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ACRONYMS

ASGM  Artisanal and small-scale gold mining
Au    Gold
ACA   Amazon Conservation Association
CESCR Committee on Economic, Social, and Cultural Rights
EIA   Environmental impact assessment
EMP   Environmental management plan
EPA   Environmental Protection Agency
GIATOC Global Initiative against Transnational Organized Crime
Ha    Hectare
Hg    Mercury
GDP   Gross domestic product
GEF   Global Environmental Facility
IBAMA The Brazilian Institute of the Environment and Renewable Natural Resources
IGF   Intergovernmental Forum
ILO   International Labor Organization
LSGM  Large-scale gold mining
MAAP  Monitoring of the Andean Amazon Project
NAP   National Action Plan
OECD  Organization for Economic Cooperation and Development
TPD   Tons per day
UNEP  United Nations Environment Programme
UNITAR United Nations Institute for Training and Research
UNODC United Nations Office of Drugs and Crime
USAID United States Agency of International Development
USGS  United States Geological Survey
WHO   World Health Organization
WWF   World Wildlife Fund
ABOUT THIS REPORT

As part of the worldwide release of our documentary film, River of Gold, we present the first in a two-part series of studies on the impacts of gold mining.

But first a little about Amazon Aid and River of Gold: our goal is to educate people about the importance of the Amazon – the implications of its destruction and solutions for protecting it. We do that through words, through images, and through relationships with communities and agencies working to protect the Amazon. Because we believe that together we are better.

Narrated by Academy Award winners Sissy Spacek and Herbie Hancock, River of Gold is the disturbing account of a clandestine journey into Peru’s Amazon rainforest to uncover the savage unraveling of pristine jungle by illicit, small-scale gold mining. With the Spring 2021 release of the film comes an accompanying social impact campaign, resource guide, school curriculum, and educational initiatives that we hope will activate governments, NGOs, industry stakeholders, scientists, artists, and the general public to take specific actions to address the consequences of unregulated gold mining.
This report broadens the scope of *River of Gold*. It synthesizes hundreds of papers, media articles and more to give an overview of the impacts of gold mining in each of the eight Amazonian countries, including the well-documented impacts of mercury contamination and human rights violations, as well as some lesser-known impacts, such as carbon emissions and outbreaks of malaria among poor miners.

While preparing the below, a new gold rush was afoot in the Amazon and beyond, triggered by the pandemic. As Covid-19 spread and the world struggled to adapt, investors saw gold as one of the few stable commodities in an unstable financial climate, driving its price per ounce to over $2,000 in August 2020, a record high. Economic desperation and lax government enforcement led to increases in deforestation, displacement of indigenous communities, and more mercury pollution of air, water, soil, and food chains. Even as illegal mining and the global price of gold rose, many in the mining sector suffered. The collapse of local supply chains led to decreases in local gold prices and reduced income for most artisanal miners.

We at Amazon Aid care deeply about the myriad and devastating impacts of our actions vis-à-vis gold, and feel responsible to help readers and viewers around the world understand those impacts while seeking cleaner approaches to gold mining.

While we made every effort to paint a comprehensive picture, data gaps still exist and, for example, we devoted little attention to large-scale gold mining, mining legislation, and the legislation governing indigenous territories.

Our hope is that this paper will be useful for a range of audiences, from consumers and industry members interested in the on-the-ground impacts of the gold market, to government and non-government actors wishing to learn about hotspots of gold mining in the Amazon. For it’s our belief that a multi-stakeholder perspective is crucial, as it distributes responsibility to create more sustainable, lasting solutions for the Amazon and its people.

But this is just a beginning. While understanding the realities of gold mining in the Amazon is the first step to raising awareness, understanding how the supply chain shapes these realities is just as important. That’s why this paper is the first in a two-part series, the second of which will provide an in-depth analysis of the gold trade and propose a set of market solutions.

We hope the below report helps you see and better appreciate the magnitude of the problem created by illicit and unregulated gold mining in eight very different Amazonian countries.
1.1 Historical Context of Gold Mining in Latin America

Long before Columbus made landfall in the Americas, native societies were mining and decorating with gold. Gold artifacts dating as far back as 2,000 BC have been found in the Lake Titicaca Basin of Southern Peru.\(^1\) By the time the Spanish met the Inca in 1526, this practice had developed into a sophisticated tradition of casting, welding and plating.\(^2\) While still a display of power, gold in pre-Colombian societies was used largely for ceremonial and ornamental purposes. By contrast, for Europeans gold held monetary value and symbolized the prospect of individual and imperial mobility. Legends about gold fueled mania in European explorers, leading them into reckless journeys into remote regions and brutal clashes with Amerindian societies.\(^3\)

When Columbus arrived in the West Indies in 1492, he was on his way to Japan to find what Marco Polo had described as the island of “endless” gold.\(^3\) Encouraged by native ornaments and rumors of gold, Columbus wrote eagerly to Spain about the extravagant riches of the New World.\(^4\) Three decades later, Spanish conquistador Hernán Cortés would march into Tenochtitlan to sack the Aztec Empire’s treasury of gold artifacts, most of which were sent to Spain and melted into bullion.\(^5\) Meanwhile, the legend of El Dorado, originally the story of a chief who sprinkled gold into the waters of Lake Guatavita whenever he bathed, inspired dozens of expeditions into the interior of South America. Among the most famous were Conquistador Lope de Aguirre’s journey down the Amazon River, and Englishman Sir Walter Raleigh’s expedition to Guiana, both brutal tales of war and indigenous slaughter.\(^6\)
In spite of these extravagant and destructive quests, colonial gold mining in Spanish America yielded little return (silver extraction was considerably more lucrative). Latin America's first large-scale colonial gold rush happened in Brazil, following the discovery of gold in the 17th century in the southeastern interior, a region still known today as Minas Gerais (General Mines). Thousands of Portuguese immigrated to the region, importing African slave labor and killing off local native tribes. Over 600 tons of gold were produced in Minas Gerais alone in the 18th century, making Portugal one of the richest European empires of the period.

Although the flow of gold in today's world works very differently than during colonial times, it is also a reiteration of a very old cycle. Not only does mining remain an industry that breeds desperation and violence, it also continues to serve the powerful at the peril of the vulnerable. In the case of the Amazon, that means neglected Brazilian immigrants in Suriname with malaria, impoverished miners in Venezuela extorted by guerilla groups, and indigenous tribe members, many of whom have been poisoned, killed and even enslaved for gold.

