's land area (50.5%, 453,915 km²), it is home to less than 7% of the Venezuelan population (INE, 2011, cited in ACFIMAN-SACC, 2018), making it the least developed region in the country. However, the relatively low level of intervention is not evenly distributed and is mainly associated with high-impact activities that involve drastic changes in land use, often concentrated in highly fragile areas, resulting in changes that are often irreversible.

One of the indicators that provides evidence of these changes is the change in vegetative ground cover. However, the literature provides few consistent estimates that adequately reflect changes in land cover, and even fewer that allow these changes to be linked to specific sectors and/or activities. However, based on available records, we find that between 2001 and 2024, the region lost between 834,009 and 875,900 ha (depending on whether GFW data or data collected by SOSOrinoco is used) of tree cover, of which 514,445 ha correspond to primary forest. This represents 33% of the national tree cover loss (2,528,043 ha) during that period and 81% of the nation's primary forest loss (633,800 ha) (GFW, 2025).

In Venezuelan Guayana, the state of Bolívar had the largest area of cover loss, amounting to between 563,000 and 767,600 ha. This represents 22% of the national total for that period and 68% of regional deforestation. The states of Amazonas and Delta Amacuro followed, with losses of 235,490 ha and 35,519 ha, respectively. We find the same distribution by state if we analyze primary forest loss, with Bolívar state accounting for 62% of the loss in Guayana (317,450 ha), followed by Amazonas with 35% (180,250 ha) and Delta Amacuro with 3% (16,745 ha).

Although Venezuela does not have carbon inventories for any natural ecosystems, some estimates can be made about the carbon density contained in its forest systems. For Venezuelan Guayana, it has been estimated that there are 320-325 t ha^{-1} of carbon contained in the biomass of standing trees (dry biomass), with extremes of 340 t ha^{-1} for the Bolívar-Delta Amacuro border. In general terms, it is accepted that living biomass has around 50% carbon content, so these values can be translated into around 160-170 t C ha^{-1} (ACFIMAN-SACC, 2018). In this regard, Scharlemann *et al.* (2014) assign carbon density values in biomass of between 50-200 t C ha^{-1} for terrestrial ecosystems south of the Orinoco, with the lowest

values associated with the southeast of Bolívar state and northeast of Amazonas state (between 50-75 t C ha^{-1}). However, these authors highlight the importance of soil, and especially organic carbon in the soil, as a reservoir to consider, assigning values ranging from 25 to 300 t C ha^{-1}, with the soils of the Amacuro Delta having the highest carbon concentration. This perfectly aligns with the estimates made by Köchy *et al.* (2015) for the global distribution of soil organic carbon.

In summary, according to ACFIMAN-SACC (2018), Venezuelan Guiana's forests contain at least between 2.9 and 5.8 thousand Mt C (Mt C = million tons of carbon), while the savannas contain around 290 Mt C in biomass. Values in soil would be around 1 Mt C for forests and 150 Mt C for savannas. It is worth noting that of the total loss of forest cover, 209,597 hectares were lost due to fires throughout Guayana, with Amazonas state being the most affected: 106,883 hectares were consumed by flames, accounting for 51% of the regional total. The state of Bolívar follows closely behind with 45% (94,240 ha), and finally Delta Amacuro with 8,474 ha, accounting for 4% of the regional total (GFW, 2025).

These records indicate that of the 834,009 hectares lost in Guayana, only 21% (209,597 hectares) were the result of fires, suggesting that other human activities are responsible for almost 80% of regional deforestation. In fact, a more detailed analysis indicates that shifts toward increased agricultural use and mining are the main drivers of changes in land cover and forest loss in the region. For example, Venezuelan Guayana added nearly 434,300 ha of forest to permanent agriculture and altered 478,030 ha of forest for migratory agriculture in the first quarter of the 21st century.

The area taken up by population centers, infrastructure, or agricultural production in the states of Amazonas and Delta Amacuro is very small compared to the vast coverage of natural vegetation. However, it has been growing over the last 25 years and currently occupies areas corresponding to 0.39% (184,400 ha) and 0.21% (102,200 ha) of the region, respectively. In the state of Bolívar, the situation is somewhat different, as it is the state with the largest population in Guayana (with 5% of the national population and 82% of the Guayanese population, according to the INE, 2011), and with the greatest urban, mining, industrial, and agricultural development. In this state, the area currently dedicated to this type of land use covers 5.27% of the region (2,478,300 ha). However, aside from the area affected by these activities, the rate of intervention in the state of Bolívar was 111,484 ha, which is more than 10 times the rates recorded in the states of Amazonas and Delta Amacuro for that year (10,687 ha/year and 9,146 ha/year, respectively).

Alluvial gold mining in Amazonian countries and its impact on the CO_2 emissions

In general, alluvial gold mining is the most commonly-practiced and widespread form of mining in various countries in the Amazon. This practice uses dredgers and backhoes to remove sediment from rivers, which upsets the balance of the riverbed, destroys riverside vegetation, and causes compaction and soil fertility loss. These mineral deposits often correspond to protected environmental zones or indigenous territories.

In spite of restrictions, illegal mining continues to wreak havoc (Figure 7). Not only does this activity destroy the rainforest, it also causes a myriad of negative effects, such as mercury contamination, biodiversity loss and the disruption of communities, particularly affecting indigenous peoples, *quilombola* communities, and traditional communities.

In the case of the Bolivian Amazon, gold mining is the most significant activity, with alluvial type mining being the most widespread practice, and vein mining most concentrated in the foothills. A large part of these deposits overlap with protected environmental zones or indigenous territories.[9] In the case of Bolivia, the areas with the greatest mining activity within the Amazon basin are located from the headwaters through the middle section of the Beni River, along the Bolivian part of the Madre de Dios river basin, in the San Ramón and San Javier municipalities within the Santa Cruz department and in the vicinity of the San Simon peak in the Beni department. During the last 5 years, these areas have expanded towards restricted zones in protected areas.

Despite regulatory flexibility in environmental control (Campanini y Villegas, 2019), not even symbolic restrictions in the heart of protected areas or indigenous territories can contain the advancement of alluvial mining. The case of the Beni River in the Multi-ethnic Indigenous Territory II (TMI II) illustrates this. In 2021, 144 mining rafts were identified, of which only 14 (7.7%) were located within areas with officially authorized mining rights. The remaining 92.3% were located outside of these authorized areas, thus operating illegally (CEJIS, 2022).

As for Brazil, despite government efforts, illegal mining continues to wreak havoc. In 2023 and 2024 alone, 4,219 hectares of tropical rainforest in Indigenous Lands such as Yanomami, Munduruku, Kayapó, and Sararé were destroyed. The destructive events, along with other unsustainable practices, are pushing the Amazon to a point of no return, or a "tipping point," in which the rainforest loses its capacity for natural regeneration and the ecosystems suffer from irreversible changes. In fact, Brazil has the second highest rate of rainforests lost due to mining on a global scale. Although overall deforestation in the region has decreased 30% between August 2023 and July 2024, the resilience of the Amazon biome remains in a fragile state.

Illegal mining is a key factor in the forest's growing fragility, as demonstrated by the unprecedented rates of fires recorded in 2024. The Kayapó Indigenous Territory, which has been particularly affected by illegal mining, led the region in recorded wildfires. The current government has pledged to achieve zero deforestation by 2030. However, this objective has been described by its own Ministry of Agriculture and Livestock as "unrealistic and unreasonable, and practically impossible to achieve," according to documents leaked by the newspaper *Folha*. This contradiction reveals the enormous challenge Brazil

[9] For example, 813 alluvial deposits, 44 fluvial-glacial deposits, and 209 vetiform deposits were identified in the Madidi-Apolobamba-Cotapata-Pilón Lajas corridor.

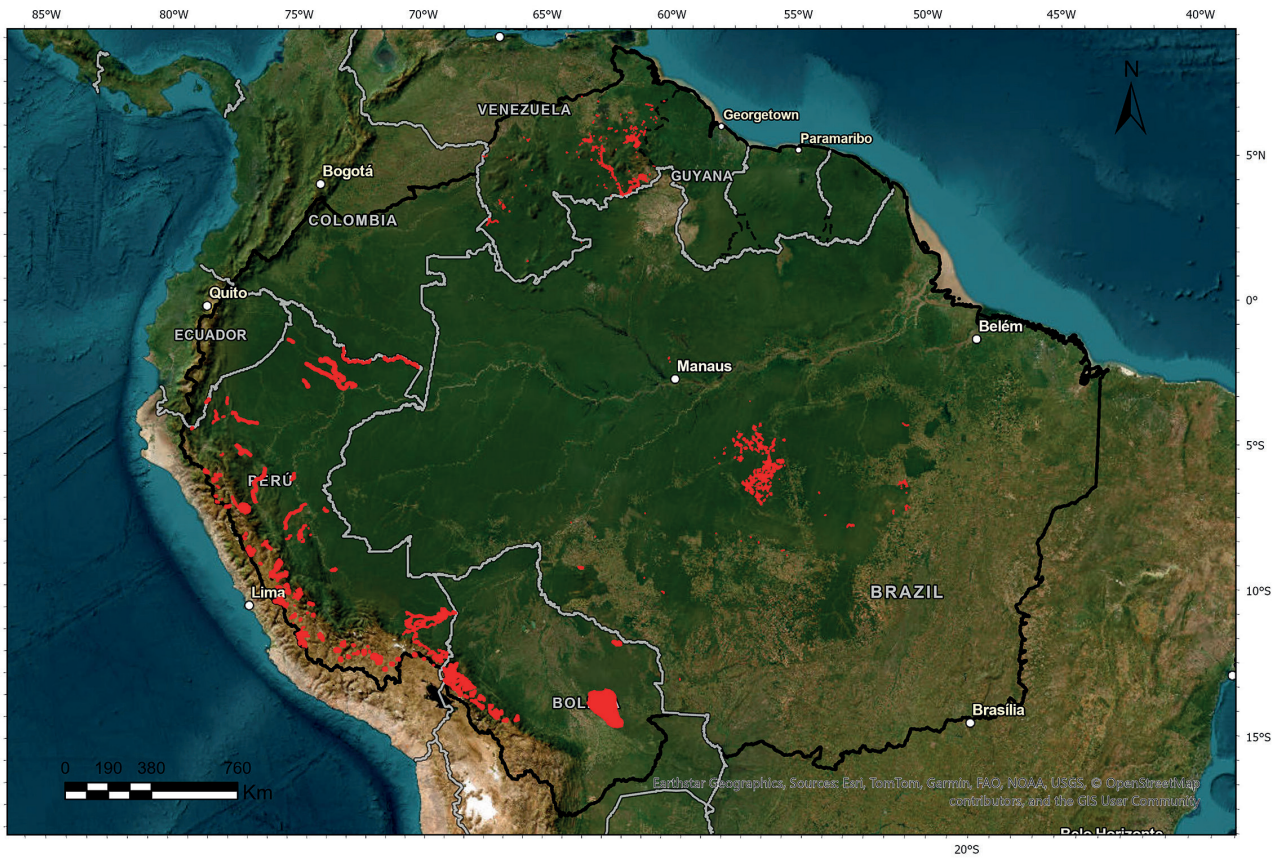


Figure 7. Detection of illegal mining in the Amazon within the framework of analysis of RAISG in 2022. Source: Prepared by the authors based on the RAISG database.

faces to protect the Amazon from soil degradation and deforestation caused by mining and other illegal activities. In order to fight this, Brazil's Federal Supreme Court[10] has taken a crucial step by repealing the presumption of good faith in the gold trade, now requiring companies to demonstrate the legal provenance of the metal, a key strategy for dismantling illicit supply chains.

The expansion of illegal mining has a direct impact on greenhouse gas emissions. Between 2013 and 2021, deforestation caused by illegal mining in the indigenous lands of the Brazilian Amazon released an estimated 96 million tons of CO_2. Astoundingly, more than 59% of these emissions were concentrated in the period from 2019 to 2021, which coincides with a boom in illegal *garimpo* (small-scale, informal mining camps) and a significant weakening of environmental oversight (Silva-Junior *et al.*, 2023). Additionally, recent studies show that artisanal and illegal gold mining generate approximately 16 kg CO_2E for each kilogram of extracted gold, based on a calculation that factors in the use of fossil fuels and rudimentary technologies throughout the operational chain (Siqueira-Gay *et al.*, 2023).

According to The Monitoring of the Andes Amazon Program (MAAP), the tri-border region between Peru, Brazil, and Colombia is one of the regions

[10] https://www.oc.eco.br/supremo-derruba-boa-fe-no-comercio-de-ouro/

most affected by illegal mining (Abad *et al.*, 2025). In Colombia, the most intense pockets of illegal mining are concentrated in the Caquetá, Inírida, Apaporis, Guainía, and Putumayo Rivers, principally in the Guaviare, Guainía, and Amazonas Departments.

Studies by the SINCHI Institute and MapBiomas Colombia indicate that, between 2016 and 2022, over 135,000 hectares of Amazonian rainforest in Colombia were lost as a direct or indirect result of illegal mining activity. The most common type of mining is alluvial gold mining, which uses dredgers and backhoes to remove fluvial sediment. In addition to the aforementioned rivers, informal mining has been reported in the vicinity of the Taraira (Vaupés) and Puerto Inírida (Guainía) municipalities, where artisanal extraction networks operate without environmental control nor state oversight.

In Peru, for example, the presence illegal mining has been identified in 13% of the districts of the following regions: Amazonas, Loreto, Madre de Dios, Huánuco, Ucayali, and San Martín (FCDS-Perú, 2024: 23-24). Unfortunately, there is no specific analysis of the total area impacted by illegal mining in each of the Amazon regions because "no studies have been conducted to measure the impact of this illicit activity on rainforest loss (FCDS-Perú, 2024: 25). In the case of Madre de Dios, 18,421 hectares of rainforest were lost due to illegal mining between 2021 and 2022. Likewise, the type of illegal mining affecting the Amazon is primarily alluvial, since "gold mining (...) is mainly carried out on the beds of bodies of water (...)"

In the case of the Venezuelan Amazon, a change in land use of approximately 112,973 ha was recorded due to mining activity from 2000 to 2024. In total, 875,900 hectares of forest have been lost throughout the region, not including the Essequibo region. There, mining activity is primarily illegal in nature, violating the established environmental and legal framework, or is carried out using untenable legal designs lacking in formal controls, that encourage resource extraction regardless of the environmental and sociocultural consequences. In some cases, the activity is completely illegal, such as mining interventions in the state of Amazonas, where mining has been prohibited since 1989 by Decree No. 269 (Venezuela, 1989), which is still in force, or within protected areas whose legal regulations prohibit it.

In Venezuela, in the majority of cases, mining is promoted by the government's extractivist policies that attempt to legalize exploitation through unconstitutional decrees, such as the Orinoco Mining Arc executive decree. This illegal mining which occurs throughout the southern Orinoco and western Essequibo River regions, is most widespread in the state of Bolívar and the Essequibo Territory (a disputed territory). The Sifontes and Cuyuni-Mazaruni sectors, respectively, account for 98% of registered mining activity and, therefore, have the greatest loss of forest cover due to mining in the last 25 years. Furthermore, the five main basins affected by forest loss are Cuyuni, Mazaruni, Esequibo, Caroní, and Barima, accounting for a total of 85% of the deforested area in these two entities. The average rate of expansion of mining between 2000 and 2024 was 45 km^2/año without taking into account the Esequibo region, reaching values of 147 km^2/year between 2022 and 2023, and 117 km^2/year between 2023 and 2024, rates which are unprecedented in the Venezuelan Amazon.

Using the Gold Mining Impact Calculator[11] (Conservation Strategy Fund -CSF- & Ministerio Público Federal de Brasil, 2021), we can estimate the socio-environmental damage that alluvial mining causes to forests. The calculator assesses social and environmental damages through an economic formula that integrates variables such as mine size, gold

[11] https://miningcalculator.conservation-strategy.org/about

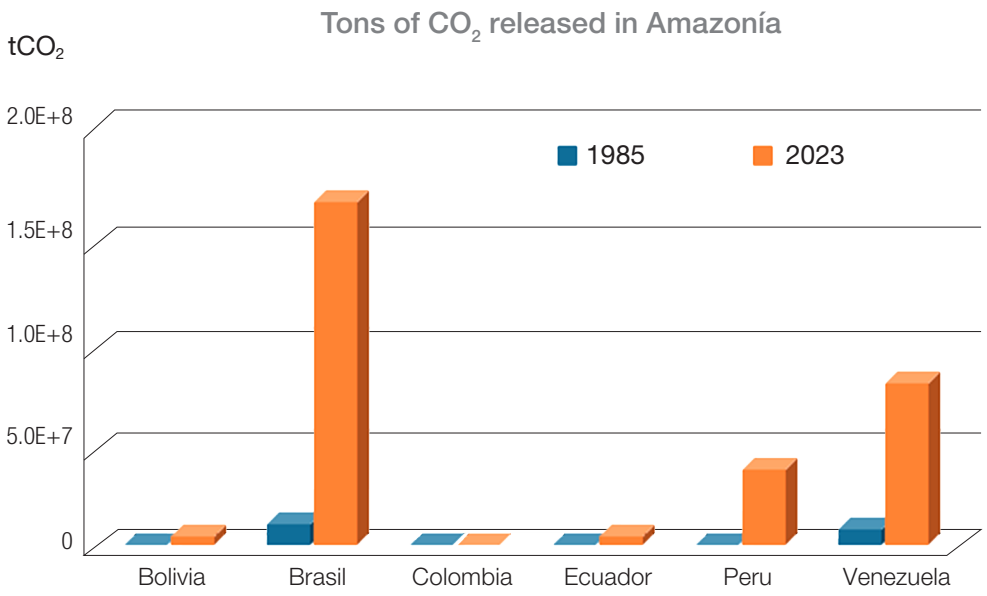


Figure 8. Estimated tons of carbon released in the Amazon, according to mining activity calculated by country in the MapBiomas temporal analysis, using the Gold Mining Impact Calculator (CSF). Source: Prepared by the authors based on the RAISG database.

production, and extraction time, using data from academic literature and interviews. It can be used to estimate compensation, plan investments in prevention, and promote mercury-free technologies. Using a conservative estimate, it is estimated that each hectare of Amazonian forest accumulates 400 tons of CO_2 and that the value that could be generated by capturing each ton of carbon is approximately USD 10. This monetary benefit represents only 31% of the economic benefits associated with standing forests, because the potential use of non-timber products, recreational and cultural uses, and important regulatory services such as erosion control, climate control, and the availability of drinking water are also lost.