1.2 Large-Scale Gold Mining

Large-scale gold mining (LSGM) operations are mechanized with high capital investment and gold yields, and comparatively low labor intensity. While not always the case, large-scale mining operations typically meet national and international requirements, including the payment of royalties and taxes, the acquisition of mining permits, and compliance with health, safety, social, environmental, and mine closure standards. Of the officially reported, newly mined gold that enters the global market each year, 80% derives from LSGM facilities.

While LSGM is typically more formalized and regulated than artisanal and small-scale gold mining (ASGM), it can still have several negative environmental and social impacts. In general, LSGM operations use open pit techniques and cyanide heap leaching to extract gold from the ore. These techniques require perpetual pollution monitoring even after mining operations end and consume large quantities of water and energy. Furthermore, LSGM often creates multi-story earthen dams that retain millions of cubic meters of mine tailings and are prone to collapse. An estimated 20 tons of waste rock, rock that has no economic value, are produced in LSGM operations to retrieve enough gold to produce one gold ring.

Finally, LSGM can push deforestation and community displacement well beyond the limits of its operating lease or concession, as it often results in land use displacement, urban expansion, development of commodity supply chains, and concerns over mine waste discharge and spills.
1.3 Artisanal and Small-Scale Gold Mining (ASGM)

Globally, 10-20 million people, including 4 to 5 million women and children, work directly in the artisanal and small-scale gold mining sector. Artisanal and small-scale gold miners are typically the poorest and most marginalized in society, and consequently often work outside the formal economy. ASGM produces about 20% of global gold output and contributes up to 90% of the gold mining workforce. Consistent with the global gold rush over the past two decades, the number of artisanal and small-scale miners in Latin America has more than doubled in the last 15 years, reaching about 1.5 million individuals directly employed in the sector.

The terms artisanal, small-scale, informal and illegal are often used interchangeably and inconsistently. According to Veiga (1997), the term “artisanal” refers to miners who use rudimentary methods (as opposed to conventional methods) but does not describe the size of the operation. However, other institutions may use the terms artisanal and small-scale to refer to the amount of ore processed. For example, the Peruvian government defines artisanal and small-scale as miners processing up to 25 tons per day (TPD) and 350 TPD respectively. Artisanal and small-scale gold miners often work illegally, because formalization is not financially or practically feasible. Illegal operations can be small-scale or heavily mechanized, with as many as thousands of hired workers and multi-million-dollar investment. Miners are also often said to work informally. In some contexts, this signifies that the miner is en-route to formalization but has not yet acquired legal license. In others, it means that miners operate outside the scope of any regulatory framework, but not in a way expressly prohibited by law. Finally, an informal miner may not have official state approval but may work in a manner unofficially sanctioned by the community or local authorities.

Mineral wealth can be a valuable asset for sustainable development in regard to stimulating economic growth, and it has played a substantial role in many developing economies. In Guyana, for example, ASGM represents about 14% of total GDP. The World Bank and a number of development agencies view ASGM as an important source of economic development and poverty relief, noting that it can provide an alternative livelihood in rural areas. Nevertheless, the unregulated environment of informally-mined gold often leads to clandestine trading practices in which buyers do not pay tax to the gold-producing states and, therefore, the states miss out on important sources of revenue.

14 United Nations Environment Programme (UNEP), (n.d.)
15 Swenson and Domec 2011
16 Ibid
17 Fritz et al., 2018
18 USAID, 2019
19 Verité, 2016
20 UNEP, (n.d.)
21 IGF, 2017
22 World Bank, 2019
23 de Haan et al., 2020
1.4 Artisanal Mining Methods in the Amazon

Most artisanal and small-scale miners in the Amazon mine from alluvial gold (deposits found on land and in rivers and streams). Alluvial (or placer) mining varies greatly according to the local context, but typically involves some combination of hand panning, sluice boxes, heavy equipment, hydraulic mining, and dredging. In the Amazon region, miners commonly clear forest cover and then remove topsoil using machinery and high-pressure hoses to form a mining pit. The remaining mixture of gold-bearing soil and water, known as a “slurry,” is then passed down a sluice system, whereby the denser gold and fine-sediment (concentrate) are trapped. Miners may also work on barges (known as balsas or dragas) using dredges. This involves the use of hoses to suck sediment and water directly from the bottom of the water body, and then processing the gold using sluices or other equipment onboard the barge.

Artisanal and small-scale miners typically use mercury to separate the gold, forming a mercury-gold amalgam. There are two ways of using mercury in gold mining: concentrate amalgamation, in which miners apply mercury after refining the ore with a concentration technique like those described above; and whole-ore amalgamation, in which miners apply greater quantities of mercury without prior concentration. While relatively uncommon in the Amazon, whole-ore amalgamation is considered by the Minamata Convention on Mercury as a worst practice, to be eliminated (the negative health and environmental effects of mercury contamination are described below). Once mercury is mixed with the gold-bearing sediment, the amalgam is then heated to vaporize the mercury and purify the gold. Although miners and gold shop owners occasionally use retorts, devices that capture mercury vapor and reduce losses by up to 95%, the more common practice is open-air burning of the amalgam, a technique that releases up to 50% of mercury into the environment.

1.5 Mercury & Cyanide

When miners and owners of gold shops burn the mercury-gold amalgam, their families and communities directly inhale significant amounts of mercury vapor, which accumulates in the kidneys and brain. Mercury exposure can also cause miscarriages, respiratory failure, psychotic reactions, cardiovascular disease and even death.

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24 USAID, 2019
25 USAID, 2019
26 UNEP, 2017
27 UN Environment, 2013
28 Veiga and Hinton, 2002
29 Agency for Toxic Substances and Disease Registry, 1999
Mercury may also enter the local environment in its liquid state, where it can precipitate into ecosystems, poisoning rivers, fish and crops. Once in waterways, bacteria absorb mercury and transform it into methylmercury, an organic compound more toxic than inorganic mercury, which bioaccumulates up the food chain.\textsuperscript{30, 31} Furthermore, miners and processors may use sodium cyanide to obtain residual gold from mercury-contaminated tailings (mining waste). When disposed of improperly, this process releases mercury-cyanide complexes into waterways, which are highly bioavailable and represent a significant threat to downstream aquatic life.\textsuperscript{32}

It is important to note that ASGM is not the only factor to consider when assessing mercury in tropical ecosystems. Many areas in the Amazon have soils naturally enriched with mercury and processes such as geologic weathering, erosion from deforestation, biomass burning, plant transpiration and decomposition, and hydrological patterns all play an important role in the release and transport of mercury.\textsuperscript{33, 34}

1.6 Criminal Activity

In some cases, the informality and opacity of ASGM contributes to illicit activities. According to the Organization for Economic Cooperation and Development (OECD), ASGM cannot be considered legitimate when “it contributes to conflict and serious abuses associated with the extraction, transport, and trade of minerals.”\textsuperscript{35} Conflict and serious abuses include any form of cruel and inhuman treatment, any form of forced or compulsory labor, the worst forms of child labor, war crimes, and other gross human rights violations.\textsuperscript{36}

Because gold holds high value in small amounts and is easily smuggled, it is a desirable resource for illicit groups. The informality and lack of transparency in ASGM enables corruption and criminal activity to flourish. Miners often have few options and are reliant on illicit groups to access materials and trade their product. This can further impede sustainable development, as once the miners are associated with criminal actors it can be more difficult to access the financial and legal means necessary to formalize. The combination of informality and extreme poverty create an environment where mining communities are vulnerable to violence, exploited or forced labor, and human trafficking.

The effects of criminal actors benefitting from ASGM are far reaching, threatening human security, the rule of law, good governance, and economic stability. In Colombia and Venezuela, where organized crime is strongly linked to illegal gold mining, narco-terrorist and guerilla groups have extorted miners in order to finance their operations.\textsuperscript{37, 38} In Peru, criminal activities are less centralized, but violence, sex trafficking and forced labor are nonetheless widespread.\textsuperscript{39}
Even when mining does not take place directly on their territory, indigenous peoples are often disproportionately affected by nearby mining activities because they are susceptible to the spread of disease and are typically more reliant on forest resources for survival. The accumulation of methylmercury in fish poses an especially large risk to indigenous people, as fish consumption tends to be an essential component of their diet. Numerous studies reveal elevated mercury levels in indigenous Amazon communities and fish consumption is widely believed to be the primary, though not exclusive, source of exposure. One review paper examined studies on 46 indigenous populations in the Amazon and found mercury exposures on average 7.5 times higher than background levels in the general population.

In some cases, indigenous peoples will participate or profit from mining. This situation often results from a lack of economic alternatives, especially after mining has spread in the region and impacted natural resources. Whether or not indigenous people engage in mining, they often demand the expulsion of miners operating without consent on their land, as is the case with the campaigns of the Mundukuru and Yanomami in Brazil. Many indigenous people and other environmental activists who resist illegal mining face threats, violence, and even murder. A 2020 Global Witness report on killings of environmental defenders concluded that mining was the most dangerous sector in 2019, with 33 people murdered in the Amazon region alone, about 15% of the global total of killings.

1.7 Protected Areas and Indigenous Peoples

In Latin America, illegal gold mining frequently occurs around protected areas, which typically have high conservation or cultural value. This is largely because by working in remote regions illegal miners can elude government enforcement. A 2015 study of gold mining sites in tropical forest regions of South America found that over 30% of total deforestation from gold mining occurred inside or within 10 km of 32 protected areas. A more recent report published by the World Resources Institute found that about 6% of total indigenous land in the Amazon (about 14,300,000 hectares) directly overlaps with active mining concessions or ongoing illegal mining activities.

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Photo by Sam Abell

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40 Alvarez-Berríos & Aide, 2016
41 Vallejos et al., 2020
42 Ashe, 2012
43 Hacon et al., 2008
44 Basu et al., 2018
45 Bristol, 2020
46 Angel, 2019
47 Branford, 2020
48 Wachenje, 2020
1.8 Land Degradation and Carbon Emissions

While agriculture and cattle ranching account for more total deforestation in the Amazon, the impact of Amazon gold mining is considered worse on a per hectare basis, due to its depletion of soil nutrients, deterioration of water quality, and transformation of riverways. Repeated soil disturbances and the formation of mining pools delays pioneer species growth and complete forest regeneration can take centuries. Furthermore, when miners use high-pressure hoses and pumps, they alter water flow patterns and increase sediment loads in rivers more than almost any other land-use activity, a process that degrades water quality and transforms underwater light fields.

Amazon ASGM, particularly when unregulated, also contributes to climate change, as the Amazon rainforest is a crucial carbon sink that stores from 90-140 billion tons. One study, conducted in the Peruvian Amazon where illegal mining has been particularly severe, found that in 2017 over 1 million tons of carbon were released in the region of Madre de Dios, equivalent to the emissions of about 250,000 cars in an average year. Another study estimated that the slow regeneration of forests degraded by gold mining contributes about 21,000 tons of carbon per year, more than other land-use activities in the Amazon such as agriculture.49

1.9 Malaria and Zoonotic Disease

Habitat destruction is a critical factor in the spread of infectious disease. Research suggests that deforestation and other land-use changes are responsible for up to 31% of emerging diseases. By pushing disease-carrying animals out of forests and closer to humans, deforestation increases the rates of zoonotic (animal-borne) infections, which account for up to 75% of emerging infectious diseases. Additionally, habitat destruction tends to weaken natural buffers to the spread of disease and strengthen disease vectors, such as mosquitoes. One study conducted in the Amazon found that increasing deforestation by 10% increased malaria cases by 3%, causing tens of thousands of cases (although malaria outbreaks have been shown to reduce clearcutting over time).

ASGM can drive malaria transmission as it often leads to deforestation and abandoned mining pools that are optimal mosquito breeding grounds. Miners are susceptible to malaria because they work in dense clusters and have poor access to education and health services. Gold mining’s role in spreading malaria and other zoonotic diseases has become an increasing source of concern, particularly in light of the Covid-19 pandemic, and it has been studied in a number of Amazon countries.

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49 Peterson & Heemskerk, 2001
45 Eakin, 2008, pp. 606-608
50 Lobo et al., 2016
51 Lobo et al., 2017
52 Yale School of the Environment, n.d.
53 Csillik & Asner 2020
54 Kalamandeet al., 2020
55 Kessler, 2018
56 Salyer et al., 2017
57 MacDonald & Mordecai, 2019
58 Langlois, 2020
59 Sanchez et al., 2017
60 Castellanos et al., 2016
61 Douine et al., 2018
Gold Mining in Amazon Countries: an overview

Photo by Tómas Muníta
2.1 Brazil

Containing about two-thirds of the total Amazon Basin, Brazil is the most biodiverse country in the world. Approximately 30% of Brazil's landmass is protected, with 708 of its 2,299 protected areas as indigenous reserves. Although Brazil made commendable efforts to significantly reduce deforestation in the early 2000s, annual deforestation rates began to increase again in 2013 and incursions into protected lands became more frequent after the inauguration of the President Jair Bolsonaro on January 1, 2019.

As of 2014, there were between 200,000 and 467,000 artisanal and small-scale gold miners in Brazil. These miners contributed up to 80% of Brazil's 87.7 tons of exported gold (though the exact figure varies according to the source). Official annual gold production has recently increased, reaching 106.9 tons in 2019. The Brazilian Federal Public Ministry recently calculated that a kilogram of gold represents approximately 1.7 million reais (over $300,000) in environmental damages.