Illegal mining in the Amazon has turned vast areas of tropical forest, traditionally considered carbon sinks, into sources of emissions. Using the Gold Mining Impact Calculator and estimates from MapBiomas, a regional methodology that processes annual land cover and land use maps, it was estimated that the approximate amount of CO_2 released by mining deforestation in the six countries analyzed exceeds 330,332,400 tons, which represents a direct threat to the climate commitments made by states in their Nationally Determined Contribution (NDC) (Figure 8).

This activity has transformed a total of 5,546,348 hectares of Amazonian forest and illegally extracted around 1,139,351 kg of gold. The impact of this problem is not limited to the climate, as it has caused profound damage to public health and the local economy. The total costs of socio-environmental damage and illegally extracted gold are estimated to exceed USD 256 billion (Figures 9 y 10).

For gold extraction, more than 16.512 billion m^3 of sediment was removed and approximately 42.6 million grams of mercury were released, exposing more than 2.3 million people to contamination (Figures 11, 12 y 13). In addition, it is estimated that more than 2.1 million miners are at risk of developing neuropsychological symptoms (see Annex 1 for data on each country). This issue requires urgent and coordinated attention and will be addressed in detail in the section on public policy.

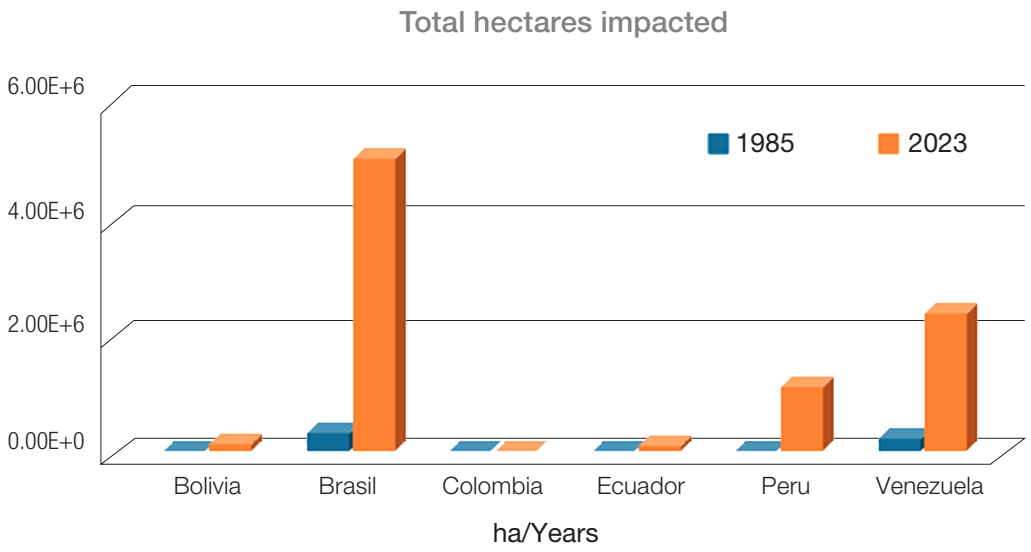


Figure 9. Hectares of the Amazon affected by illegal mining according to the MapBiomas time series 1985-2002. Source: Prepared by the authors based on the MapBiomas database for each country.

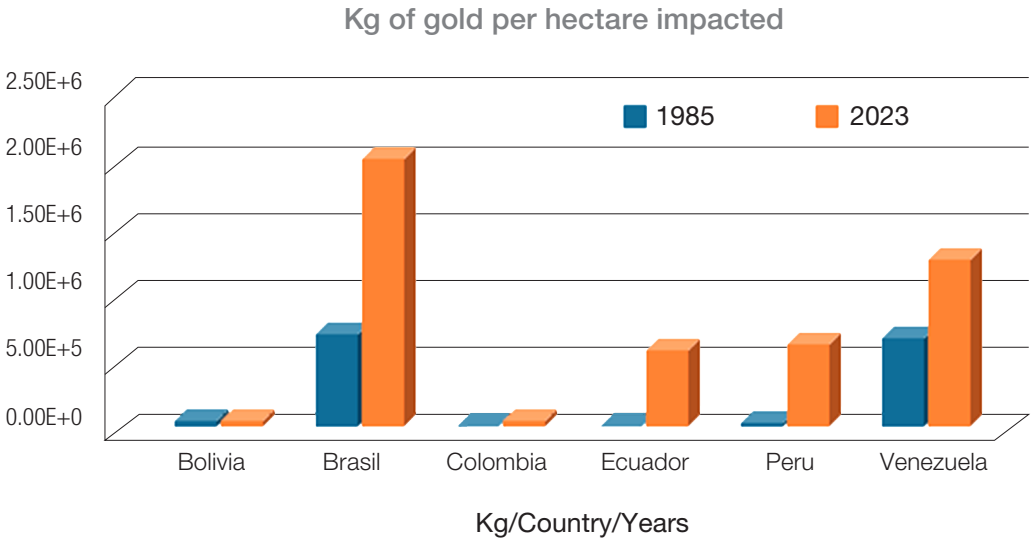


Figure 10. Estimated kilograms of gold extracted, according to the Gold Mining Impact Calculator (CSF), taking into account national data from MapBioma for each Amazonian country. Source: Prepared by the authors based on the MapBiomas database for each country.

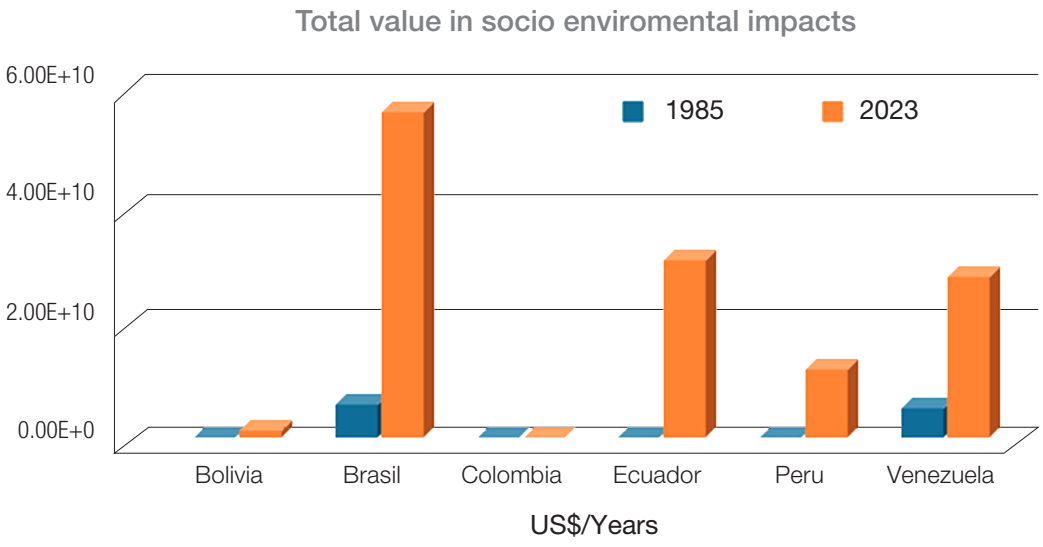


Figure 11. Estimated socio-environmental cost related to the transformation of Amazonian forest cover into hectares of mining, calculated by country according to the Gold Mining Impact Calculator (CSF), taking into account national data from MapBioma for each Amazonian country. Source: Prepared by the authors based on the MapBiomas database for each country.

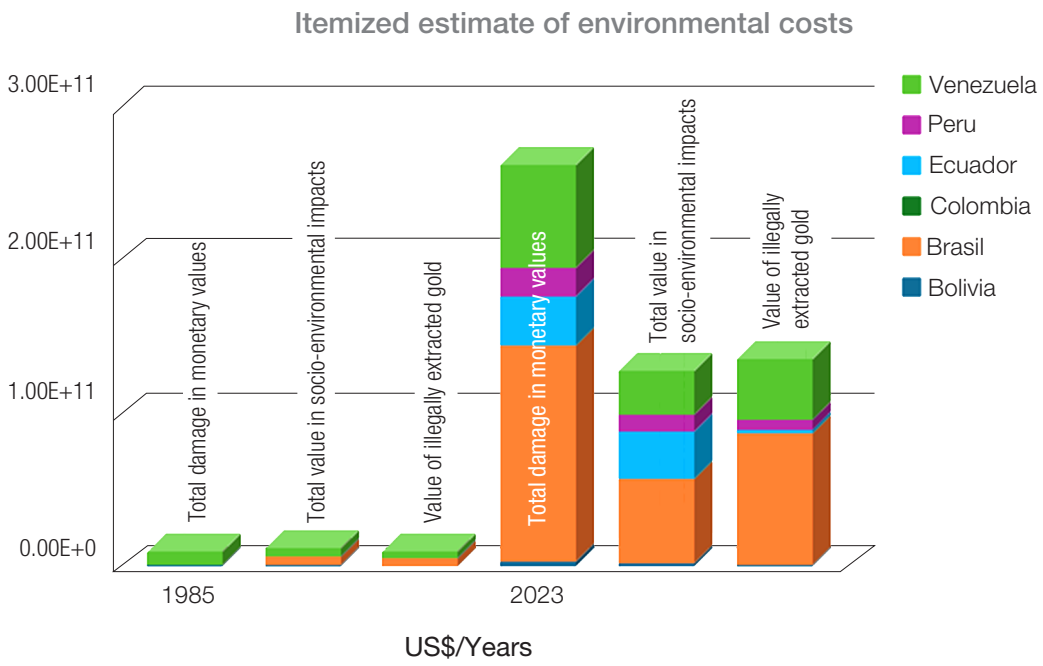


Figure 12. Breakdown of estimated socio-environmental costs resulting from the transformation of Amazonian forest cover into hectares of mining area, calculated by country using the Gold Mining Impact Calculator (CSF) and taking into account national data from MapBioma for each Amazonian country. Source: Prepared by the authors based on the MapBiomas database for each country.

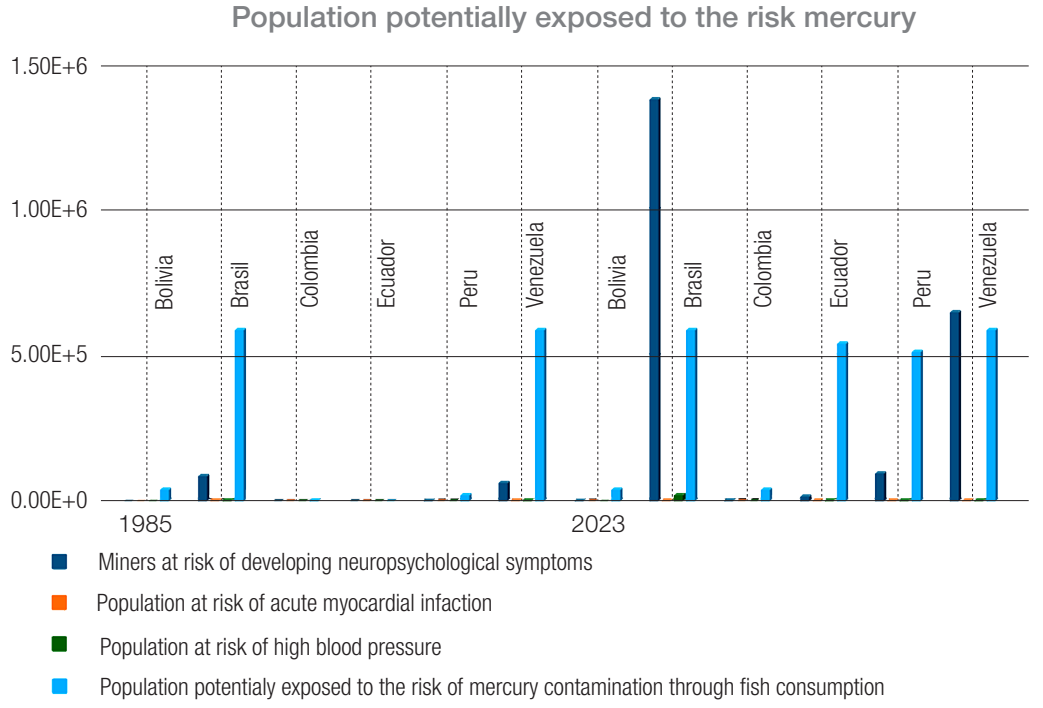


Figure 13. Estimation of the population potentially affected by mercury use, based on estimated mining hectares per country, using the Gold Mining Impact Calculator (CSF) and taking into account national MapBioma data for each Amazonian country. Source: Prepared by the authors based on the MapBiomas database for each country.

Impact of mining within Protected Natural Areas

Over the last decade, the expansion of illegal mining in the Amazon has posed a growing, crosscutting threat to the integrity of protected areas in Bolivia, Brazil, Colombia, and Venezuela (Figure 14). The phenomenon is characterized by the systematic penetration of extractive activities into territories legally designated for conservation, with direct impacts on forest cover, biodiversity, and indigenous peoples. Despite the existence of regulatory frameworks that prohibit or restrict mining in these areas, institutional weakness, lack of effective surveillance, and, in some cases, collusion by state actors have facilitated the proliferation of illegal operations. As a result, there is a sustained trend of deforestation, mercury contamination, and ecosystem fragmentation, as well as the displacement of mining activity to new areas in response to control efforts and the

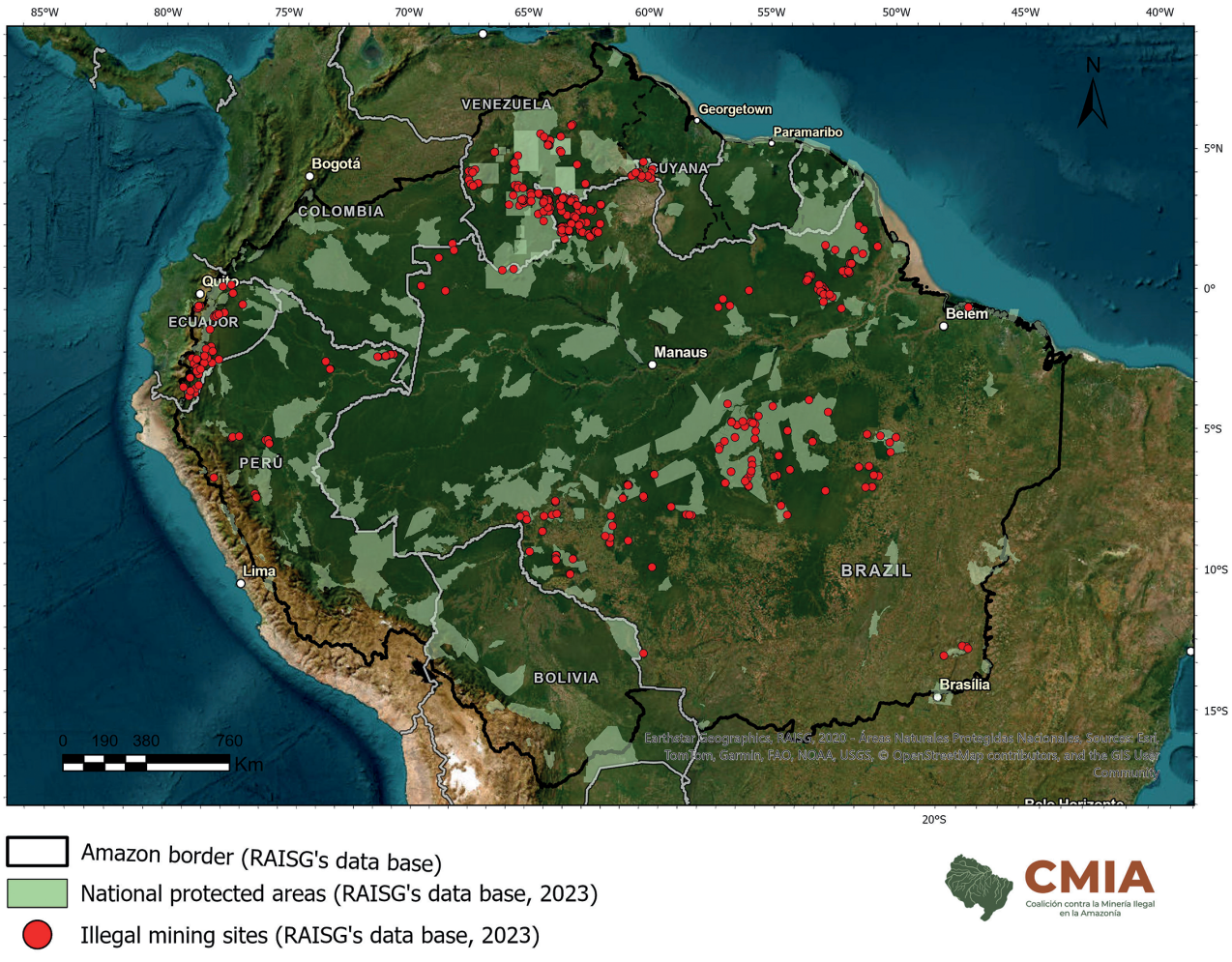


Figure 14. Illegal mining sites and national protected areas in the Amazon. Source: Prepared by the authors based on the RAISG database.

expansion of capital frontiers. This dynamic not only compromises conservation objectives and the rights of indigenous peoples, but also contributes significantly to carbon release, exacerbating the region's vulnerability to climate change.

Protected areas in the Bolivian Amazon

Between 2012 and 2020, illegal mining grew significantly in the Bolivian Amazon, affecting 17.3% of its protected natural areas (RAISG, 2020). According to government authorities from the National Service for Protected Areas (SERNAP), there are six protected areas with illegal mining activity, five of which are located in Bolivia's Amazon basin[12] (SERNAP, 2023). It should be noted that SERNAP's definition of illegal mining refers to mining activities without authorizations and land use compatibility certifications, a requirement that, according to Bolivian law, is necessary for mining activities to be carried out within protected areas that are "compatible" with the purpose of conservation.[13] It does not refer to other mining activities that, although they may have a land use compatibility certification, do not comply with Bolivian regulations and must be considered illegal.

A specific case in Bolivia is that of the Manuripi Amazonian Wildlife Reserve (Pando), where in early 2025, more than 120 dredgers were operating illegally, especially on the Madre de Dios River and in communities such as Puerto Palma Real. This situation poses a serious threat to its more than 700,000 protected hectares. Although military operations temporarily reduced mining activity within the reserve, it shifted to the surrounding areas, where it continues alongside fuel smuggling (Paredes, 2025).

A second illustrative case in Bolivia, with more accurate –albeit outdated– information, is that of the Madidi-Apolobamba-Cotapata-Pilón Lajas conservation corridor, which forms part of the Amazon basin. In 2018, 1,066 mining operations were identified in this area, covering 5.7% of the corridor's surface area –5.8% of protected areas and 2.2% of indigenous territories in this corridor– and only 12% complied with environmental licensing requirements. It was estimated that these mining activities produced 18.5 tons of gold and used 34 tons of mercury[14] in that same year, discharging 74 million m^3 of sediment. The ecosystems identified as highly impacted are the Apolobamba rainforests and the Yungas páramo in Cotapata. A total of 38,866 hectares of forest overlapping with mining rights were identified (WCS, FZS, and FCDS, 2020) (Figure 15).

Protected areas in the Brazilian Amazon

Garimpo is one of the main threats to protected areas in the Brazilian Amazon, with a devastating impact on ecosystems and communities. Although the activity is widespread throughout the country, 92% of the affected areas are located

[12] Manuripi Amazonian Protected Area and Wildlife National Reserve, Tunari National Park, Cotapata National Park and Integrated Management Natural Area, Madidi National Park and Integrated Management Natural Area, and Pilón Lajas Biosphere Reserve and Indigenous Territory

[13] It is important to note that this provision originally refers to artisanal mining activities carried out within protected areas, such as gold panning. However, in practice, this provision has been interpreted to include virtually any type of mining activity. Almost all mining activities that apply for this land use certification are large-scale mining operations involving heavy machinery, large amounts of capital, and the use of harmful chemicals that are not compatible with artisanal mining.

[14] Per protected area, the estimated data for 2018 used in this study are as follows: Apolobamba 3.78 tons Au and 3.91 tons Hg; Pilon Lajas 0.25 tons Au and 0.6 tons Hg; Cotapata 0.26 tons Au and 0.77 tons Hg; and for Madidi 0.3 tons Au and 0.41 tons Hg (WCS, FZS, and FCDS, 2020:77).

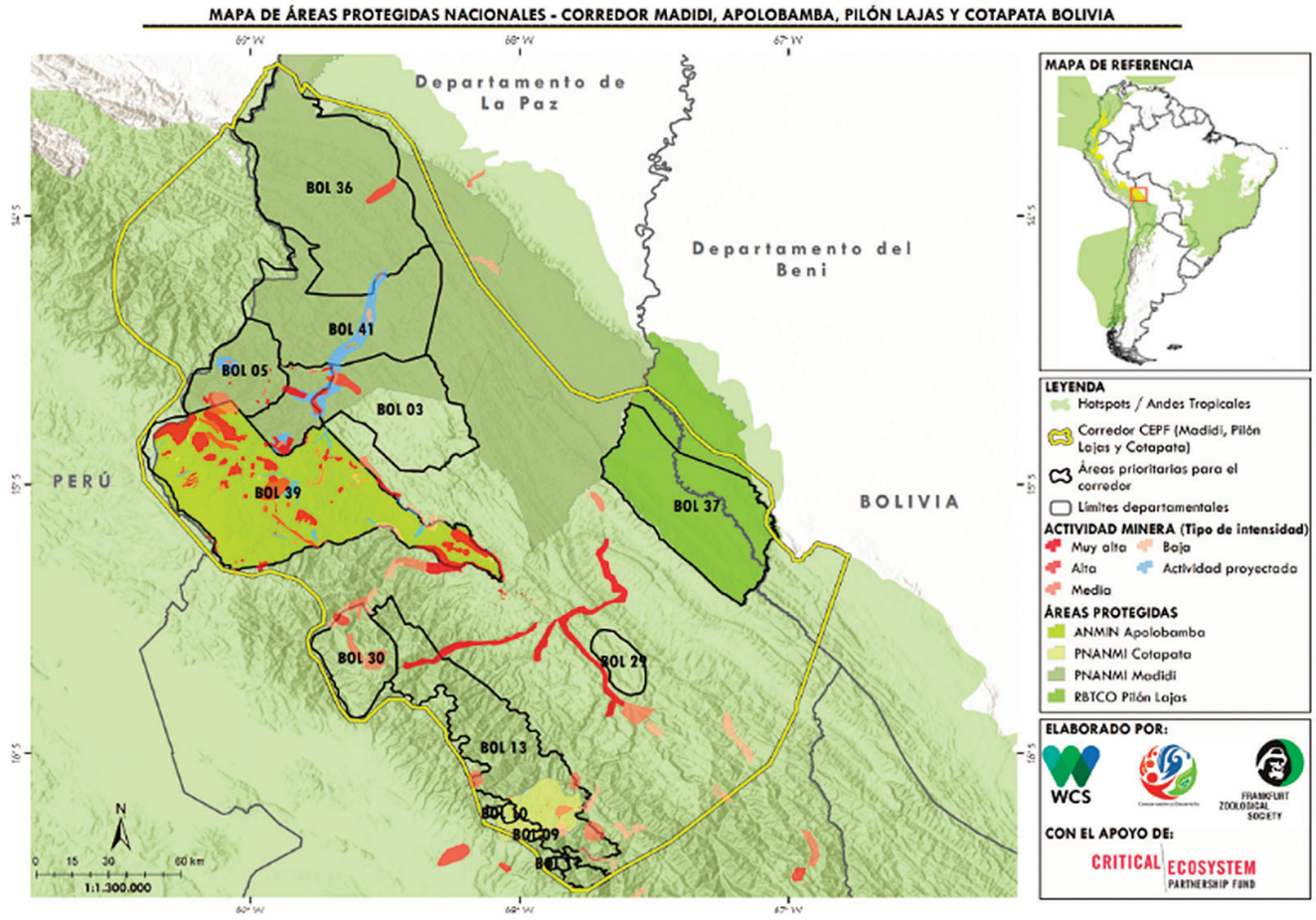


Figure 15. Illegal mining within protected areas of the Madidi, Apolobamba, Pilón Lajas, and Cotapata conservation corridor. Source: taken from WCS, FZS, and FCDS, 2020.

in the Amazon biome. In particular, illegal gold mining affects 16 indigenous lands, impacting some 23 ethnic groups and nearly 94,000 people (MapBiomas, 2024).

Over the last 20 years, illegal mining has grown exponentially in Brazil, expanding from 86,000 hectares in 2002 to 263,000 in 2022. This expansion has surpassed industrial mining, which dominated the sector at the beginning of the century and is now outpaced by artisanal *garimpos* by at least 80,000 hectares. Between 2018 and 2022, policies promoting gold exploration led to a 265% increase in illegal mining on indigenous lands, violating the rights of indigenous peoples and causing serious environmental damage. In the last two years (2023 and 2024), illegal mining destroyed 4,219 hectares in key indigenous territories such as Kayapó, Munduruku, and Yanomami, which together account for more than 90% of illegal mining within indigenous lands in the Brazilian Amazon.

Starting in 2023, the Brazilian government began implementing neutralization, security, and monitoring operations in an effort to reduce mining activity. These actions have been institutionalized with the creation of the Neutralization

(Desintrusão) Committee by Decree No. 11,702 of 2023 (Brazil, 2023), and have resulted in effective operations in several protected areas, including the Alto Rio Guamá, Apyterewa, Trincheira Bacajá, Karipuna, and Munduruku Indigenous Lands, with ongoing operations in the Yanomami Indigenous Land. However, monitoring data from Greenpeace Brazil[15] reveals a worrying trend: although illegal mining has decreased in territories such as Yanomami (-7%), Munduruku (-57%), and Kayapó (-31%), the activity has not disappeared, but has shifted to other areas, such as the Sararé Indigenous Territory, where it increased by 93% in the same period. This shift suggests that the fight against illegal mining is an ongoing challenge that requires continuous vigilance and strategy.

The impact of *garimpo* in protected areas goes beyond the physical destruction of the forest. Mercury contamination, a byproduct of illegal gold mining, represents one of the most serious violations of the fundamental rights of indigenous peoples, irreversibly affecting their health. The federal government is combating this problem through Indigenous Land Neutralization and Recovery Plans, focused on restoring the environment and protecting affected communities.

Protected areas in the Colombian Amazon

Illegal mining in Colombia has also penetrated legally protected areas, including national parks, forest reserves, and indigenous reserves with dual conservation status. In the Amazon region, there are various forms of protection, including eight national parks, two nature reserves, and a flora sanctuary.

Although official information is patchy, various studies and reports by RAISG (2020) and the SINCHI Institute confirm direct impacts on at least seven protected areas in the Amazon. One of the most visible cases is that of the Río Puré National Natural Park, located in the department of Amazonas. This park –which has restricted access due to its ecological and cultural value, as it coincides with the territory of indigenous peoples in isolation– has experienced illegal mining activities along its Puré and Cotuhé rivers. In 2024, five dredgers were detected operating within the boundaries of the park and the Cotuhé–Putumayo indigenous reserve, posing a direct threat to these ecosystems and to the territorial autonomy of indigenous peoples living in isolation (MAAP, 2025).

Another highly affected area in Colombia is La Paya National Natural Park (Putumayo), where the use of heavy machinery and chemicals has been documented in critical riverside areas. According to MapBiomas Amazonía (2023), active deforestation hotspots have been identified on the northern edge of the park, linked to informal alluvial mining. Serranía de Chiribiquete National Park, declared a World Heritage Site by UNESCO in 2018, also faces indirect pressures from the expansion of illicit mining corridors in its buffer zones, which fragments highly sensitive ecosystems such as rainforests and interfluvial savannas.

Protected areas in the Venezuelan Amazon

In Venezuela, the state policy that characterized the years of democracy favored the vision of the Amazon and Venezuelan Guayana as a region for biodiversity conservation and protection of ancestral culture. That is why eight national parks, 19 natural monuments, and two biosphere reserves were established in the states of Amazonas,

[15] https://storage.googleapis.com/gpbr-public/toxic-gold/Greenpeace_Relato%CC%81rio_Ouro_To%CC%81xico.pdf

Bolívar, and Delta Amacuro (SOSOrinoco, 2023), occupying approximately 44% of the surface area of the three states.

Venezuelan law prohibits mining of any kind within protected areas, which are areas under special administration dedicated to conservation: national parks, natural monuments, reserves, wildlife refuges and sanctuaries, as well as biosphere reserves. However, we have quantified the deforestation of more than 2,500 ha of forest due to illegal mining activity within protected areas, with the Yapacana, Canaima, and Caura national parks suffering the greatest loss of forest cover, with 1,440, 471, and 457 hectares lost, respectively (SOS Orinoco, 2025). The mining footprint in each of these parks is large. For example, Yapacana National Park covers 3,258 hectares, according to our latest update. However, only 1,440 hectares are directly related to forest loss, while the rest affects other highly significant natural cover such as savannas and grasslands. Yapacana has a high level of endemic grasses, which are the main component of the park's savanna ecosystems.

Over the last 25 years, there has been a sharp deterioration in institutional capacities in Venezuela associated with the management of these protected areas, mainly due to a lack of investment and the deprofessionalization and politicization of the National Parks Institute. This has led to the virtual disappearance of administrative measures, including surveillance and monitoring of the areas. Furthermore, the negligence and/or association of the regime and its Armed Forces with extralegal armed groups in the implementation of their extractivist policies has favored the entry and ongoing presence of mining activities within the protected areas of the southern Orinoco (SOSOrinoco, 2021, 2022, 2023). As a result, the areas with the greatest diversity and forest cover in the country have been jeopardized, including Venezuela's only World Natural Heritage Site (Canaima National Park) (SOS Orinoco, 2025). In general, it is estimated that these activities contribute to the potential release of 1,000,000 tons of CO_2 into the atmosphere, according to conservative estimates by the Mining Impact Calculator.

Illegal mining infrastructure

Illegal mining in the Amazon has evolved into increasingly sophisticated and destructive forms, establishing itself as one of the main threats to Amazonian ecosystems and indigenous communities. In Brazil, this activity has gone from being rudimentary to operations using heavy machinery, advanced logistical infrastructure, and satellite technology, which has allowed for rapid expansion into indigenous territories and conservation units. In Colombia, alluvial mining has been linked to criminal networks and highly mobile floating structures, penetrating remote areas through clandestine airstrips and makeshift camps, even within national parks. EIn Venezuela, illegal and para-state mining has transformed vast areas of the Amazon, not only through direct extraction, but also through associated infrastructur e–roads, processing plants, airstrips– that amplifies the loss of vegetation cover. These patterns reveal a regional trend toward the technification, territorialization, and operational resilience of illegal mining, with cumulative impacts on biodiversity, environmental governance, and climate stability in the Amazon basin.

Mining infrastructure in Brazil

Illegal mining in the Amazon has evolved from a rudimentary practice into an increasingly advanced infrastructure, which has intensified its destructive impact. In recent years, heavy machinery and sophisticated logistics have been incorporated, allowing for an unprecedented level of environmental damage. Studies show that a hydraulic excavator operating in the Amazon can do in 24 hours the same work that three men would do in 40 days (Greenpeace, 2023). The potential for destruction is therefore unprecedented, as these large machines continue to operate irregularly on indigenous lands and in conservation units, causing the area destroyed by illegal mining in the Amazon basin to increase significantly over the last decade. In recent years, policies benefiting miners have resulted in the emergence of specialized and highly professional structures with significant financial resources, heavy machinery, and advanced logistical infrastructure.

In 2023 and 2024, the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) seized and destroyed approximately R$ 1.1 billion in assets and infrastructure used in illegal mining activities in the Amazon region of Brazil. The operations included the seizure of a wide range of equipment, reflecting the industrial structure of illegal *garimpo*. Among the confiscated materials were heavy machinery such as tractors, backhoes, and dredgers used to remove large volumes of earth and sediment, as well as rafts and floating platforms adapted for gold extraction directly from riverbeds. Aircraft –including light planes and helicopters– used for the clandestine transport of personnel, supplies, and gold were also intercepted. Complementary equipment included hydraulic motors, generators, speedboats, motorcycles, pickup trucks, and makeshift camps designed to support operations in remote areas. A highlight of these operations was the seizure of more than 30 Starlink satellite system kits, used to ensure remote communication and real-time logistics, demonstrating the use of advanced technologies in these illegal networks (Basso, 2023).

Mining infrastructure in Colombia

Illegal mining in the Colombian Amazon operates in remote areas that require covert logistical infrastructure, oftentimes controlled by armed actors. In departments such as Guainía, Vaupés, and Amazonas, there have been reports of clandestine airstrips hidden in forest clearings for transporting supplies and machinery, illegal roads opened without licenses in protected areas to facilitate access to dredgers and fuel, and makeshift mining camps within indigenous reserves or national parks such as Río Puré and La Paya..

Illegal mining in the Colombian Amazon is mainly carried out using alluvial mining rafts. Some of these, known as "dragons," are large vessels, typically measuring approximately 25 by 10 meters and two stories high. They are well equipped , and even feature technology such as Starlink internet. Small, highly mobile tugboats can penetrate primary forests located on riverbanks. As rafts, dredgers, and dragons set up to dredge riverbanks in search of gold, they are supported by rapid transport boats and other vessels that bring them supplies and, in turn, transport the extracted minerals. When gold is found, mining rafts often invade a river en masse, numbering in the dozens. These large-scale invasions generate additional infrastructure, such as floating stores, brothels, and other types of constructions on dry land at strategic points, which serve as collection sites. According to the UNODC Organized Crime Observatory (2021), illegal mining in Colombia is associated with drug trafficking networks, which amplifies its territorial reach and capacity to reestablish itself after state operations.