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Highlights

- Brazil's rapidly growing ASGM sector is concentrated in the Amazon, particularly the Tapajós River Basin, which represents the largest ASGM district in the world.
- Native communities bear much of the burden for illegal ASGM, with 10,245 hectares lost over three indigenous territories from 2017-2019.
- Brazil's mercury emissions are among the highest in the world (105 tons/year), though it is difficult to precisely determine ASGM's contribution.
- Due to relaxed government enforcement, deforestation caused by illegal gold mining reached 10,500 hectares in 2019 alone and is on track to be even worse in 2020.

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62 UNEP-WCMC, 2018
63 Azevedo-Ramos & Moutinho, 2018
64 Kolen et al., 2013
65 Fritz et al., 2018
66 USAID, 2019
67 Gold Hub, 2020
68 Semana Sostenible, 2020
Much of Brazil’s gold sector is concentrated in the Amazon, with four of the ten municipalities with highest production in Amazonian states.

Much of Brazil’s gold sector is concentrated in the Amazon, with four of the ten municipalities with highest production in Amazonian states. The Tapajós River Basin, which in 2012 contained at least 50,000 miners (known locally as garimpeiros) distributed in over 300 mining sites, represents the largest ASGM district in the world.69 Similar to other hotspots of illegal mining, miners working in the Tapajós River Basin have minimal access to education and struggle to meet stringent legal requirements, which limits their capacity to improve practices.70

ASGM activities in the Tapajós have severely impacted the river through sedimentation as well as mercury and cyanide contamination71 and between 2001-2013 deforestation reached 18,300 hectares.72 Furthermore, with 105 tons released annually, Brazil’s mercury emissions are among the highest in the world.73 Although it is difficult to determine what percentage of this derives from gold mining, a World Wildlife Fund (WWF) report estimated that ASGM accounts for about 70% of emissions in the Amazon, suggesting about 74 tons / year.74

Large-scale mining has also had a strong environmental and social impact in the Brazilian Amazon. Canadian gold companies in Godofredo Viana in the State of Maranhão (Equinox Gold) and in Pedra Branca do Amapari in the State of Amapá (Great Panther Mining) each produce over four tons of gold per year. In Peixoto de Azevedo, in the State of Mato Grosso, ASGM and LSM have severely disrupted the Peixoto de Azevodo river, an area inhabited by isolated indigenous people.75

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69 Lobo et al., 2016
70 Sousa et al., 2011
71 Ibid
72 Alvarez-Berríos & Aide, 2016
73 USAID, 2019
74 Dalberg & WWF, 2018
75 Semana Sostenible, 2020
76 Sonter et al., 2017
A Gold Rush in Brazilian Indigenous Territories

Relaxed enforcement of illegal gold mining in Brazil in the past few years, exacerbated by the Covid-19 pandemic and a loosening of environmental protections under Bolsonaro, has had severe consequences for the rainforest and indigenous communities. The Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) reported that in 2019 illegal deforestation caused by gold mining broke a record: 10,500 hectares lost, an increase of 23% over the previous year, with Tapajós the most affected region.\(^7\)

According to data from January-June, the trend in 2020 appears to be worsening, with 2,230 hectares lost inside conservation units and 1,016 hectares inside indigenous territories, an 80% increase compared to the same period in 2019.\(^8\)

Indigenous communities are paying the price for this deluge. The Monitoring of the Andean Amazon Project (MAAP) of the Amazon Conservation Association (ACA) conducted a study across three Amazon indigenous territories (Yanomami, Kayapó, Munduruku) and found that 10,245 hectares were cleared by illegal miners from 2017-2019, with 44% of damage occurring in 2019.\(^9\) Elevated mercury levels have been found among Yanomami people living in proximity to ASGM sites.\(^8\) Experts also assert that stagnant pools induced by mining activities are increasing incidences of malaria among native and mining populations.\(^8\)

In mid-June 2020, two members of the Yanomami tribe, South America’s largest isolated indigenous group, were killed, igniting fears of a second “Haximu Massacre,” a bloody 1993 conflict in which miners killed 16 tribesmen and Yanomami killed two miners. After the Yanomami launched the “Miners out, Covid out” campaign, a federal judge ordered the Bolsonaro administration to stop the spread of the pandemic by removing 20,000 invading miners within ten days.\(^\) While this is a victory, some stakeholders fear the ruling will push miners into Yanomami territory in Venezuela. Additionally, it does not address gold mining in the Munduruku and Kayapó lands, which according to MAAP have inflicted even more damage.

\(^7\) Semana Sostenible, 2020  
\(^8\) Vega et. al., 2018  
\(^9\) Gonzaga, 2020  
\(^\) Finer, 2020
2.2 Peru

In 2019, Peru was the largest gold producer in Latin America and the tenth largest in the world, officially exporting about 143.3 tons.\(^83\) While the numbers vary, the Peruvian government estimated between 300,000-500,000 artisanal and small-scale gold miners working in Peru as of 2014.\(^84\)

In recent decades, Peru has experienced an explosion in ASGM in the Amazonian region of Madre de Dios, particularly around La Pampa, a city of about 25,000 in what is known as the “Buffer Zone” of the Tambopata National Reserve. The high price of gold ($1,300-$2,000/oz) has attracted thousands of migrants, particularly from the Andes, most of whom turn to mining to escape extreme poverty and unemployment. While estimates of illegal miners in the region vary considerably, the Global Environmental Facility (GEF) stated in 2018 that half of the population of Madre de Dios was involved in ASGM, or about 70,000 people.\(^85\)

Although this gold rush brought some economic benefits (illegal mining constitutes about 60% of the region’s economy\(^86\)), it has left many negative impacts on the environment and human health. A 2018 study of the Peruvian Amazon concluded that 100,000 hectares were deforested due to ASGM activities over the last 34 years, with about 65,000 hectares deforested from 2010 to 2017.\(^87\) Despite strict laws protecting the Buffer Zone around the Tambopata Reserve, illegal miners have cut down

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\(^83\) Workman, 2020  
\(^84\) United States Agency of International Development, 2020  
\(^85\) GEF, 2018  
\(^86\) Catanoso, 2020  
\(^87\) Caballero Espejo, et al., 2018
A 2018 study of the Peruvian Amazon concluded that 100,000 hectares were deforested due to ASGM activities over the last 34 years, with about 65,000 hectares deforested from 2010 to 2017.

over 20,000 hectares of forest since 2016 and converted an area roughly the size of Manhattan into pools contaminated with mercury. Furthermore, in the last 20 years, more than 3,000 tons of mercury has been dumped into the Peruvian Amazon, with about 185 tons released per year.

A 2012 study in the Amazon city of Puerto Maldonado found that 60% of fish species sold in markets and 78% of 226 adults tested had elevated mercury levels, in some cases over 27 times the EPA’s reference limit. While mercury poisoning affects the entire population, indigenous tribes have been particularly impacted, with one study showing elevated levels in 78% of the Nahua tribe. In 2016, government authorities declared a state of emergency in eleven districts of Madre de Dios due to elevated mercury levels in people, which was correlated strongly with fish consumption.

Gold mining in the Peruvian Amazon has also resulted in the expansion of criminal activity and labor abuses. As with neighboring Colombia, gold has surpassed cocaine as Peru’s most valuable illicit export. Since 2010, at least 50,000 children have been forced to work in illegal gold mines or subjected to sex trafficking in mining camps and in 2017 Madre de Dios police uncovered a mass grave with 20 burned bodies thought to be laborers from illegal mining camps. Thousands of women and children are vetted to work in bars that also serve as brothels and then have few options to escape. In 2016, local police estimated up to 4,500 trafficked girls in Peru’s La Riconada region alone.

Operation Mercury and its Aftermath

Responding to global outcry and local unrest, the Peruvian government launched Operation Mercury in 2019, forcibly expelling and arresting thousands of illegal miners in La Pampa. As a result of this operation, the MAAP project reported that deforestation from gold mining in 2019 was reduced by 92% compared to 2018. Although the region’s current governor is making bold efforts to regulate mining and generate tax revenue, the decrease in ASGM activity plunged the region into a recession and precipitated a rise in crime that has hurt the local ecotourism sector.

Furthermore, evidence suggests illegal mining has expanded in isolated areas in the region, particularly in indigenous communities. Boca Pariamanu, one of the multiple native communities in Madre de Dios, has seen a 70% increase in 2020 around its territory. As a result of contamination of the nearby Pariamanu river with mercury from these operations, the Amahuaca people stopped eating fish and installed new drinking water systems. Additionally, indigenous leaders from the 4,000-hectare Amarakaeri Communal Reserve report expelling illegal miners and are concerned that activities will go unchecked amid Covid-19, a period of heightened vulnerability to illegal incursions.
2.3 Colombia

With recent estimates ranging from 182,000-350,000 artisanal and small-scale gold miners, Colombia, along with Brazil, has experienced the greatest increase in its ASGM workforce in Latin America over the last fifteen years.\textsuperscript{99,100} Gold production in 2016 reached 61.8 tones, with the formal sector producing about 13\% of production and the illegal and informal sector about 87\%.\textsuperscript{101} However, from 2017-2019, official gold production diminished to about 38 tons per year, likely due to an increase in illicit production and a decrease in production controls, rather than an actual mitigation of the sector.\textsuperscript{102}

Gold mining in Colombia is characterized by its unusually high association with organized crime, with about 50\% of all illegal gold linked to criminal groups.

Highlights

- The artisanal gold mining sector in Colombia is among the fastest growing in Latin America and mercury pollution is among the severest in the world.
- About 87\% of Colombian gold production comes from the informal and illegal sector, 50\% of which is associated with criminal groups.
- As of 2019, about 52\% of alluvial gold mining operations took place in protected areas and 88\% in the non-Amazonian departments of Chocó, Antioquia, and Bolivar.
- In the bioverse, tropical region of Chocó, alluvial gold mining has impacted over 35,000 hectares of land.

\begin{itemize}
  \item Bebbington et al., 2018
  \item PlanetGOLD, (n.d.)
  \item Verdad Abierta, 2017
  \item UNODC, 2018
\end{itemize}
Gold mining in Colombia is characterized by its unusually high association with organized crime, with about 50% of all illegal gold linked to criminal groups. It is important to note that this does not mean that 50% of illegal miners belong to criminal groups. Rather, miners are very often exploited, sometimes receiving only a small share for their gold while having to pay a fee, or vacuna, to the controlling group, often under threat of torture or death. As with neighboring Peru, gold has replaced cocaine as Colombia’s most lucrative illegal economy and 43% of territories affected by alluvial ASGM are also associated with coca production. As of 2016, criminal groups profiting from illegal gold mining included FARC, which in 2012 received 20% of its funding from gold sources; Ejército Nacional de Liberación (ELN) guerrilla groups; and Urabeños and Rastrojos criminal bands (BACRIM). Forced labor and sex trafficking is widely documented, particularly in rural areas controlled by these groups.

Between 2014–2019, alluvial gold mining in Colombia impacted over 145,000 hectares of land and, in 2019, resulted in the loss of about 7,000 hectares of forest cover with “high environmental value,” as defined by the United Nations Office of Drugs and Crime (UNODC). As of 2019, about 52% of alluvial mining operations took place in protected areas and 88% in the non-Amazonian departments of Chocó, Antioquia, and Bolivar. In the tropical forests of Chocó, which boast over 50,000 species, alluvial gold mining impacted over 35,000 hectares of land. Although about 35% of Colombia in land mass is Amazon rainforest, 1% or less of alluvial gold mining took place in Amazonian departments as of 2019. Nonetheless, the national natural park most affected (75 hectares) by alluvial mining in 2019 is located in the Amazonas region (the Puinawai National Nature Reserve) and about 138 hectares of the Amazonia Forest Reserve have also been affected. Mercury pollution in Colombia is among the worst in the world, with 50 to 100 tons of mercury released into rivers each year. Due to mercury and cyanide contamination from mining operations, the Atrato River in Chocó has become the most polluted river in Colombia.

Afro-Colombian populations, known in Colombia as Comunidades Negras, are the specialized group most impacted by ASGM, with alluvial mining operations affecting 40,000 hectares of their territories, primarily in Chocó. While many of these communities have mined on an artisanal and micro-scale for centuries, an influx of small-scale miners in the last decade using backhoes and dredges have transformed the sector substantially and gold flow is now dominated by criminal and guerilla groups. Indigenous people are in general less impacted by gold mining than other specialized groups in Colombia. In total, only about 494 hectares of alluvial mining was detected on native territories, primarily in territories of the Emberá-Katio and Emberá peoples in Chocó. The Colombian magazine Semana reported widespread mercury poisoning in a remote Vitoto community. The article draws on a government report showing mercury levels among the highest in the country among inhabitants of several native communities along the Caquetá River, an area subject to illegal mining incursions from Brazil and Peru.