Mining infrastructure in Venezuela

In Venezuela, mining activity, both legal and illegal, brings with it the transformation of land cover beyond the impact on the area where raw extraction takes place. It requires roads, airstrips, processing plants, housing development, and crop areas. To date, 45 clandestine airstrips have been detected in the states of Bolívar and Amazonas, as well as 22 gold processing plants using cyanide, in addition to countless gold mills that use mercury. However, the impact in relation to the area affected by this type of infrastructure has not yet been quantified, which means that an analysis still needs to be carried out to estimate the loss of forest due to this mining-related infrastructure (SOSOrinoco, 2022).

Impacts on local communities and indigenous peoples

The expansion of illegal mining in the Amazon has had profound, multidimensional impacts on local communities and indigenous peoples living in the region. In the different Amazonian countries, mining activity has altered ecological and social systems, affecting food sovereignty, health, community cohesion, and the fundamental rights of indigenous peoples. In Bolivia, alluvial mining has shifted hydrological cycles and the availability of food resources, while weakening indigenous organizational structures. In Brazil, mercury contamination and invasions into indigenous territories have put the health and cultural integrity of communities such as the Yanomami at risk, prompting interministerial responses and environmental monitoring protocols. In Colombia, illegal mining is associated with the contamination of water sources, pressure from armed groups, and the silent displacement of indigenous communities, while in Peru, the risks faced by environmental defenders, forced displacement, and gender-based violence highlight the severity of the crisis. These patterns all converge in a regional trend where illegal mining not only undermines Amazonian ecosystems, but also threatens the physical, cultural, and spiritual survival of the people who depend on them, deepening social and environmental vulnerability in the basin.

Local communities and indigenous peoples in Bolivia

In Bolivia, CEJIS (2022) identified alluvial mining's different impacts on the Tacana, Ese Ejja, and Cavineño indigenous peoples of the TIM II indigenous territory. These include dredging rafts, which increases suspended solids in the river, reducing light availability and affecting the growth of aquatic plants that feed fish, a fundamental part of their diets. There is also increased fat and oil in the water, as well as more landslides and collapsed ravines and hillsides, resulting in the loss of fertile soil. Engine noises, meanwhile, scare away game animals, disrupting the diet of riverside communities. Additionally, this activity weakens community organizations (CEJIS, 2022).

Local communities and indigenous peoples in Brazil

Illegal mining in Brazil is poisoning the territories of local and indigenous communities, threatening their rights and the health of their inhabitants (Greenpeace, 2025). According to the Ministry of the Environment, the most affected regions in the state of Roraima are Auaris, Couto Magalhães, Ericó, Homoxi, and Parima, among others, all of which are located upstream from important conservation areas managed by the Chico Mendes Institute for Biodiversity Conservation (ICMBio). In the state of Amazonas, the situation is equally dire, especially in the Pico da Neblina National Park, where illegal mining has created a complex logistics network with connections to the Venezuelan border, which seriously affects densely populated communities such as Maturacá. This organized crime network directly impacts the Yanomami communities living downstream along the Ariabu, Cauabixis, and Massiripuei rivers.

The Brazilian government has created an interministerial response to tackle this problem. In 2023, the Ministry of the Environment, together

with the Ministry of Indigenous Peoples, the Ministry of Health, and the Ministry of Science, Technology, and Innovation, launched the project "Network for Monitoring Environmental Pollution in the Yanomami and Upper Amazon Indigenous Territory." The National Indigenous Peoples Foundation (FUNAI) and the Secretariat of Indigenous Health (SESAI) are working in partnership on this project. With ICMBio joining at the end of 2023 and funding from extraordinary resources, the pollution assessment protocol was expanded to include the analysis of fish tissue, which is a vital food source for the Yanomami. The Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) has also committed to collecting fish samples during its auditing activities.

SESAI is at the forefront of efforts to combat mercury contamination. It works on several fronts in collaboration with the Department of Primary Health Care for Indigenous Peoples and the Department of Projects and Environmental Determinants of Indigenous Health. To comply with the Sectoral Plan for Implementation of the Minamata Convention and Federal Public Ministry (MPF) and Inter-American Commission on Human Rights (IACHR) recommendations, SESAI is developing a series of initiatives in coordination with government agencies, state and municipal health secretariats, and specialized teaching and research institutions. One of the key initiatives is the partnership with the Joaquim Venâncio Polytechnic School/Fiocruz, which trains professionals from the Multidisciplinary Teams for Indigenous Health to identify the symptoms of mercury contamination, report cases, and ensure that those affected receive specialized care (Greenpeace, 2025).

Local communities and indigenous peoples in Colombia

In Colombia, illegal mining has multidimensional impacts on Amazonian indigenous communities. In areas such as Cotuhé-Putumayo, Yaigoje Apaporis, and Puerto Inírida, indigenous peoples report contamination of water sources and fish stocks, which are the basis of their food sovereignty; threats and armed pressure from illegal actors occupying their territories; the criminalization of land defenders who report mining activities within collective reserves; and the loss of traditional livelihoods (fishing, hunting, agriculture) due to alterations in water and forest cycles. The Vaupés Regional Indigenous Council (CRIVA) and OPIAC have warned that these impacts are not only environmental, but also cultural, spiritual, and generational. Many communities face a silent displacement, without any official recognition.

The recent increase in illegal mining on the Puré River is particularly serious due to its proximity to the isolated Yurí and Passé communities. According to satellite monitoring and flyover estimates, since 2020, rafts and dredgers have moved from 100 km away to just 10 km from these communities' territory. The presence of the Yuri and Passé peoples, who live in the Río Puré National Natural Park, was one of the principal reasons for declaring this area a protected zone in 2002. The presence of mining rafts reduces the supply of animals for these peoples due to noise pollution from the engines and contamination of water sources and the fish the communities consume. In addition to these threats, there is the possibility of contact with unpredictable consequences and the spread of diseases carried by miners, against which the indigenous people may have no defense. For centuries, indigenous peoples in isolation have chosen

to avoid contact with mainstream society as a way of protecting themselves from the violence and impacts inherited from colonialism.

The Jaguars of Yuruparí Macroterritory covers approximately 8 million hectares in the eastern Colombian Amazon, which represents 16.5% of the country's Amazon region. It includes the Amazon hydrographic basin, extending beyond the border with Brazil, and connects important basins such as the Caquetá-Japurá and the Río Negro-Vaupés. Four Indigenous Territorial Entities (ETIs) make up the Macroterritory: Pirá Paraná, Yaigojé Apaporis, Miritíi Paraná, and Río Tiquié.

In 2019, the Indigenous Governments of the Jaguars of Yuruparí Macroterritory filed a writ of injunction to defend their fundamental rights to physical and cultural survival, health, sovereignty, identity, territory, self-determination, life, and food security, as well as access to water, a healthy environment, and cultural integrity, due to threats from gold mining and mercury contamination.

The Constitutional Court, in Ruling T-106 of 2025, ruled on this case and warned that the identity and survival of the knowledge system of the indigenous peoples in the Macroterritory were at risk, as were their rights to health (both individual and collective) and to food security and sovereignty, due to widespread territorial contamination and a lack of coordination between non-indigenous state institutions and indigenous governments. Furthermore, the Court noted that this risk and the violation of fundamental rights have been exacerbated by the lack of formalization of ETIs. Aside from orders about how the ETIs should be formalized and operated, the Court ordered the Chancellor's Office and the Ministry of Environment and Sustainable Development to implement the cooperation bodies and mechanisms set out in the Minamata Convention on Mercury. It also ordered the Ministry of Environment and Sustainable Development to carry out an assessment of environmental impacts and impacts related to "...climate change from mining exploration and exploitation activities derived from current concessions within the macroterritory" (Constitutional Court of Colombia, 2025).

Local communities and indigenous peoples in Peru

According to the the Peruvian Ministry of Justice and Human Rights' registry of human rights defenders at risk (SIRIDEDH), of the 84 cases of risk as a result of illegal mining nationwide, 77 relate to regions in the Amazon: Madre de Dios (32), Loreto (18), Amazonas (17), Huánuco (5), Cusco (3), San Martín (1), and Ucayali (1). Of all the cases of risk associated with this illegal activity, the leading type of risk is threats to personal and/or family safety (70). This is followed by physical, sexual, or psychological assaults (18), stalking and surveillance (9), harassment and hostility (6), attacks on honor, image, and/or reputation (4), destruction of property and/or livelihoods (4), homicide (3), kidnapping or forced disappearance (3), and others (3) (MINJUS, n.d.).

One of the effects that the Amazonian indigenous population in Peru faces as a result of illegal mining is forced displacement. According to information provided by the PCM, on January 19, 2025, the Peruvian Army rescued 53 members of the Awajún Kumpanam community in the Amazonas region who had been displaced by illegal mining in the area; 13 of the community members were minors (CooperAcción, 2025).

Moreover, in Peru, "women are affected differently than men by gold mining and related activities" (SPDA, 2024). According to records from the Ministry of Justice and Human Rights (MINJUSDH) and the National Human Rights Coordinator, attacks

or threats against women environmental defenders in the Amazon region stem from illegal activities, including illegal mining. Likewise, according to the CNDDHH Registry, 44 of the 49 attacks recorded were related to this activity, accounting for 89.8% of cases (OXFAM, 2024: 39-40).

Local communities and indigenous peoples in Venezuela

Illegal mining's effects on local communities and indigenous peoples in Venezuela cause enormous socio-environmental damage and human rights violations. Among the indigenous peoples most affected by illegal mining are the Pemón, Akawayo, Kari'ña, Ye'kwana, Sanema, E'ñepá, Uwottüja, Jivi, Mako, Yavarana, Yanomami, Curripaco, Baré, Baniva, and Piapoco, as well as local Creole and Afro-descendant communities in the states of Bolívar and Amazonas.

In 2019, the United Nations Human Rights Council expressed concern about "the violation of various individual and collective rights of indigenous peoples, particularly in the Orinoco Mining Arc region, using methods that include excessive use of force, extrajudicial executions, ill-treatment, forced displacement, and violations of their rights to maintain their customs, traditional ways of life, and spiritual relationship with their land" (United Nations, 2019).

In 2022, the Council expressed its "deep concern about the human rights and environmental situation in the Orinoco Mining Arc region, where miners are exploited, child labor and human trafficking are prevalent, and expressed particular concern about violations and infringements of the rights of indigenous peoples in the region" (United Nations, 2022).

The Office of the United Nations High Commissioner for Human Rights reported on "allegations of sexual violence against indigenous women and girls, particularly in mining areas" in the context of illegal mining activity (United Nations, 2023) involving various non-state actors (armed and criminal organizations, drug traffickers, and illegal miners), including the trafficking of indigenous women and girls for sexual exploitation. Likewise, these groups have been reported to have threatened and intimidated communities, leaders, and defenders of indigenous rights, resulting in the forced displacement of two defenders (United Nations, 2023). It was in this context that Virgilio Trujillo, an indigenous rights activist and coordinator of the Uwottüja indigenous territorial guardians in Puerto Ayacucho, capital of Amazonas state, was murdered on June 30, 2022. This incident and others like it remain in impunity.

The Independent International Fact-Finding Mission on Venezuela has documented the existence of criminal groups in the mining area of Bolívar state and the struggles for control of mining territories, including those within indigenous territories, between non-state armed groups and the Venezuelan military forces (United Nations, 2022). The State's response to regain control of the territory has been militarization. The Mission determined that there is evidence of extrajudicial executions, forced disappearances, arbitrary detentions, torture, and other forms of cruel, inhuman, or degrading treatment, as well as sexual and gender-based violence in the Mining Arc region. The state has systematically failed to fulfill its obligation to investigate these cases impartially and independently, including some cases in which the Venezuelan Armed Forces may have been involved (United Nations, 2022).

Mining has also had a significant impact on indigenous territories, resulting in water and soil contamination, deforestation, and loss of fauna and flora. It has also brought about changes in indigenous community life, as some members have decided to join the mining industry or have been forced to do so for economic reasons (United Nations, 2022).

Photo: Diego Pérez/ SPDA

The impacts of mercury associated with mining

Mercury contamination from gold mining represents one of the most serious and persistent threats to environmental and human health in the Amazon. Case studies in Bolivia, Brazil, Colombia, Peru, and Venezuela show an alarming trend of mercury release and accumulation in aquatic and terrestrial ecosystems, with effects that transcend mining areas and affect riverside, indigenous, and urban communities. Mercury, released into water, soil, and the atmosphere, is transformed into methylmercury and biomagnifies throughout food chains, compromising food security, public health, and biodiversity. Research shows contamination levels that far exceed international limits in fish, plants, wildlife, and humans, with long-term neurological, reproductive, and social consequences. Furthermore, the persistent use of mercury, the lack of effective regulation, and institutional weakness exacerbate the crisis, hindering mitigation and perpetuating an extractivist model that erodes the ecological and social resilience of the Amazon basin.

The impact of mercury use in Bolivia

In Bolivia, mercury contamination of fish, and therefore of humans, extends beyond the aforementioned river basins and affects large cities and population centers that are not necessarily located near rivers. It has been estimated that between 1952 and 2000, more than 330 tons of mercury were released into the environment in Bolivia, either directly into rivers or indirectly through the open-air burning of amalgam. It is concerning that since 2015, Bolivia has become the world's leading legal importer of mercury, importing an average of 180 tons per year. Under the Minamata Convention, the Bolivian government conducted a baseline study and a National Inventory of Mercury Emission Sources as initial efforts to assess the mercury situation in Bolivia (Campanini, 2020). The inventory shows that gold mining using mercury is responsible for 82.3% of national mercury emissions in Bolivia, or the equivalent of 37,579.2 kg Hg/year (it is estimated that 10,146.39 kg are released into the atmosphere, 19,120.29 kg into water, and 12,806.99 kg into soil) (Campanini, 2020).

Apart from the direct or indirect release of mercury from mining activities, the major concerns in Bolivia are deforestation, the resulting erosion, and the release of millions of tons of sediment and soil contaminated with Hg in the areas being exploited (Maurice-Bourgoin, 2002: 162). The total concentration of mercury in sediments varies from 8 ng l^{-1} during the dry season to 1600 ng l^{-1} during the rainy season. The Beni River has numerous tributaries, half of which have been used for gold mining since the 1960s, including the Kaka, Tipuani, and Mapiri rivers (Paz *et al.*, n.d.). Along the Beni River, an estimated 4.5 tons/year of mercury associated with clay are deposited in the floodplain as it flows out of the Andes. Up to 47% of that amount (2.1 tons) may re-enter the river through erosion (Miller & Villarroel, 2011: 423).

Bodies of water that originate in the Bolivian Andes and feed the Amazon face increased mercury concentrations, from 126 kg km-2 d^{-1} in a river without mining activity to between 590 and 2900 kg km-2 d^{-1} in rivers with recent human activity (Maurice-Bourgoin *et al.*, 2003).

The presence of mercury in Bolivian ecosystems has a direct impact on biodiversity. Although there may be low transfer of Hg from soil to plants in some cases, plants near gold mining operations have >0.1 mg Hg kg^{-1} and contribute to the accumulation of Hg in the food chain. Camelids depend entirely on these high Hg content plants for forage, and their meat is an important source of protein for communities and miners in the upper part of the basin. The health risk of Hg may increase if miners ingest plant species for medicinal purposes (e.g., *Alchemilla pinnata*). The high Hg content in Poaceae and Rosaceae may increase Hg accumulation in the food chain because llamas and alpacas can only thrive off these plants as food. All plant samples exceeded the European Union's limit of 0.1 mg kg^{-1} plant for desirable animal feed (Directive 2002/32/EC, 2002; Terán-Mita *et al*., 2013).

As mentioned above, organic forms of mercury, primarily methylmercury, pose the greatest socio-ecological risks. Regardless of its source, once mercury is released into rivers, anaerobic bacteria can convert it into methylmercury (MeHg) under certain environmental conditions. Methylmercury then penetrates aquatic organisms and ultimately accumulates to a maximum concentration at the top of the food chain (Benefice *et al*., 2010). Regardless of their location or trophic source, all food chains studied in Bolivia showed biomagnification of methylmercury with no significant differences at the same trophic level (Molina *et al*., 2010). This confirms recent findings on the rapid spread of methylmercury in aquatic systems. The differences between hydrological seasons are more pronounced due to the entry of mercury during floods. Recent studies in the basin analyzed in the report show very high levels of mercury in the muscles of five of the eight species of fish that are native to the area and widely consumed by the local population (Peñates-Hernández *et al*., 2023).

The impact of mercury use in Brazil

In Brazil, studies have shown that various indigenous communities have been exposed to this chemical, with contamination levels far exceeding safe limits. A 2024 study by the Oswaldo Cruz Foundation (Fiocruz) revealed that 84% of the population in nine Yanomami villages suffered from mercury contamination. Previous research also showed that six out of ten Munduruku indigenous people had mercury levels above the limits set by the World Health Organization (WHO) (Greenpeace, 2025). Contamination is not limited to communities: a 2023 study found that in markets in 17 Amazonian cities, one in five fish contained mercury concentrations above safe limits set by the WHO.