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103 Castilla et al., 2015
104 UNODC, 2020
105 Castilla et al., 2015
106 Verité, 2016
107 UNODC, 2018
108 Ibid
109 UNODC, 2020
110 Sarmiento, et al., 2013, 46-67
111 Gillingham & Valenzuela, 2019
112 Ibid
113 OECD, 2017
114 UNODC, 2020
115 Guarnizo, 2018
2.4 The Guianas

Although the Guianas (Guiana, Suriname, and French Guiana) represent just 7% of the Amazon rainforest, their proportionate rate of gold mining, deforestation and mercury use are extremely high. In 2017, the Intergovernmental Forum (IGF) on Mining, Minerals, and Sustainable Development estimated at least 40,000 gold miners operating in Suriname. In French Guiana and Guyana, recent figures from journalists estimate 8,000-10,000 gold miners and about 20,000 miners respectively.

Combined, the Guianas officially produced almost 55 tons in gold in 2017, roughly equal to Colombia’s production the same year (see Table 1). In each country, LSGM coexists with ASGM and, although multinational operations account for only about 1% of land affected, there may be illicit cooperation between the two spheres.

The gold sector in Suriname, a multi-ethnic country with the highest percentage of forest cover in the world, is particularly significant. With over 80% of its income from gold exports, Suriname reached an annual official production of 32.8 tons in 2019, making it the tenth largest gold producer in the world relative to country size. French Guiana is a French territory with a better standard of living than other Guiana countries and more effective government enforcement. Nonetheless, despite official production rates of around 2 tons of gold per year, other estimates have found that actual total extraction counting illegal activities is closer to 10 tons, worth about a half billion dollars.

Highlights

- Gold mining is the greatest threat to forests in the Guianas, accounting for over 70% of deforestation in Guyana and Suriname and over 120,000 hectares of loss since 2000.
- Guyana is a regional hub of mercury trade, importing about 22 tons per year, while in Suriname about 50 tons are released into the environment per year.
- Elevated mercury levels have been recorded in Amerindian and Afro-indigenous populations (Maroons) in all three countries.

116 Press, 2019
117 Ebus & Leeuwin, 2020b
118 Dezécache et al., 2017
119 Ebus & Leeuwin, 2020a
120 Goldhub, 2020
121 Douine et al., 2018
It should be noted that roughly 60-75% of gold miners in Suriname and French Guiana are Brazilians who crossed the border illegally and a large share of mining takes place on the lands of the Maroon People, an Afro-Indigenous group with members directly and indirectly active in the mining economy.  

In Guyana, an impoverished nation where gold mining is more formalized than most other Latin American countries, small and medium-scale gold mining account for about two-thirds of gold production and in 2014 artisanal mining supplied about 14% of total GDP.  

As the only country in the Guianas that still imports licensed mercury, Guyana also functions as a hub of illegal mercury trade to Suriname and Brazil. Since Guyana joined the Minamata Convention, annual imports of mercury have decreased, though the average annual import since 2014 of over 22 tons per year is still substantial.  

While the Guianas have comparatively low rates of deforestation, gold mining is the biggest threat to their forests and has increased exponentially since 2000. In Suriname, mining accounts for 73% of deforestation, primarily from small and medium-scale gold mining, resulting in the loss of almost 60,000 hectares from 2000-2015.  

In Guyana, ASGM accounts for over 80% of deforestation and approximately 57,000 hectares were lost from 2010-2017, a total roughly equivalent to ASGM deforestation in Peru during the same period. Although deforestation rates in French Guiana remained low from 2000-2015 (~1,000 ha / year), one study estimated that the expulsion of miners by French authorities precipitated an increase of 12,100 hectares in Suriname, even as it decreased deforestation by 4,300 ha in French Guiana.  

Mercury released into the environment from ASGM, which primarily enters the Guianas through Guyana and China, reaches up to about 50 tons per year in Suriname, where gold production is highest. Elevated mercury levels, occurring primarily from methylmercury exposure through fish consumption, have been found in Amerindian tribes and Maroon groups in Suriname, French Guiana (Wayana tribe), and Guyana. Furthermore, immigrant Brazilian miners in French Guiana, a marginalized population with poor health and access to social services, have triggered malaria outbreaks and experts fear their strenuous lifestyle in remote areas may encourage the spread of additional zoonotic illnesses.  

### Table 1 Estimates of Official Gold Production and Small-Scale Miners in the Guianas

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of small-scale miners</th>
<th>Annual gold production in 2017125 and 2019126</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suriname</td>
<td>40,000 (2017)127</td>
<td>30.1 tons (2017)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32.8 tons (2019)</td>
</tr>
<tr>
<td>Guyana</td>
<td>20,000 (2020)128</td>
<td>22.4 tons (2017)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.5 tons (2019)</td>
</tr>
<tr>
<td>French Guiana</td>
<td>8,000-10,000 (2019)129</td>
<td>1.98 tons (2017)</td>
</tr>
</tbody>
</table>

122 Heemskerk & Oliviera, 2004  
123 World Bank, 2019  
124 Ebus & Leeuwin, 2020b  
125 George, 2020  
126 Goldhub, 2020  
127 IGF, 2017  
128 Ebus & Leeuwin, 2020b  
129 Douine et al., 2018  
130 Ibid  
131 Popkin, 2019  
132 Guyana Forestry Commission, 2018  
133 Dezécache et al., 2017  
134 Ebus & Leeuwin, 2020a  
135 Ouboter et al., 2018  
136 Fréry et al., 2001  
137 Watson et al., 2020  
138 Douine et al., 2018
2.5 Bolivia

Bolivia contains the third greatest amount of Amazon landcover and about 100,000 artisanal and small-scale gold miners.\textsuperscript{139} The small-scale mining sector is organized into cooperatives, which produced about 90% of the country’s 30-ton total official gold production in 2018.\textsuperscript{140} Roughly 30% of gold production is illegal in Bolivia, a moderate figure when considering that there are very few large-scale mining operations active in the country.\textsuperscript{141} Due to its sophisticated organization and political influence, the mining sector in Bolivia is less associated with violent conflicts and labor abuses, although cases of exploitation of miners by cooperative leaders do exist.\textsuperscript{142}

As with many other Amazon countries, ASGM and medium-scale gold mining have increased in Bolivia over the last two decades, especially in the departments of Pando and Beni, which intersect the Amazon biome, and in Santa Cruz.\textsuperscript{143} However, according to available data, deforestation in the Bolivian Amazon from ASGM is relatively mild, with principal hotspots in 2018 related to agricultural activities.\textsuperscript{144,145} According to RAISG (2018), Bolivia has among the highest mineral extraction areas of any Amazon country (1,129,103 hectares), but a relatively small percentage (<1%) of active mining in proportion to total area of Amazon rainforest.

\begin{itemize}
  \item While the total mineral extraction area (>1,000,000 ha) and number of small-scale miners (~100,000 miners) is high compared to other Amazon countries, existing datasets do not report significant Amazon deforestation.
  \item According to research published in 2016, the Bolivian gold mining sector emits about 93 tons of mercury per year, 7-20 tons of which end up in the Pantanal and Amazon lowlands.
  \item When Peru banned mercury imports, Bolivia’s mercury imports skyrocketed, becoming the second largest importer in the world and hitting a peak of almost 40 tons in 2015.
  \item Data gaps exist in documenting Bolivia’s total environmental degradation and mercury exposure of affected populations.
\end{itemize}

\textsuperscript{139} Bebbingoton et al., 2018  
\textsuperscript{140} http://www.mineria.gob.bo  
\textsuperscript{141} Verité, 2016  
\textsuperscript{142} Hendus, 2020  
\textsuperscript{143} Salman et al., 2013  
\textsuperscript{144} Ortega, 2015  
\textsuperscript{145} MAAP, 2019
When Peru banned mercury imports, Bolivia’s mercury imports skyrocketed, becoming the second largest importer in the world and hitting a peak of almost 40 tons in 2015. According to research published by WWF in 2016, the Bolivian gold mining sector contributes about 50% of Bolivia’s total 133 tons of mercury emissions per year, 7-20 tons of which end up in the Pantanal and Amazon lowlands. Furthermore, roughly 75% of Bolivian miners practice whole-ore amalgamation, a process that includes using greater quantities of mercury without prior concentration. Experts fear that proposed dams along the Madeira River watershed, which lies downstream of the Madre de Dios river, could act as a methylmercury reservoir for basin-wide ASGM activities, including mining hotspots in Madre de Dios, Perú.

According to the World Resource Institute, illegal mining affects 16 indigenous territories in Bolivia. Along the Bolivian Madre de Dios river, miners’ relationship to five overlapping indigenous communities (the Esse Ejja, the Machineri, the Cavineño, the Tacana and the Yaminahua) reportedly range from symbiotic to hostile. Although research on mercury poisoning in Bolivia is scarce, one study on the Beni River basin found lower levels than typical Amazonian populations, but higher concentrations in more remote tribes, such as the Esse Ejja.

146 Ebus, 2020
147 WWF, 2016
148 UN Environment, 2017
149 Caballero Espejo, et al., 2018
150 Salman et al., 2013
151 Bénéfice et al., 2009
2.6 Venezuela

Venezuela is a mineral-rich country with the highest percentage of illegal gold miners in Latin America (~90%)\(^{152}\) and the most identified illegal sites (at least 1,899).\(^{153}\) About 30% of the Amazon rainforest within Venezuela contains active or inactive mining concessions, a higher percentage than any other Amazon country.\(^{154}\) Estimates of artisanal and small-scale miners in Venezuela range between 250,000 and 500,000,\(^{155}\) with about 10,000 working in the State of Amazonas.\(^{156}\)

The recent increase in gold mining is in large measure due to the "Orinoco Mining Arc," an area the size of Portugal, established in 2016 by the Maduro Regime, containing one of the world’s largest gold reserves.\(^{157}\) The Arc is an effort to offset losses from the collapse of the oil industry, hyperinflation and international financial pressure. Although the majority of gold is smuggled outside of the country, state-run enterprises both mine and purchase illegally mined gold, which is then diverted to Venezuela’s Central Bank and either deposited or exported.\(^{158}\) The country reported producing about 28 tons in 2019\(^ {159}\) and internally purchasing 9 tons in 2018,\(^ {160}\) though rampant illegality makes these estimates suspect.

Highlights

- Precipitated by economic collapse and the creation of the Orinoco Mining Arc in 2016, Venezuela has the highest percentage of illegal gold production in Latin America (~90%).

- Mining concessions in Venezuela cover a higher percentage of land in the Amazon basin and more total area in indigenous territories than any other Amazon country.

- Estimates of total miners and deforestation in Southern Venezuela vary considerably, ranging from 250,000-500,000 miners and 80,000-280,000 hectares.

\(^{152}\) No Citation
\(^{153}\) Zuñiga, 2019
\(^{154}\) Vallejos et al., 2020
\(^{155}\) Montiel & Benezra, 2019
\(^{156}\) Despacho del Comisionado para la Organización de las Naciones Unidas (DCONU), 2019
\(^{157}\) Testimony of Carrie Filipetti
\(^{158}\) Rendon et al., 2020
\(^{159}\) Goldhub, 2020
\(^{160}\) Costa, 2020
Crime, violence, and human rights violations are prevalent in the Orinoco Mining Arc, which has been identified as a security threat to the United States.

Crime, violence, and human rights violations are prevalent in the Orinoco Mining Arc, which has been identified as a security threat to the United States. Guerilla groups and gangs regulate the flow of gold, including members of the ELN (dissidents of the FARC), prison gangs known as pranes, and pro-government groups known as colectivos. The miners, who receive only a small share for gold, are coerced (often under threat of torture or death) into paying a fee, or vacuna, of 10-15% to the controlling group. Mass graves have been found in mining pits, which are legacies of disputes between criminal groups, as well as between miners and criminal groups. Sex trafficking and prostitution, including with underage girls, have sharply increased, particularly in the State of Bolívar, where one official estimated about 3,500 women were employed.

The Orinoco Mining Arc contains over 190 indigenous communities. Over 6,000,000 hectares in indigenous territories are designated for mining, significantly more than any other Amazon country. It is difficult to determine what portion of this mining is invasive. In some cases, armed cartels and miners exploit or even enslave indigenous people, as in the case of members of the Yanomami tribe, some of whom were found with identifying numbers tattooed on their shoulders. Elsewhere, indigenous groups like the Pemon people, who occupy a nature preserve in the State of Bolívar, have been engaged in gold mining and a series of armed land conflicts, in order to survive amid the collapse of the tourist industry.


Home to over 9,400 flora species, the Orinoco Mining Arc intersects with 36 protected areas. Although mining is officially prohibited in specialized areas, illegal mining is pervasive, including in the Canaima National Park, a UNESCO World Heritage Site. According to a congressional testimony, about 280,000 hectares were cleared by illicit miners from 2011-2015. Other sources are more conservative, estimating between 80,000 – 105,000 hectares in total. One hotspot of concern is the Amazon Yapacana National Park, where between 2,000 and 10,000 miners operate, many of whom are Colombian guerrillas, and about 2,300 hectares have been cleared. Despite the official ban on mercury use, Colombian communities downstream from Yapacana had about 60 times WHO-recommended levels, though other sources may also have contributed. The increase in illegal mining in Venezuela, particularly in the South, has also contributed to spikes in malaria of almost 800% from 2010 to 2018.