The fauna and flora of the Brazilian Amazon also suffer the consequences. Aquatic species, such as fish and amphibians, are the most severely impacted. Mercury can alter habitats and breeding grounds. In certain poisonous frogs, a link has been observed between mercury levels in the water and the development of their tadpoles. The chemical accumulates in fish, increasing in concentration as it moves up the food chain (Greenpeace, 2025). Birds that live near mining areas and feed on fish and insects have up to six times higher levels of contamination. Mammals such as jaguars and monkeys are also affected.

In addition to poisoning, illegal mining has a profound social impact in Brazil. Mining activities significantly reduce the availability of hunting and fishing areas, which are essential for these communities' subsistence. Illegal miners' presence often leads to the social breakdown of indigenous peoples and traditional communities. By offering alcohol, money, and boats in exchange for permission to mine, illegal mining has led to instances of forced labor, sexual exploitation (often

of minors), and increased conflict. Miners can also introduce infectious diseases into villages, posing a considerable risk to isolated peoples and increasing rates of illness and death.

The impact of mercury use in Colombia

The systematic use of mercury in illegal mining in the Colombian Amazon not only causes environmental pollution, but also amplifies the climate crisis and reduces the local communities' ability to adapt. In regions such as Puré, Apaporis, and Guainía, riverside communities face chronic mercury accumulation in fish and sediments. This heavy metal affects not only human health but also food security by reducing the availability of healthy fish, an essential nutritional staple for indigenous peoples. It also reduces water security by contaminating surface and groundwater sources for decades, as well as the capacity for ecosystem regeneration, as mercury alters microbiological processes in soil and water that are essential for the natural recovery of the forest.

Studies by Gaia Amazonas (2023) in Colombia show that water bodies contaminated with mercury have lower species diversity, affecting ecological balance and limiting ecosystem response to extreme events (droughts, fires). In climate terms, this loss of biodiversity and ecosystem services likely reduces the territory's capacity to store carbon and mitigate climate impacts. As communities lose their livelihoods and cultural systems linked to the forest, their collective ability to adapt is reduced.

The impact of mercury use in Peru

In Peru, according to Conservation and Sustainable Development – Peru (FCDS-Peru, 2024), 22 Amazonian rivers are contaminated with mercury. Of these, 66.66% are linked to illegal alluvial mining. These rivers are "the Marañón, Huallaga, Santiago, Nanay, Napo, Mazán, Curaray, Putumayo, Tapiche, Yaguas, Cenepa, Pachitea, Pozuzo, Yuyapichis, Inambari, Madre de Dios, Malinowski, Punkiri, Pariamanu, Palma Real Grande, and other minor tributaries of the Madre de Dios basin" (FCDS-Peru, 2024:16).

According to ACCA, by 2024, Peru's Loreto region had the highest number of rivers affected by illegal mining dredgers, with 12 basins affected, most notably the Nanay River basin. From 2021 to 2024, 310 dredgers were recorded in this area alone (Novoa *et al.*, 2024: 14-17). According to an Amazonian Scientific Innovation Center (CINCIA) study of six indigenous communities in Loreto, in the Nanay and Pintuyacu river basins, 79% (215 people) of the 273 people tested had mercury levels above the maximum limits established by the WHO, 37% (101 people) had high-risk levels, and 10% (10 people) had levels below the WHO limits. 79% (215 people) had mercury levels above the maximum limits established by the WHO, 37% (101 people) had high-risk levels, 42% had medium-risk levels, and only 21% of people had acceptable levels (Mongabay, 2025).

The impact of mercury use in Venezuela

Over the last ten years, mining activity in the Venezuelan Amazon has mainly been carried out by small-scale miners (as defined by the Mining Law), who have wrongly been classified as artisanal miners, given that they use technical equipment such as hydraulic monitors ("suckers"), motor pumps, power plants, and hoses, all of which require huge amounts of capital. In the case of dredges and mining rafts, it can

Figure 16. Use of mercury in illegal mining. Source: SOSOrinoco, 2021.

be considered medium-scale mining. All of this mining has generated a multidimensional socio-ecological crisis, in which the intensive use of mercury (Hg) catalyzes environmental, health, and climate vulnerability. The most affected areas have been the Caroní, Caura, Aro, Cuyuní, and Ventuari river basins. Despite the official ban on the use of mercury in mining activities established by presidential decrees issued in 1991, 1992, and 2016, mercury continues to be used in an uncontrolled manner. It is estimated that for every kilogram of gold extracted, 2.6 kg of mercury is used, a significant fraction of which is released into the environment, affecting both the mining areas and downstream regions. This contaminates biota, water, sediments, and fish consumers in these rivers, as well as the miners themselves.

A study by SOS Orinoco (2021) in Venezuela confirmed the presence of mercury in sediments, water, fish, and human samples, including in communities far from mining sites. Although concentrations in sediments and fish generally do not exceed international limits, worrying levels were detected in hair samples from Pemón indigenous children and women, surpassing WHO thresholds. This suggests indirect exposure through contaminated water and food, especially fish, which facilitates the bioaccumulation of methylmercury. This contamination compromises water and food security, as drinking water sources have Hg levels above the permissible limits and the diet depends largely on fish species with high mercury concentrations. This increases the risk of chronic poisoning, affecting neurological development and reproductive health. Ecologically, mercury reduces aquatic biodiversity, disrupts the reproduction of key species, and weakens ecosystem services such as carbon sequestration. Mining-related deforestation exacerbates these impacts, and the movement of mercury along rivers such as the Orinoco spreads its effects to distant regions. Socially, mercury exposure erodes community resilience by causing disease, disrupting cultural practices, and increasing dependence on extractive economies. The lack of oversight or effective regulation and the presence of armed actors hinder mitigation strategies. Venezuela's failure to ratify the Minamata Convention and the absence of coherent public policies perpetuate an extractivist model that sacrifices the communities' well-being and the integrity of the biome.

Socioeconomic Factors as Underlying Causes of Illegal Mining

Poverty and unemployment

Poverty and unemployment rates are a structural factor that runs through and shapes the expansion of illegal mining throughout the Amazon, creating a cycle of vulnerability and environmental degradation that affects countries in the region. In Brazil, gold mining has historically emerged as a means of subsistence for large swathes of the population excluded from formal development, especially in urban and rural areas marked by precarious living conditions and a lack of access to basic services. Rising international gold prices and persistent inequality have encouraged migration to mining areas, fueling criminal networks and increasing rates of violence. This phenomenon is self-perpetuating, as environmental degradation and the destruction of traditional livelihoods push more people toward mining as their only economic option. In Venezuela, the humanitarian emergency and socioeconomic collapse have exacerbated dependence on illegal mining, particularly in the Amazon, where extreme poverty and lack of job opportunities have driven massive internal displacement and the proliferation of illicit economies. Thus, illegal mining is not only a consequence of poverty, but also perpetuates it, deepening social exclusion and environmental degradation throughout the Amazon basin. Below are two illustrative cases of this phenomenon.

The Case of Brazil

Gold mining in Brazil cannot be understood without examining the deep relationship between poverty, unemployment, and the vicious cycle that feeds back into mining itself. Although most of the population of the Legal Amazon lives in cities, the region accounts for 36.2% of Brazil's population living in poverty, and access to basic services like sanitation is extremely limited. This precarious context, coupled with the rise in the price of gold on the international market, creates a breeding ground for illegal mining to expand, attracting those with few income opportunities into criminal networks. Increased illegal activity has also led to rising violence in the region.[16]

The history of mining in Brazil demonstrates this connection. Starting in the 1980s, artisanal gold mining became the main source of mercury contamination in the country (Lacerda & Pfeiffer, 1992; Lacerda, 1997; Lodenius & Malm, 1998). This change was largely due to the dramatic increase in the international price of gold, which sparked a "gold rush" in the Amazon, turning the northern region into the main source of contamination (Feijão & Pinto, 1992). This fever, which began in the 18th century but intensified in the 1970s with the discovery of mines in Serra Pelada (Cleary, D., 1990; Ferreira & Appel, 1991; Veiga *et al.*, 2002), led to an estimated 1 million miners working in the region by 1989 (Feijão & Pinto, 1992).

The vicious cycle of poverty and mining is evident. As illegal mining proliferates, it damages

[16] https://imazon.org.br/wp-content/uploads/2025/05/FatosAMZ2025.pdf

the environment, pollutes rivers, and destroys traditional livelihoods based on agriculture, fishing, and hunting, which pushes more people to depend on mining (Veiga *et al.*, 2002; Greenpeace, 2025). Corruption and institutional and regulatory fragility exacerbate the problem, allowing such criminal activities to operate with impunity.

The Case of Venezuela

The case of Venezuela speaks volumes about the relationship between illegal mining and the socioeconomic situation of a society. More than 20 million Venezuelans (70% of the population) live in multidimensional poverty, lacking adequate access to essential goods and services, including food and medicine; more than 5 million people face hunger and nearly 8 million have emigrated to other countries (HumVenezuela, 2023, HRW, 2024). This humanitarian emergency is even more serious in the Venezuelan Amazon. In Amazonas state, 99% of the population lives below the poverty line and 87% live in extreme poverty, the highest levels nationwide. Amazonas and Delta Amacuro have the lowest employment rates in the country and are the states with the highest percentage of households living in inadequate housing and lacking public services (UCAB, 2021). There, indigenous peoples suffer disproportionately from the effects of "malnutrition and extreme poverty, as well as exposure to disease and environmental degradation, partly due to extractive activities carried out in their territories" (OHCHR, 2024). Illegal mining activities and violence by armed and criminal groups have also caused the forced displacement of many indigenous communities (HRW, 2024). Mining, mostly illegal mining, is the main economic activity and source of employment in the area. The creation of the Orinoco Mining Arc prompted massive internal migration to the mining areas in the south of the country, creating a cycle of vulnerability and exploitation of thousands of people seeking a livelihood (OHCHR, 2020), as well as the resurgence of malaria and other diseases that had been controlled or eradicated. In addition to legitimate commercial activity, which provides goods and services, there are other illicit activities such as smuggling, drug and arms trafficking, human trafficking, etc., managed by organized crime groups (SOSOrinoco, 2021).

Corruption and institutional and regulatory weakness

The expansion of illegal mining in the Amazon is closely linked to systemic corruption, institutional weakness, and regulatory failures that are characteristic of states in the region. In all Amazonian countries, the lack of effective oversight, the capture of public institutions, and regulatory permissiveness have facilitated the advance of illicit economies in protected territories and vulnerable communities. EIn Bolivia, the lack of oversight by mining authorities and the direct involvement of officials in illegal activities are evidence of fragile institutions. In Brazil, contradictory policies and legal loopholes have allowed *garimpo* to surpass industrial mining, affecting indigenous lands and conservation areas. Peru faces weakened institutionality due to regressive legislative reforms and high levels of corruption in its Amazonian regions, which have encouraged the expansion of organized crime. In Venezuela, mining has become a state strategy to weather the economic crisis, but under a "Great Corruption" scheme involving high-ranking officials, the military, and illicit networks, entrenching a predatory extractivist model. This section examines how corruption and institutional weakness not only enable illegal mining, but structure and perpetuate it as part of a parallel form of governance in the Amazon.

Institutionality in Bolivia

In Bolivia, the case of the Charopampa community in the municipality of Mapiri in the department of La Paz illustrates how weak regulatory and oversight mechanisms encourage illegal mining. The Ombudsman's Office (2022) concluded that the Jurisdictional Administrative Mining Authority (AJAM) lacks control and oversight, despite the provisions set forth in Law 535 on mining. A case that highlights the authorities' involvement was that of former Deputy Minister of Mining Policy Marcelo Tellería, who was caught red-handed engaging in illegal mining activities in the municipality of Palos Blancos. This sting was not carried out by the Jurisdictional Administrative Mining Authority (AJAM), which has jurisdiction in this area, but by a commission from the Mosetén Indigenous People's Organization (OPIM) and the Autonomous Government of that municipality (Sumando Voces, 2025).

Institutionality in Brazil

Mining in Brazil has proliferated due to institutional weakness and the lack of sustainable solutions for local communities and indigenous peoples. This situation has been exacerbated by past government policies that supported the opening of indigenous lands to mineral exploration, despite the illegality of such activity. The lack of effective law enforcement and the failure to support local populations have allowed illegal practices to expand unchecked.

Brazil's institutional fragility is reflected in the growth of artisanal mining. According to data from MapBiomas (2024), 92% of the mined areas in the country are located in the Amazon biome, affecting 16 indigenous lands and nearly 94,000 people. Over the past 20 years, mining activity has skyrocketed in the country, growing from 86,000 hectares in 2002 to 263,000 in 2022. Surprisingly, artisanal mining, or *garimpo*,

now exceeds industrial mining by at least 80,000 hectares (MapBiomas, 2024). This expansion is particularly notable in the state of Pará, which is leading the statistics for mining activity in the Legal Amazon. The municipalities of Itaituba and Jacareacanga, in the Tapajós River Basin, are mining hotspots, with Itaituba alone accounting for 16% of the mined area in all of Brazil (MapBiomas, 2024).

In Brazil, the lack of institutionality is also reflected in the difficulty of protecting the most vulnerable territories. The Kayapó, Munduruku, and Yanomami Indigenous Lands are the areas most affected by illegal gold mining, underscoring the urgency of prioritizing inspection and protection measures in these areas. In this context, environmental monitoring is crucial to evaluate the extent of mercury contamination. These activities must include measuring the concentration of the chemical in water, soil, sediments, air, and fish to verify compliance with the health and environmental parameters established by Brazilian agencies. The fact that there is a manual for treating indigenous people exposed to mercury[17] highlights the gravity of the situation, which requires a robust and coordinated institutional response to protect communities and their territories.

In Brazil, illegal mining has been incentivized by poor sectoral policies and a regulatory framework that has historically favored illicit activity. Without clear sustainable development policies, legal loopholes and perverse incentives have allowed illegal gold mining to flourish, especially in protected areas (Greenpeace, 2025). However, in 2023, the country took important steps to reverse this trend and control the gold trade, marking a turning point.

In the past, Brazilian law operated under the presumption of good faith on the part of the buyer, which made it practically impossible to trace the source of the metal. The Plenary of the Federal Supreme Court (STF) addressed this problem by ruling that Article 39, paragraph 4, of Law 12.844/2013, which established the presumption of legality of gold based solely on information provided by the seller, was unconstitutional (OCMAL, 2023). Even though the law had already been suspended by a court order since April 2023, this decision had a significant and immediate effect on the market. The STF's ruling not only overturned the presumption of good faith, but also forced the executive branch to adopt regulatory and administrative measures to prevent the mining and procurement of gold from environmentally protected areas and indigenous lands. In addition, it mandated new guidelines to oversee the gold trade, with a focus on verifying the legal origin of metal purchased by securities and asset brokers.[18] This decision, together with the mandatory use of electronic invoices for transactions involving gold bought from *garimpos*, represents a crucial step in dismantling the illegal mining supply chain and closing the loopholes that previously allowed illegal mining to operate with impunity.

Institutionality in Peru

In Peru, Congress "has passed legislation that undermines environmental protections that helped prevent deforestation and pollution by private actors, organized crime groups, and others." (Human Rights Watch, 2025), including amendments to the Forestry Law and the expansion of the Comprehensive Mining Formalization Registry.[19]

[17] The manual can be accessed online through the following link: https://bvsms.saude.gov.br/bvs/publicacoes/manual_atendimento_indigenas_expostos_mercurio.pdf

[18] https://escolhas.org/wp-content/uploads/2024/09/Estudo_Ouro-em-choque.pdf

[19] Law No. 31973, which amends Law No. 29763, the Forestry Law,

In this context, corruption is another problem that undermines institutions, facilitating the expansion of organized crime and encouraging illegal mining (Idem). The Comptroller General of the Republic of Peru has implemented the Corruption and Functional Misconduct Index, which measures corruption on a scale of 0 to 100 points, with the highest score indicating the highest level of corruption. In 2022, the Amazonian regions obtained a medium-high level of corruption: Amazonas scored 49.2 on the INCO; Ucayali, 50.6; Loreto, 59.3; Madre de Dios, 48.1; and San Martín, 52 (CEPLAN, 2024). Furthermore, in an analysis of the challenges and territorial dynamics of the Amazon region with regard to illegal mining, the National Center for Strategic Planning (CEPLAN) identified the lack of employment and the institutional weakness of the State, which has limited capacity for monitoring and control in the territories, as factors contributing to the expansion of illegal mining (FCDS-Peru, 2024: 19-20).

Institutionality in Venezuela

Corruption in Venezuela has reached alarming levels, being labeled "Great Corruption" by Transparency International. In 2023, the country was ranked as the second most corrupt in the world and the most corrupt in the Americas (Deutsche Welle, 2024). The Venezuelan mining sector, particularly in the Orinoco Mining Arc, is characterized by systemic "Great Corruption," profound institutional fragility, and significant regulatory deficiencies (Observatorio Ciudadano de Corrupción, 2021), facilitating a vast illicit economy. The formal legal and institutional framework, namely the Ministry of the Popular Power of Ecological Mining Development and the Mining Law, exists, but its effectiveness is undermined by insufficient political will, militarization, and state complicity (Idem).

In Venezuela, mining is a government strategy to generate alternative income in the face of the oil crisis in the country (Ruíz, 2018). However, the Mining Arc has taken on a "predatory character," with billions of dollars being diverted to political elites and their allies (Cardozo, 2022). Estimates indicate that in 2023 alone, more than $2.17 billion was diverted from gold mining (Transparencia Venezuela, 2025). Corruption occurs through various mechanisms, including bribery and extortion, as well as the "capture of the legislative, regulatory, and judicial systems by high-level officials" (Deutsche Welle, 2024). The militarization of public administration and the control of mining areas by senior military officers, who receive "kilograms of gold as bribes," exacerbates corruption and impunity in the sector (Tablante, 2018; International Crisis Group, 2019).

Institutionality in Colombia

In Colombia, the biome zoning system is based on the mining and energy sector, which has led to large-scale socio-environmental conflicts, given that in some cases, indigenous peoples' rights to participation, autonomy, and territorial rights have been disregarded. This system is significant because the granting of mining concessions in departments such as Guainía and Vaupés has been shown to have brought *garimpeiros* (from Brazil) and miners from the interior of the country

promotes deforestation by eliminating the procedure whereby land is classified according to its maximum use capacity without including a technical alternative to prioritize the best use of the land and protect forests. The law also infringes upon the rights of indigenous peoples as it was passed without a prior consultation procedure. Likewise, the Ministry of Energy and Mines approved Supreme Decree 012-2025-EM, which extends the deadline for completing the mining formalization process through the Comprehensive Mining Formalization Registry until December 31, 2025. The new deadline allows thousands of miners to continue operating without any environmental standards, without environmental management tools, and without any legal consequences for the environmental damage they cause to our environment.

to illegally extract gold and other minerals for more than a decade (FIO, 2024).

In keeping with the above, there are institutions with authority over geoscientific research for prospecting, the granting of mining concessions, environmental licenses and permits, the monitoring and oversight (albeit weak) of mining titles, and even the management of prior consultation with ethnic groups, but there is no similar framework to deal with the phenomenon of illegal mining, its containment, and the mitigation of its impacts. As is often the case in Colombia, there are many regulations and court rulings that urge or compel the state to act in a coordinated manner, but in practice, the state's response and efforts to address this problem are dysfunctional.

One of the most noteworthy initiatives is the Departmental Committees against Illegal Mining, which have different names in each Amazonian department. These are inter-institutional coordination mechanisms with varied compositions, in which local authorities convene national institutions and invite civil society organizations to discuss this issue. However, aside from the challenges inherent to public administration, such as a lack of resources, lack of continuity among officials, and political ups and downs, they also face the additional challenge of adapting to the formalization of Indigenous Territorial Entities (ETIs).

Photo: Diego Pérez/ SPDA

Institutional disinvestment and deprofessionalization

Once again, Venezuela is a prime example of this point. Environmental protection in the country, particularly in the Amazon region, is in crisis due to profound disinvestment and the systematic deprofessionalization of key institutions. The chronic lack of resources and erosion of technical capacity, together with politicization, have weakened the state's ability to safeguard ecosystems and protect citizens' rights. This institutional fragility is not only a result of the economic crisis, but also seems to facilitate the uncontrolled expansion of illegal mining. Opacity and the lack of official information prevent an accurate assessment of the damage and hinder accountability.

The environmental crisis in Venezuela is inherently linked to the broader socioeconomic and political crisis. The economic crisis is pushing people toward informal extractive activities, such as illegal mining (OHCHR, 2020). In turn, the state's strategy of promoting extractivism to "solve" the economic crisis further weakens environmental oversight and encourages illegal activities (OEP, 2021).

There has been a steep decline in the institutional framework in the form of the Ministry of Popular Power for Ecosocialism (MINEC) and INPARQUES. There is clear underinvestment, with reports indicating that environmental degradation is the result of policies that prioritize extractivism and tourism development in protected areas (El Nacional, 2022). INPARQUES faces serious operational difficulties (Sánchez, 2021), including a shortage of competent park rangers, which contributes to the proliferation of illegal activities in ecologically valuable areas (Meléndez, 2020). De-professionalization has devastated the state's technical capacity, resulting in a total loss of expertise in environmental institutions (Tarazona, 2023). The lack of transparency is reflected in the absence of reliable official statistics on environmental problems, preventing accurate diagnoses and effective public policies (Radwin, 2022; Tarazona, 2023). This erosion of environmental oversight suggests a deliberate undermining of institutions in order to facilitate unaccountable resource exploitation (OEP, 2021).

Violations of the right to life, economic, social, cultural, and environmental rights, and territorial rights as a result of illegal mining activities

Recent cases in Colombia, Peru, and Venezuela illustrate the severity and variety of territorial, environmental, and human rights violations in the Amazon region caused by illegal mining and the absence of public safeguards.

The Colombian Constitutional Court, in its Ruling T-106 of 2025, recognized that gold mining involving intensive use of mercury in the Jaguares de Yuruparí Macroterritory –which encompasses nearly 30 indigenous communities along the Caquetá and Apaporis rivers– constitutes a direct threat to their fundamental rights to health, water, cultural identity, and food sovereignty (Constitutional Court, 2025; Mongabay, 2025).

In its ruling, Colombia's highest court documented mercury levels up to 17 times higher than those permitted by international safety standards in water sources, fish, and human bodies. The Court emphasized that these findings compromise not only health (with neurological, reproductive, and sensory effects), but also cultural survival, ancestral knowledge, and indigenous food systems. As a reparations measure, the Court ordered the immediate suspension of mining licenses, the creation of Indigenous Territorial Entities, the delineation of the macro-territory as an environmental management unit, and the establishment of intercultural dialogue entities led by the Ministries of the Interior, Environment, and Health. Furthermore, it ordered the implementation of mobile health brigades and water source remediation programs, with biannual institutional monitoring by the Attorney General's Office, the Ombudsman's Office, and regional courts.

Peru, meanwhile, does not have a binding land use planning system. This has led to each regional government deciding when and how to carry out its territorial and economic zoning processes. In Madre de Dios, overlapping rights have made it easier for illegal mining to expand and increased the risk to defenders from local communities. This was the case of Alfredo Vracko Neuenschwander, Roberto Carlos Pacheco Villanueva, and Juan Julio Fernández Hanco, who owned forestry rights in the buffer zone of the Tambopata National Reserve, and who were allegedly murdered by invaders linked to mining activities (Montoya *et al.*, 2024).

In Venezuela, the invasion of indigenous peoples' and communities' lands by miners and irregular armed groups violates their territorial rights, given the lack of protection from the State, which has failed to fulfill its obligation to demarcate and adjudicate collective property titles. It has also failed to fulfill its duty to guarantee "the protection and security due to the habitat and lands of indigenous peoples and communities in border areas…" as established in Article 21 of the Organic Law on Indigenous Peoples and Communities (Venezuela, 2005).

Land delimitation remains the principal unresolved right of Venezuela's indigenous peoples and communities, and has remained at a standstill at the national level since 2016. With regard to the Venezuelan Amazon, only eight titles have been granted, benefiting 61 communities of the Warao, Jotï, Kari'ña, Pemón, and Mapoyo peoples and covering a total area of 1,206,060.91 ha (MINPI, 2016). However, this figure represents just

4% of the approximate total number of indigenous communities in the south of the country (Coalition for the Rights of the Amazon, 2023). The lack of delimitation leaves indigenous peoples legally unprotected against third parties who invade, settle, and exploit the natural resources in their territories.

The imposition of extractivist plans and projects in indigenous territories, such as the Orinoco Mining Arc, the so-called "mining alliances," and the areas granted to state mining companies represent violations of the right to free, prior, and informed consultation of indigenous peoples and communities (GTAI, Provea, and Laboratorio de Paz, 2016). Furthermore, such extractive plans and projects are approved and implemented without complying with the environmental and sociocultural impact studies provided for in Article 55 of the Organic Law on Indigenous Peoples and Communities (Venezuela, 2005). Mining activities are damaging indigenous communities' cultural, social, and economic integrity, contravening the provisions of Article 120 of the Constitution, as well as the prohibition on mining activities in indigenous habitats and lands "that seriously or irreparably affect the cultural, social, economic, environmental, or any other kind of integrity of said peoples or communities" (Venezuela, op cit, Art. 12). Indigenous peoples' right to receive economic and social benefits from extractive activities carried out by the State or by private individuals, as provided for in Article 57 of the same legislation (Venezuela, op cit, Art. 57), has also been ignored.

The overwhelming presence of irregular armed groups, illegal miners, and state security forces has turned the region into an area of violent, armed conflict, where massacres, selective killings, disappearances, death threats, harassment, and persecution have occurred. This constitutes a serious violation of the human right to life, compounded by the failure of government institutions to protect the region's inhabitants from these threats, thereby undermining communities' peace and security (OHCHR, 2020).

In some areas of Venezuela, indigenous peoples have become an obstacle for invaders and have formed self-defense groups known as indigenous territorial guards. Irregular armed groups such as the ELN, FARC dissidents, mining "unions" or "systems," drug trafficking mafias, and other criminal groups operating in the Venezuelan Amazon recruit people from indigenous communities, especially young people. Given the difficult economic context in the region and the lack of employment, many people are easily persuaded to join criminal groups. This situation also generates divisions and internal conflicts within communities (OHCHR, 2020).

The violation of territorial rights, a context of violent conflict, and the complex humanitarian emergency in Venezuela have caused thousands of people from the region, including numerous indigenous communities, to be forcibly displaced to neighboring countries. Several thousand indigenous Venezuelans have emigrated to Brazil, Colombia, Guyana, and Trinidad as part of the massive flow of Venezuelan refugees and migrants (Coalition for the Rights of the Amazon, 2023).

Cultural erosion and loss of traditional practices

With the expansion of illegal mining in the Amazon, the erosion of indigenous cultures is accelerating, affecting both traditional practices and the transmission of knowledge across generations. Recent cases in Bolivia, Colombia, Peru, and Venezuela show how mining pressures are transforming social structures, weakening community cohesion, and displacing ancestral activities such as fishing, agriculture, and hunting, which are pillars of indigenous identity and food sovereignty. Furthermore, environmental degradation and mining-related violence intensify the loss of territories, the abandonment of languages and knowledge, and the fragmentation of spiritual and cultural ties with the environment, jeopardizing the continuity and resilience of indigenous cultures in the Amazon.

Of great concern is the case of the Ese Ejja people on the Beni and Madre de Dios rivers in Bolivia. The Ese Ejja are classified as having had recent contact with the outside world, meaning that until a couple of decades ago they were still nomadic and largely disconnected from Bolivian population centers and institutions. Although they are now settled in certain territories –some communities have managed to consolidate territorial rights, while others have not– fishing is still a central activity for both their food supply and as a means of participating in economic activities and getting access to other complementary foods: fishing is the basis of their culture (CEJIS, 2022). In the case of the Leco people in the Charopampa community, the Ombudsman's Office (2022) notes that the diversion of the river, as well as the resulting damage to crops and homes, is one of the impacts of illegal mining.

Research by the Sinchi Institute in Colombia has documented the social and cultural impacts on Amazonian communities. Local testimonies indicate that mining has led to the emergence of unknown diseases and intensified existing ones, especially among women and children. This situation worries the elders, who warn that the new epidemics could put the lives of the youngest at risk. Shamans, traditionally responsible for healing, face limitations in treating these new problems, as their symptoms do not correspond to known or previously treated diseases. Even common ailments are now more difficult to cure, due to the high demand for health care caused by the increase in the mining population. Apart from its health impacts, mining is transforming the social and economic structure of communities (Salazar *et al*., 2019). Lured by the promise of quick profits, many residents have abandoned traditional activities such as fishing, hunting, and farming in the chagra (traditional agricultural system). Fewer and fewer people are learning how to farm or farming themselves, as they are now engaged in mining work. This loss of interest in ancestral practices also contributes to cultural decline (Tropenbos, 2015). Although some people still work with NGOs or public institutions, no other activity produces as high an income as mining, which reinforces its appeal (Salazar *et al*., 2019).

According to Peru's Ministry of Culture, 38.5% of the country's indigenous population lives in poverty (MINCUL, 2022). The structural problem of poverty in rural Amazonian areas makes illegal mining attractive to these segments of the population (FCDS-Peru, 2024: 20,22). According to CEPLAN, poverty and lack of access to basic services encourage people to see

illegal mining as a quick solution to their economic needs (2024). In the Amazonian community of Wampi, illegal mining came to their territory in 2015, as a supposed opportunity for "economic development." However, this activity created deep sociocultural divisions in their community (SPDA, 2024).

Indigenous communities in the Venezuelan Amazon have taken up mining as an economic activity, disrupting their traditional ways of life and introducing problems such as alcoholism, drug use, school dropouts, and violence. This has caused numerous problems that disrupt community life and directly threaten their customs and traditions, as well as the practice and transmission of their traditional culture to new generations. The neglect or abandonment of traditional food production practices, whether through farming, hunting, or gathering forest resources, as well as other activities that require in-depth knowledge and a close relationship with ecosystems, is leading to cultural erosion, changes in identity, and the loss of traditional knowledge. The environmental damage caused by mining, including deforestation and river pollution, also significantly reduces access to forest resources for food, medicine, housing construction, tool production, crafts, etc.

All these elements contribute to a decline in the intergenerational transmission of knowledge, which normally occurs as children, adolescents, and young people accompany and participate in everyday activities alongside adults and elders. In the long term, these factors may also be creating profound changes in the ways in which indigenous peoples relate to their environment, leading to a loss of respect for the norms and guidelines for coexistence with ecosystems and the spiritual world that they had maintained over the centuries. Finally, the forced displacement of thousands of indigenous Venezuelans to neighboring countries, with no prospect of returning to their territories of origin, will surely lead to profound changes in the ways of life and identities of these groups.

Commitments, Follow-up, and Solutions

The Paris Agreement and the Amazon

By signing the Paris Agreement, the Amazonian countries, as Parties to the United Nations Framework Convention on Climate Change, demonstrate their awareness that the pressing threat of climate change requires a progressive and effective response. This response must be based on the best available scientific knowledge and, at the same time, reduce the rate of global temperature increase and keep it below 2°C above pre-industrial levels, as well as develop adaptive capacities to cope with the adverse effects of climate change. (United Nations, 2015).

From this perspective, when they signed the Agreement, each of the countries in the region made a commitment to contribute to the global effort to tackle climate change. However, each country's contributions do not have to be equal. In fact, the Agreement introduces an implementation mechanism that reflects "equity and the principle of common but differentiated responsibilities" based on "respective capabilities" and "in light of different national circumstances" (United Nations, op cit). In other words, each Party has individual discretion to choose its own goals and actions to achieve the Convention's Mitigation and Adaptation Objectives.

This discretionary differentiation between the Parties was designed with the clear intention of breaking the deadlock in fruitless negotiations that would allow for the establishment of mandatory reductions in carbon emissions, ensuring that each Party would set its own ambitions for mitigation based on national climate change policies, thereby making commitments voluntary. This departure from the approach attempted in Kyoto eliminates one of the biggest obstacles to international climate cooperation, while seeking to integrate different countries' commitments into a system of climate accountability and an adjustment mechanism. (Falkner, 2016).

However, as Pauw *et al.* (2020) warned, the pressure to comply with agreements has shifted from "mandatory actions" to conditioning now "voluntary" mitigation and adaptation contributions on international support (financing, technology transfer, or capacity building). While this new arena for climate policy discussion is based on the search for necessary equity among countries, the actual implementation of the proposed measures could be severely compromised as Parties make their execution conditional on obtaining increasingly inadequate and inequitable international support.

Another immediate consequence is that this new policy makes it difficult to compare goals and objectives other than the general ones. This includes those aimed at mitigation and adaptation, and among the mitigation goals, those that could be considered aimed at reducing emissions and those aimed at maintaining and/or increasing carbon reservoirs.

Thus, for example, we find that the eight Amazonian countries recognize mining, both legal and illegal, as one of the main causes of

forest cover loss in their respective countries, either directly caused by mining activity or as a driver of other quantified changes in land use such as the establishment of new roads, airstrips, settlements, and supporting agricultural activities . However, its significance does not appear to be reflected in the various Nationally Determined Contributions (NDCs) developed by the countries.

In Bolivia, a country that does not list mining as a problem in its NDC, illegal mining activity is concentrated in regions with high levels of endemism and biodiversity, such as the heart of Santa Cruz, the banks of the Madre de Dios and Orthon rivers, and the Yungas region, which promotes its uncontrolled expansion in the Bolivian Amazon (RAISIG, 2020), highlighting the adverse effects on local populations due to mercury contamination caused by this industry.

In general, illegal mining, especially gold mining, affects 17.3% (129) of protected natural areas and 10% (664) of indigenous territories in the Amazon region. (RAISG, op cit).

However, it is important to note that if we consider mining in general, both legal and illegal, according to Stanimirova *et al* (2024), Brazil had the highest level of tree cover loss related to mining activity from 2001 to 2020, with more than 45% of regional cover loss. Brazil was followed by Peru (18.4%), Suriname (15%), Guyana (11.5%), Venezuela (6.1%), Colombia (2.6%), and Ecuador and Bolivia with 0.5% respectively.

These apparent discrepancies are due to the different ways in which different countries in the Amazon region define the legality of mining operations, which in turn reflect national interests with respect to this activity. For example, RAISG (2020) distinguishes between two different trends: while Bolivia, Venezuela, and Ecuador increased the quantity and size of mining areas, Colombia, Brazil, and Peru moved in the opposite direction.

In terms of policy, Suriname, Guyana, Bolivia, Ecuador, and Venezuela consider mining an industry that could diversify their economies and provide significant resources for their development plans, including as a source of financing to meet their climate adaptation goals (Guyana, 2016; Suriname, 2015, 2019; Bolivia, 2021; Ecuador, 2025; Venezuela, 2021). In this context, Venezuelan mining policy stands out for favoring illegal mining (SOSOrinoco, 2021a). Other countries, such as Peru, barely reference mining activity directly, generally referring to it as a problem to be addressed (Peru, 2015, 2020). Only Brazil and Colombia explicitly indicate the need to initiate a process that will lead to a reduction in illegal mining (Colombia, 2020; Brazil, 2024). However, in both cases, the actions refer to administrative activities that contribute to the reduction of illegal mining, demonstrating that the most important issue appears to be not the mining itself nor its consequences, but rather its illegality.

However, not a single country addresses mining activities beyond the issue of deforestation and its implications for national capacities to maintain carbon reservoirs, ignoring the fact that mining also impacts bodies of water by modifying their physicochemical characteristics, thereby affecting fish populations and their life cycles, which tends to reduce the fishing resources available to riverside populations, affecting their nutrition and economy. Nor do they address mercury contamination, which directly affects the health of local populations in the very long term, slowly poisoning them and causing multigenerational repercussions.

These circumstances suggest that mining should be seen as a major obstacle to effective adaptation to climate change, with a direct impact on the health of populations within the affected basins. However, this does not seem to be a factor

in national discussions when it comes to establishing development and climate adaptation plans.

Likewise, vectors of endemic diseases such as malaria have proliferated, due to changes in topography caused by mining and the interruption of water flows, which fosters conditions conducive to the reproduction of vector populations. This, combined with the sporadic movement of people between mines, creates a significant breeding ground that puts the region's populations at exponential risk, whether they are close to mine sites or not. These circumstances also increase the vulnerability of the region's populations to climate change.

The commitments that countries have made in their NDCs that are related to mining activity stem from two types of goals: those that directly address mining management and those whose achievement requires running such activities. Management includes controlling, reducing, eradicating, or mitigating the impacts of mining (the latter being applicable mainly to legal mining). In general, these commitments are linked to national initiatives aimed at the protection and sustainable management of forests.

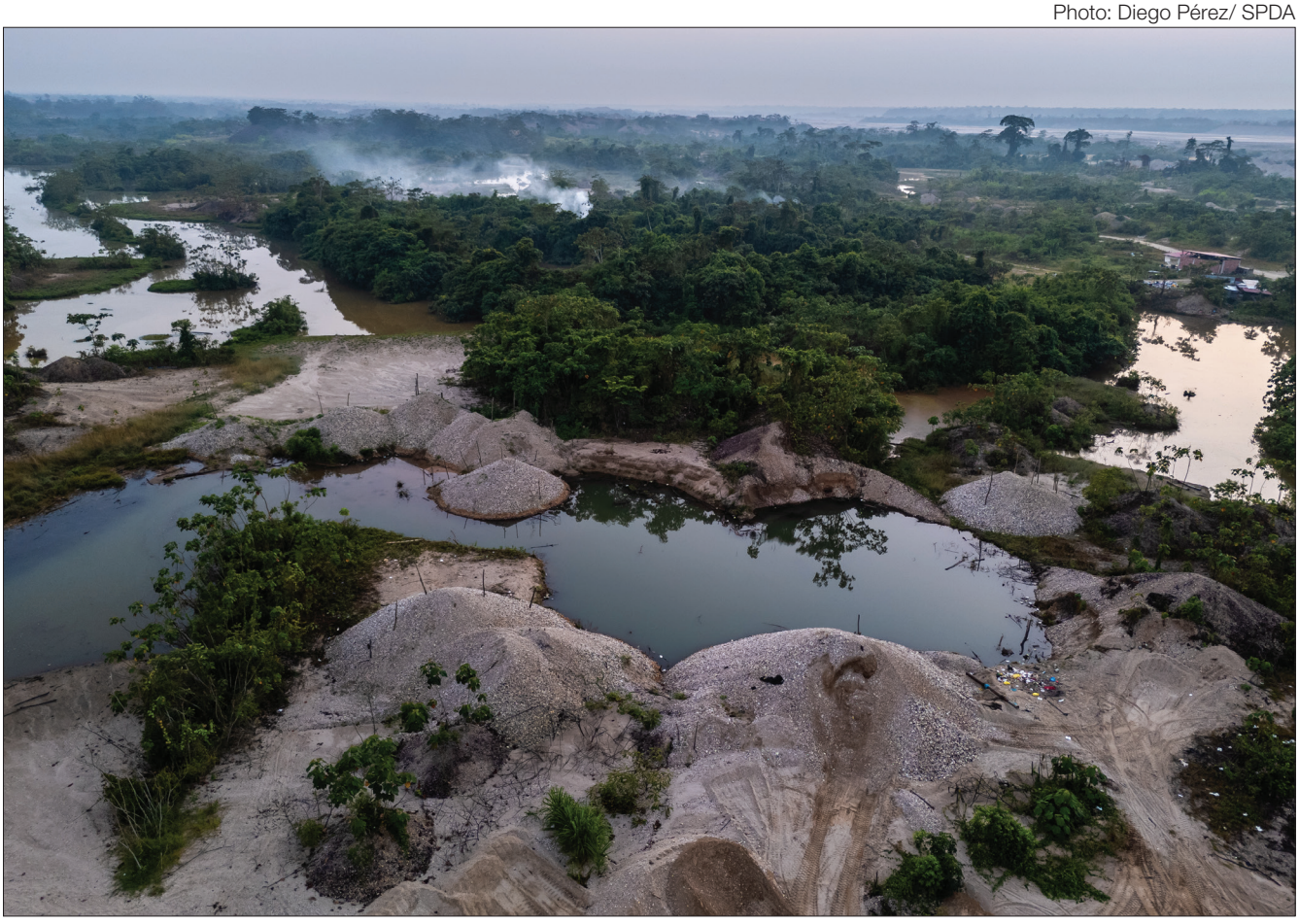
Current policies and programs

The countries analyzed in this report have adopted technologies and policies to curb deforestation, though their implementation has been uneven. Brazil is a notable example, using INPE's PRODES and DETER systems, together with MapBiomas, to monitor deforestation over relatively short periods of time. RAISG complements these efforts with cross-border satellite monitoring. However, adoption and implementation vary across countries (RAISG & ANA, 2023).

For its part, Colombia has expanded its use of satellite alert systems with international support, but has been unable to implement effective, on-the-ground surveillance. Although monitoring technologies exist in Peru and Venezuela, they are underutilized or not used by state agencies, allowing illegal activities such as gold mining and logging to continue unchecked (SOS Orinoco, 2023).

Conservation initiatives show uneven results. Protected areas that overlap with Indigenous Territories have more than 50% less deforestation than areas protected solely by the government (RAISG, 2023). However, weak institutional capacity limits their effectiveness.

Photo: Diego Pérez/ SPDA



Proposals for action

Going beyond national actions, it must be understood that no country can protect the Amazon on its own and that taking on this task requires real working agreements between members of the international community. Thus, it should consider initiatives promoted by RAISG and other actors to align with the Global Biodiversity Framework and the Paris Agreement to improve accountability and foster regional cooperation (RAISG & ANA, 2023).

Identifying and controlling the illegal gold supply chain is a common need that needs to be addressed as a priority. Despite international standards, high demand and poor monitoring continue to encourage illegal mining, especially in regions such as southern Venezuela and Madre de Dios in Peru (SOS Orinoco, 2023). There is still a lack of robust regional frameworks to monitor and oversee these activities and, more generally, [1] [2] to promote transparency. Tools like the blockchain to track timber and gold could improve governance (Planet, 2024), but they must be accompanied by institutional capacity. Satellite monitoring must also be expanded in scope and frequency.

For example, agroforestry practices managed by indigenous communities offer a double benefit: they restore degraded land and maintain livelihoods (Pinho *et al.*, 2024). These practices should be strengthened with subsidies, investment, and access to markets.

Most importantly, Indigenous Peoples must be recognized as full partners in climate governance. Their territories show better forest health. Strengthening their rights, governance structures, and participation in decision-making is one of the most effective strategies for conservation and climate resilience (UNDP, 2024).

In Colombia's case, approximately 42% of the Amazon's remaining stable forest is located outside protected areas or indigenous territories (RAISG, 2023), making it necessary to promote the expansion of areas under collective ownership by indigenous peoples. If the aim is to expand protected area systems or promote conservation strategies, new approaches are recommended, such as those being discussed within the Convention on Biological Diversity in relation to the fulfillment of Target 3 of the Kunming-Montreal Global Framework, which recognize the contributions made by indigenous and traditional communities' territories, without the need to continue establishing protected areas in the old-fashioned way.

Likewise, one of the strategies identified in Colombia is to strengthen territorial protection for the Yuri and Passé indigenous peoples living in isolation within the Río Puré National Natural Park through the effective implementation of Decree 1232 of 2018,[20] which establishes prevention measures and rights protection measures, and activates the National Prevention and Protection System. This strategy seeks to safeguard the lives, culture, and territory of indigenous peoples such as the Yuri and Passé, whose existence and territoriality are under serious threat from the expansion of illegal gold mining in the Caquetá and Putumayo

[20] In Colombia, Decree 1232 of 2018 establishes special prevention and protection measures for Indigenous Peoples in Isolation or a Natural State. This decree seeks to guarantee these peoples' right to live freely in accordance with their cultures, in their ancestral territories–a right which must be considered untouchable.

river basins. Implementing this decree will require inter-institutional action, environmental monitoring, and indigenous participation as key mechanisms to ensure these peoples' holistic well-being and to halt socio-environmental degradation in the region.

In general, joint efforts by civil society, such as networks or alliances with local and international reach, need to be promoted and strengthened. Additionally, it is important to evaluate the effectiveness of bilateral cooperation mechanisms focused on integration and social and economic development, including the protection of human rights and the coordination of efforts to combat drug trafficking and other cross-border crimes (i.e. "neighborhood" and integration commissions established between Colombia, Brazil, Peru, Ecuador, and Venezuela).

Bilateral or multilateral programs must be created to establish coordination and joint action programs between different governments, including the protection of territories through mosaics of Protected Natural Areas, territorial corridors, cross-border biocultural corridors, and conservation areas, taking into account the recommendations of ACTO3 (Amazon Cooperation Treaty Organization).

Photo: Diego Pérez/ SPDA

International Human Rights Standards in the Context of Climate Change and Advocacy in International Forums Related to Mining

The relationship between climate change and human rights

Adopted at the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in 2015, the Paris Agreement is the main multilateral commitment to reducing greenhouse gas (GHG) emissions (UNFCCC, 2015). More than 130 countries have established NDCs and other forms of climate change mitigation and adaptation. In accordance with the Paris Agreement and in light of resolutions adopted in recent years by various intergovernmental forums, these measures must be interwoven with obligations to protect and guarantee internationally recognized human rights.

Reconciling human rights and climate change is a process that requires reinterpreting international human rights instruments in light of climate commitments, especially with respect to groups that are most vulnerable to the effects of climate change and most affected by the energy transition.

As the Inter-American Commission on Human Rights (IACHR) stated in its resolution on climate emergency and human rights:

Tal como indicó la Comisión Interamericana de Derechos Humanos (CIDH) en su resolución sobre emergencia climática y derechos humanos:

> "...the nexus between climate change and human rights is increasingly evident and its recognition at the international level has reached significant levels of consensus, not only in the legal regime pertaining to climate change, but also in the international human rights regime. The basis for this development lies in the existence of a directly proportional relationship between the increase in greenhouse gas (GHG) emissions… and the frequency and intensity of meteorological changes, which entails the amplification of risks to people and ecosystems." (IACHR, 2021).

The Inter-American Court of Human Rights (IACrtHR), in its recent advisory opinion "*Climate Emergency and Human Rights*", went even further in concluding that:

> "[...] climate change impacts the conditions required for human beings to enjoy a dignified existence. The exposure to extreme climate events such as heatwaves, floods, droughts, forest fires, and air pollution can, among others, lead to injury and death." (IACrtHR, 2025).
> "[t]o comply with the obligation to respect

human rights in the context of the climate emergency, States must refrain from any conduct that results in a setback or delay or that limits the results of measures required to protect human rights from the impacts of climate change." (IACrtHR, 2025).

The obligation to guarantee human rights implies organizing the entire government apparatus and, more generally, all the structures through which public power is exercised, so that they are capable of legally ensuring the free and full exercise of human rights. Fulfilling this obligation in the face of the climate emergency requires that all the powers of the State, both domestically and internationally, work together to protect the human rights threatened and affected by this phenomenon (IACrtHR, 2025).

While extreme natural phenomena and other consequences of climate change affect a wide range of human rights, respect for and guarantee of the right to a healthy environment is particularly relevant.

Photo: Diego Pérez/ SPDA

Climate change in international law

In addition to being enshrined in numerous national constitutions (Wolkmer and Radaelli, 2016), the right to a healthy environment was recognized by the Human Rights Council through Resolution 48/13 (2021) in October 2021. In the Inter-American System, Advisory Opinion OC 23/17 of the IACrtHR on Environment and Human Rights reinforces the interdependence and indivisibility of environmental protection and human rights, and highlights that environmental damage can affect all fundamental rights, since their full enjoyment depends on a conducive and balanced environment.

In recent decades, environmental protection has been developed under international law, laying the foundations to specifically address climate change. Since 1972, the Stockholm Declaration on the Human Environment has emphasized that the release of heat in such quantities or concentrations as to exceed the capacity of the environment to render them harmless must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems (United Nations Conference on the Human Environment, 1972).

In 1987, the United Nations (UN) Commission on Environment and Development, in its report Our Common Future, emphasized how activities such as mining cause environmental damage, affecting sustainable development (1987). It also highlighted the link between global warming, the abuse of natural resources, and environmental damage. In this regard, the report states:

> "[t]he 'greenhouse effect', one such threat to life support systems, springs directly from increased resource use. The burning of fossil fuels and the cutting and burning of forests release carbon dioxide. The accumulation in the atmosphere of CO_2 and certain other gases traps solar radiation near the Earth's surface, causing global warming." (World Commission on Environment and Development, 1987).

The Preamble to the Vienna Convention for the Protection of the Ozone Layer (1985) emphasizes the need to protect human health and the environment from the adverse effects resulting from changes in the ozone layer. The preamble to the Montreal Protocol on Substances that Deplete the Ozone Layer (1987) recognizes the climate effects of emissions of substances that deplete or modify the ozone layer on health and the environment.

These precedents are important milestones in the development of international commitments on environmental issues, including the protection of the ozone layer. Below, we will discuss the specific international framework for climate change mitigation and adaptation.

In 1992, the preamble to the UNFCCC highlighted concerns about the substantial increase in atmospheric greenhouse gas concentrations as a result of human activities. This instrument emerged in response to the intensifying natural greenhouse effect and the additional warming of the surface and atmosphere resulting in adverse effects on ecosystems and people. The UNFCCC set out common obligations for all States Parties, as well as other obligations differentiated according to each country's cumulative GHG emissions. These obligations cover three pillars: (i) mitigation or reduction of GHG emissions; (ii) adaptation to the effects of climate change; and (iii) remediation, aimed at addressing losses due to climate damage.

Furthermore, as mentioned above, the Paris Agreement, adopted in 2015, represents a key milestone in the international framework on climate change, contributing to the establishment of NDCs and other forms of climate change mitigation and adaptation, which are linked to the obligation to respect human rights.

At the Inter-American level, the IACrtHR's Advisory Opinion OC 32/25 on climate emergency and human rights explains that climate change produces a series of consequences that profoundly impact people, their dignified existence, and their rights to health, food and water security, and economic well-being, inevitably affecting their human rights (IACrtHR, 2025). This decision contains a comprehensive interpretation of the Inter-American human rights instruments in light of the obligations to respect and guarantee those rights that are likely to be affected by climate change. In this regard, the advisory opinion sets out a series of state obligations derived from substantive and procedural rights, as well as the rights of individuals and groups vulnerable to climate change.

Photo: Diego Pérez/ SPDA

Regulatory frameworks for controlling the gold supply chain

The Organization for Economic Cooperation and Development (OECD) has indicated that the gold supply chain refers to "the system of all the activities, organisations, actors, technology, information, resources and services involved in moving the mineral from the extraction site downstream to its incorporation in the final product for end consumers." (OECD, 2016).

Supply chain monitoring is essential for countries that are destinations for illegal gold to prevent, oversee, and sanction companies registered or domiciled under their jurisdiction whose actions in third countries contribute to human rights violations (IACrtHR, 2017). Regulating gold supply chains is useful for identifying and addressing the actual and potential negative impacts of supply chains and business relationships (OECD, 2018). In this regard, several European states have adopted corporate due diligence laws to ensure that companies identify risks and prevent human rights violations, such as those referenced in this report, resulting from the activities of certain groups, individuals, or companies in their supply chains.

As Human Rights Watch highlighted in its report *The Hidden Cost of Jewelry: Human Rights in Supply Chains and the Responsibility of Jewelry Companies*, although there are some standards established for gold supply chains and due diligence, they are inadequate (Human Rights Watch, 2018).

One of the most relevant regulatory frameworks is the United Nations Guiding Principles on Business and Human Rights (hereinafter Guiding Principles), which establish that companies have an obligation to exercise due diligence in human rights matters in order to identify, prevent, mitigate, and respond to the negative consequences of their activities. In order to comply with the second pillar (duty to protect) of the Guiding Principles, several States and regional integration organizations, such as the European Union, have adopted sector-specific or general laws on corporate due diligence in the field of human rights. Several of these laws enable the application of criminal and administrative penalties and/or the filing of compensation claims by individuals or groups harmed by non-compliance with the due diligence plan.

In addition, the OECD has issued specific guidelines for due diligence in mining supply chains, developing the corporate due diligence introduced by the Guiding Principles. The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas is a multilateral initiative involving both states and private companies. This guidance establishes commitments to respect human rights through the establishment of transparent supply chains that reflect a corporate commitment to prevent the trade and extraction of minerals from becoming a source of abuse (OECD, 2016).

Although these standards provide relevant guidance for companies, one of their greatest weaknesses is their non-binding nature. In addition, as Human Rights Watch has highlighted, many of these voluntary due diligence initiatives are undermined by inadequate and non-transparent audits (Human Rights Watch, 2018).

There are also efforts to regulate the supply chain coming from organized companies themselves. For example, the Responsible Jewelry Council (RJC) brings together jewelers, mining companies, manufacturers, and others, and has

issued guidelines under which it certifies companies participating in the supply chain, including a code of practices and a chain of custody standard. Despite this, the RJC has been criticized for flawed governance, regulations, and auditing systems that allow companies to receive certifications even if they do not meet basic standards of due diligence and respect for human rights (Human Rights Watch, 2018).

Voluntary standards arising from private initiatives include the Fairtrade and Fairmined gold standards, which certify mining activities and attest to their respect for human rights. These standards are characterized by rigorous requirements in terms of human rights, the environment, and gold traceability. Nonetheless, both standards have shown gaps in their certification processes and in public disclosure of audit information (Human Rights Watch, 2020).

While the above initiatives are valuable, their voluntary, non-binding, or private character face some of the aforementioned shortcomings, highlighting the need for mandatory regulations by states and regional integration forums.

In 2017, the European Union issued Regulation (EU) 2017/821, which establishes supply chain due diligence obligations for importers of certain minerals and gold originating in conflict-affected and high-risk areas. This mandatory regulation took effect in 2021 and established supply chain due diligence obligations for importers of gold and other minerals into the European Union. The regulation also requires member states to establish a system of penalties for violations of the regulation (European Union, 2017).

While voluntary initiatives for the regulation and certification of supply chains seek to implement the due diligence required by the Guiding Principles and OECD guidelines, there is a clear need for mandatory national or regional standards on due diligence and supply chain monitoring that require companies to prevent human rights violations in their operations.

Areas of international advocacy and coordination

Conferences of the Parties (COP) to certain treaties, as well as other multilateral forums, offer key international advocacy and coordination platforms for addressing illegal mining and its impact on climate change. Several of these forums enable a coordinated response between states and companies focused on the rights of communities and individuals directly impacted by illegal mining. Particularly relevant are those spaces that strengthen cooperation between states, companies, and multilateral organizations to confront criminal networks that cause serious human rights violations, pollution, and biodiversity loss in natural systems essential to the planet's climate balance, such as the Amazon. Civil society participation in such forums raises awareness of local realities and puts pressure on states and companies to commit to more ambitious environmental protection, mining regulation, and human rights measures.

For example, the COP to the Convention on Biological Diversity (CBD) has increasingly recognized mining's impacts on biodiversity. Since COP4 (1998), an assessment of the socioeconomic impacts of mining on inland water ecosystems has been recommended (COP CBD). More recent COPs, such as COP14 (2018), have highlighted the need to integrate biodiversity into certain extractive sectors such as gold mining, by reviewing legal frameworks, adopting safeguard measures, and promoting sustainable practices, with the full participation of indigenous peoples, local communities, and other relevant actors (COP CBD). However, despite these advances, illegal mining has not been explicitly addressed in CBD decisions, despite its growing impact on biodiversity in regions such as the Amazon. At the most recent COP16 (2024), several NGOs, government delegations, and United Nations agencies raised the issue of illegal mining as a threat to the Amazon (Global Witness).

As with the CBD COP, at the Conference of the Parties to the UNFCCC, which specializes in climate change, government delegations have not specifically addressed illegal mining. Despite this, it has been an important forum for civil society and international agencies to promote strategies and parameters for state action in this area. For example, at COP 28 (2023), the United Nations Office on Drugs and Crime (UNODC) organized, in partnership with several actors, a high-level side event on the impact of environmental crimes on natural carbon sinks and ecosystem resilience (UNODC, n.d.). In the same year, coinciding with COP28, UNODC launched the International Law Enforcement Initiative for Climate Change (I2LEC), which seeks to strengthen the role of international law enforcement agencies in responding to climate change on a global level (I2LEC, n.d.). UNODC has highlighted illegal mining as one of the environmental crimes that this initiative seeks to combat (UNODC, n.d.).

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body responsible for assessing the science related to climate change. The IPCC provides regular assessments of the science related to climate change, its impacts and future risks, and adaptation and mitigation options. The IPCC is a scientific authority on climate change, and its annual and thematic reports are a reference for experts in the field, providing an overview of the factors that contribute to climate

change, its impacts and risks, as well as adaptation and mitigation measures to reduce them. Although IPCC reports have referenced certain illegal activities affecting the Amazon, its climate, and its biodiversity, such as deforestation, linking it to increased carbon emissions, they have not addressed illegal mining in depth.

In Latin America, a relevant forum for advocacy on issues related to illegal mining, climate change, and human rights is the Inter-American Human Rights System (IAHRS). In particular, the IACHR can be a valuable forum where affected communities, indigenous peoples, social and environmental organizations can speak out about the impact of illegal mining on climate change and its effects on their rights. In 2023, the IACHR held a regional thematic hearing on the impacts of illegal mining on human rights, at the request of some of the organizations that authored this report.[21]

The aforementioned spaces provide platforms for international coordination and monitoring, which allow civil society, indigenous peoples, and affected communities to present evidence, influence the formulation of inter-American standards, and visibilize the need for a just transition, free from illegal mining and human rights violations.

[21] https://www.oas.org/es/CIDH/jsForm/?File=/es/cidh/prensa/comunicados/2025/054.asp

Photo: Diego Pérez/ SPDA

Conclusions and recommendations

The Amazon, as the largest tropical forest on the planet with an area of approximately 600 million hectares and a critical role in the world's carbon and hydrological cycle, is facing accelerated deterioration that threatens its resilience and global climate stability.

From 1985 to 2023, more than 88 million hectares of forest cover were lost, fueled by extractive activities such as illegal gold mining, which not only releases millions of tons of CO_2 –over 330 million in the countries analyzed– but also causes mercury contamination, impacts on human health, and violations of the rights of indigenous peoples, including those in voluntary isolation. However, the specific impacts of forest loss due to mining do not receive the importance and relevance they deserve, which must be considered in policies aimed at preventing atmospheric carbon release and increasing carbon capture.

This intersection between climate change, illegal mining, and human rights underscores the urgency of recognizing indigenous peoples –whose territories cover more than 80% of intact forests in the region– as central actors in environmental governance, especially given the inadequacy of national commitments under the Paris Agreement and the expansion of illicit activities associated with poverty, corruption, and institutional weakness.

COP30 in Belém represents a historic opportunity to articulate climate justice, biodiversity, and the protection of rights, thus avoiding a point of no return for the Amazon biome.

We therefore make the following recommendations:

1. Strengthen the participation of indigenous peoples in climate governance. Amazonian states must fully integrate the knowledge and rights of indigenous peoples into their Nationally Determined Contribution (NDC) and the measures put in place to meet them, promoting differentiated territorial approaches and mechanisms for free, prior, and informed consultation to enhance their role in conserving intact forests, while guaranteeing rights such as autonomy, participation, and their land and territory.

2. Deepen efforts to contain and eradicate illegal mining through regulations and regional cooperation. Implement strict regulatory frameworks to track the supply chain of illegal gold, including bans in protected areas and indigenous territories, and encourage cross-border cooperation through the Amazon Cooperation Treaty Organization (ACTO) for satellite monitoring and joint legal action, using tools such as the Gold Mining Impact Calculator to estimate damages and compensation.

3. Explicitly recognize illegal gold mining as a critical factor in the deforestation and environmental degradation of the Amazon rainforest, incorporating it into climate and conservation agendas with more emphasis and political force. This entails placing political weight on it that is proportional to its real impact, strengthening regulatory and institutional frameworks for its effective control, and ensuring systematic and coordinated monitoring of public policies aimed at its prevention, control, and eradication, with a human rights focus.

4. Promote sustainable productive alternatives, backed by innovative and effective financial mechanisms, that offer competitive economic incentives and discourage mining as an economic alternative. These measures should be aimed at generating decent and resilient livelihoods, reducing dependence on extractive activities.

5. Strengthen the implementation of payment mechanisms for ecosystem services as tools for conservation and sustainable development, ensuring stable and equitable financing. At the same time, investing in mercury-free technologies and job retraining programs for communities living in poverty and unemployment is a priority, in order to reduce dependence on gold mining and promote sustainable and socially just economic alternatives.

6. Improve the implementation of international commitments at COP30, setting ambitious and coordinated targets for reducing deforestation. These targets must prioritize the integration of the Amazon into global climate and human rights agendas, incorporating a specific approach to protecting peoples in voluntary isolation and restoring ecosystems that have been damaged by mining.

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Appendix

Illegal mining in the Amazon: Comparative analysis of impacts in Bolivia, Brazil, Colombia, Ecuador, Peru, Venezuela, and Guyana

Illegal gold mining in the Amazon has become one of the main drivers of deforestation in the region, with direct consequences for climate change. This activity turns vast swathes of tropical forest into degraded zones, releasing large amounts of carbon dioxide (CO_2) that were previously stored in the biomass. Based on a conservative estimate, calculations show that each hectare of deforested Amazonian forest releases approximately 400 tons of CO_2 (Conservation Strategy Fund & Federal Public Ministry of Brazil, 2021). These estimates allow us to gauge the cumulative climate impact for several Amazonian countries between 1985 and 2023.

Figures on surface area transformed by mining come from a MapBiomas analysis for each country. In this methodology, annual land cover and land use maps are generated through pixel-by-pixel classification of Landsat satellite images, using machine learning algorithms on the Google Earth Engine platform. This process is supported by a processing structure, developed by specialists, with national categorization by region and cross-cutting themes.

In Bolivia, illegal gold mining is mainly concentrated in the Beni River basin and the department of Santa Cruz, affecting indigenous territories and protected areas. By 2023, it is estimated that approximately 147,696 hectares had been transformed by mining, representing the release of more than 4,923,200 tons of CO_2. The approximate value of the associated socio-environmental impacts amounts to USD 1,264,792,375, while the value of the illegally extracted gold reaches USD 1,040,543,840, resulting in a total economic loss of USD 2,305,336,216.

Cumulative gold production is estimated at 9,023.3 kg, with a ratio of 0.73 kg per hectare impacted. According to projections, extracting this amount of gold requires removing more than 130,772,500 m³ of sediment, affecting river structure and water quality. Mercury contamination could be around 625,314.86 grams, which could potentially enter the food chain, with the possibility of affecting 38,492 people. In addition, 1,049 miners could be at risk of developing neuropsychological symptoms, highlighting the occupational health impacts.

Brazil, meanwhile, has had the greatest cumulative impact in the region. From 1985 to 2023, approximately 5,004,000 hectares were transformed, releasing around 166,800,000 tons of CO_2. The estimated value of the socio-environmental

impacts is USD 54,392, 337,798.24, while illegally mined gold represents an approximate value of USD 83,612,487,605.29, adding up to total damages of USD 138,004,825,403.53 according to estimates by the Mining Calculator.

For Brazil, gold production is estimated at 719,325 kg, with an intensity of 1.73 kg per hectare. Based on the approximate amount of other minerals extracted, it is estimated that the volume of sediments removed exceeds 10,425,000,000 m³, severely affecting aquatic ecosystems. Potential mercury contamination is a concern, with 26,744,503.5 grams converted into methylmercury, which could affect nearly 600,000 people. In addition, an estimated 1,386,536 miners are at risk of neuropsychological damage, and 26% of births in affected areas show an IQ loss of more than 2 points.

In the Colombian Amazon, illegal mining has expanded in riverside areas of the departments of Guaviare, Guainía, and Amazonas. By 2023, it was reported that approximately 716 hectares were impacted, with a potential release of 286,400 tons of CO_2. The estimated value of the socio-environmental impacts amounts to USD 90,931,455, while the illegally mined gold is estimated to be worth USD 71,214,264, resulting in total damages of USD 162,145,719.

Based on the area of mining activity reported in the MapBiomas analysis, gold production is estimated at 617.55 kg, with a ratio of 0.86 kg per hectare. Thus, it is assumed that at least 8,950,000 m³ of sediment was removed and 14,245.03 grams of mercury potentially be released into the food chain. Some 41,714 people could be exposed, and 1,191 miners could be at risk of developing neuropsychological symptoms. Although the affected area is smaller than in other countries, there is considerable impact on fragile ecosystems and indigenous communities.

Ecuador is the only country that did not record any mining activity in the Amazon region in the base year of analysis (1985). However, by 2023, approximately 107,364 hectares had been transformed, with an estimated 42,945,600 tons of $COCO_2$ released. The estimated value of the socio-environmental impacts is USD 30,146,094,356, while illegally mined gold could total USD 1,779,759,839, with total damages reaching USD 31,925,854,195.

With mining activity in the Ecuadorian Amazon identified until 2023, gold production is estimated at 15,433.58 kg, with an intensity of 1.73 kg per hectare. Based on these projections, 223,675,000 m³ of sediment had to be removed, and 573,820.32 grams of mercury released. The number of people exposed could exceed 542,886, and 17,552 miners could be at risk of neuropsychological damage. Forty-five percent of births in affected areas show IQ loss, which is evidence of a serious public health problem.

In the Peruvian Amazon, more than 90,000 hectares will be directly impacted by mining by 2023, which is equivalent to the release of 36,749,200 tons of $COCO_2$. The estimated value of the socio-environmental impacts amounts to USD 11,697,291,447, while illegally mined gold may represent USD 6,442,152,248, representing total damages of approximately USD 18,139,443,695.

The estimated gold production, based on mining activity, is 55,864.53 kg, with a ratio of 0.61 kg per hectare. Therefore, it is possible that 809,630,812.5 m³ of sediment had to be removed, releasing 2,077,043.08 grams of mercury. The exposed population could reach 513,220 people, and 95,299 miners are at risk of developing neuropsychological symptoms. Thirteen percent of births in affected areas show IQ loss, reflecting the intergenerational impact of this activity.

Venezuela has transformed approximately 196,572 hectares of Amazonian forest, releasing more than 78,628,000 tons of CO_2. The estimated worth of the social and environmental impacts is USD 26,939,108,356.31, while the illegally mined gold could total USD 39,414,565,739.99, adding up to total damage of USD 66,353,674,096.30.

It is estimated that 339,086.7 kg of gold were produced in Venezuela, with an intensity of 1.73 kg per hectare. To achieve this, it is estimated that 4,914,300,000 m³ of sediment was removed and 12,607,243.51 grams of mercury released. The exposed population could reach 592,177 people, and it is possible that 653,607 miners are at risk of suffering neuropsychological damage. Twenty-six percent of births in affected areas show IQ loss, evidence of a silent health crisis.

Unfortunately, not all Amazonian countries are using the MapBiomas platform and have not published an updated estimate of their mining footprint. In the case of Guyana, SOSOrinoco has estimated the mining footprint for Essequibo, a territory claimed by both Guyana and Venezuela, until 2024. In this Amazonian region, it is estimated that 108,474 hectares were affected by mining, implying the potential release of more than 43 million tons of CO_2 during the period from 2000 to 2024, when SOSOrinoco conducted its analysis.

The more than 100,000 hectares transformed for mining in Essequibo represent a potential production of 187,117.65 kg of gold, based on an estimate of 1.73 kg per hectare. Gold production causes damages estimated at more than USD 31 billion, considering the socio-environmental damage and the illegal channels through which the extracted mineral may be transported. In addition, it is estimated that 2,711,850,000 m3 of sediment may have been removed and 6,957,034.23 g of mercury released, potentially affecting more than 42,000 people.

Illegal mining in the Amazon has turned vast swathes of tropical forest, traditionally considered carbon sinks, into sources of emissions. The approximate total CO_2 released by mining-related deforestation in the six countries analyzed exceeds 330,332,400 tons, posing a direct threat to the climate commitments made by states in their Nationally Determined Contributions (NDCs). Apart from the climate impact, the data shows profound effects on public health, the local economy, and ecological resilience. This issue requires urgent and coordinated attention and will be addressed in detail in the section on public policy.

Climate Change, Illegal Mining, and Human Rights in the Amazon:

Reflections from a Coalition of Civil Society Organizations and Indigenous Peoples

Coalición contra la Minería Ilegal en la Amazonía (CMIA)

Amazon Conservation Team

https://www.amazonteam.org/

Documentation and Information Centre Bolivia (CEDIB)

https://www.cedib.org/

Due Process of Law Foundation (DPLF)

https://dplf.org/

Gaia Amazonas Foundation

https://gaiaamazonas.org/

Hutukara Yanomami Association (Brasil)

https://hutukarayanomami.org/

People in Need (PIN)

https://www.peopleinneed.net/

Peruvian Society for Environmental Law (SPDA)

https://spda.org.pe/

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