2.7 Ecuador

ASGM accounts for 85% of total production in Ecuador, with estimates ranging from 90,000-200,000 miners.\(^{175}\)\(^{176}\) Following decline in its oil economy and the rise in gold price over the last two decades, Ecuador’s official gold production has steadily increased, peaking at 11 tons per year in 2019 (significant decreases were observed in 2016 and 2017, reportedly due to stricter government enforcement of small-scale mining).\(^{177}\)\(^{178}\) Nevertheless, other estimates of Ecuador’s gold production are significantly higher, likely due to the high rate of illegality (77% in 2016) and poor government control of the sector.\(^{179}\)\(^{180}\) ASGM production is highest in Southern Ecuador, with mining hotspots in Nambija in the Amazonian Province of Zamora-Chinchipe, Ponce Enriquez in the Province of Azuay, and Portovelo-Zaruma, in the Province of El Oro. In an effort to formalize the ASGM sector, increase tax revenues, and reduce illegal gold exports, the Central Bank of Ecuador (CBE) began a gold purchasing program that buys directly from ASGM, which saw some success but also ongoing security and economic challenges.\(^{181}\)

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**Highlights**

- Illegality and the artisanal and small-scale gold mining sector are significant, accounting for about 85% and 77% of total gold production, respectively.
- Gold production is highest in Southern Ecuador, with hotspots in Nambija in the Amazonian Province of Zamora-Chinchipe, Ponce Enriquez in the Province of Azuay, and Portovelo-Zaruma, in the Province of El Oro.
- A 2015 mercury-use ban resulted in some reduction but coincided with increased cyanide-use, posing environmental and health risks via mercury-cyanide complexes.
- Data gaps exist in documenting Ecuador’s total environmental degradation and mercury exposure of affected populations.

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\(^{175}\) Thomas et al., 2019
\(^{176}\) Bebbington et al, 2018
\(^{177}\) Banco Central del Ecuador, 2018
\(^{178}\) Goldhub, 2020
\(^{179}\) Gonçalves et al, 2017
\(^{180}\) United Nations Comtrade, 2019
\(^{181}\) Thomas et al., 2019
Although Ecuador banned mercury in 2015, the majority of gold mining processing centers continue using it and many have also expanded the use of cyanide. One study conducted in Portovelo-Zaruma reports that between 2013-2015 mercury use decreased by 60% but employing cyanide increased by about 30%, posing high risk to human health and aquatic environments via mercury-cyanide complexes. Among the 87 processing centers included in the study, an estimated 2,033 tons of cyanide were released in 2015, as well as about 0.22 tons of mercury released from tailings and 0.33 tons from amalgam burning.\textsuperscript{182} Downstream contamination from mercury and other pollutants by processing centers along Puyango-Tumbes River has recently led a coalition of Peruvian farmers, supported by the Organization of American States (OAS), to launch a multimillion dollar lawsuit against the Ecuadorian government.\textsuperscript{183} Furthermore, ASGM in Zamora-Chinchipe Province has contaminated the Amazonian Nangaritza River Basin with mercury and dissolved magnesium, putting children at risk and also indicating that ASGM can precipitate the release of heavy metals other than mercury.\textsuperscript{184}

Indigenous groups in the Ecuadorian Amazon have historically been greatly affected by and resistant to the aggressive expansion of the oil and mining industries. Following a series of illegal incursions, the Kofan people of Sinangoe won a landmark case in 2018, halting the development of over 52 mining concessions along the Aguarico River and protecting nearly 32,000 hectares of land.\textsuperscript{185} Furthermore, the Shuar peoples, one of the largest indigenous groups in the Amazon, along with other non-indigenous farmers, have recently appealed to the Constitutional Court of Ecuador and the United Nations Committee on Economic, Social, and Cultural Rights (CESCR) to contest a large-scale, multinational mining project (Mirador). Mirador is currently an open-pit copper mining operation, which resulted in forced evictions and the loss of up to 120 hectares from 2010-2015.\textsuperscript{186} While currently copper-focused, Mirador also sits on 3.4 million ounces of gold and 27.1 million ounces of silver.\textsuperscript{187}

\textsuperscript{182} Ibid
\textsuperscript{183} RPP Noticias, 2020
\textsuperscript{184} González-Merizalde et al., 2016
\textsuperscript{185} Mainville, 2018
\textsuperscript{186} Vallejos et al., 2020
\textsuperscript{187} Liangari, 2019
On-the-ground Solutions to Destructive Gold Mining

Any sustainable solution to destructive gold mining needs to come from all links of the gold supply chain. In this section, we summarize some of the major on-the-ground solutions to reduce the negative impacts of gold mining in the Amazon. However, it is important to keep in mind that it is not only miners and ASGM countries which are fueling crime or contaminating the environment. By buying jewelry and electronics that are irresponsibly sourced, companies and consumers from developed countries are subsidizing environmental, social, and legal abuses. The second part of this series will include downstream market solutions, which are equally if not more essential for change.
3.1 Minamata Convention on Mercury

The Minamata Convention on Mercury is a global treaty organized by UNEP to protect human health and the environment from the adverse effects of mercury. The major objectives of the Convention include "a ban on new mercury mines, the phase-out of existing ones, the phase out and phase down of mercury use in a number of products and processes, control measures on emissions to air and releases to land and water, and the regulation of the informal sector of artisanal and small-scale gold mining."188 Effective since 2017, 127 countries are currently party to the Convention, including all Amazon countries with the exception of Venezuela.

Under the Convention, countries with significant ASGM are obligated to create a National Action Plan (NAP) to reduce, and where feasible, eliminate the use of mercury.

Under the Convention, countries with significant ASGM are obligated to create a National Action Plan (NAP) to reduce, and where feasible, eliminate the use of mercury. NAPs typically include training in mercury-free or mercury-reducing mining techniques, steps to facilitate formalization, strategies to regulate the mercury trade, education in affected communities, public health strategies, and market-based incentive mechanisms. The Global Environmental Facility (GEF) is the financial instrument providing monetary support to countries participating in the Minamata Convention on Mercury and the development of NAPs.

Learn more:
MINAMATA Convention on Mercury
NAP Guidance for ASGM

188 UNEP, 2017
3.2 Formalization

As we have seen, gold mining is a livelihood dominated by informality and illegality. As a result, it is very difficult for Amazon authorities to regulate the negative impacts of gold mining or collect taxes that can be distributed at the national and local level.

Formalization is the process of integrating illegal and informal miners into the formal economy and regulatory system. For countries party to the Minamata Convention, implementing a formalization strategy is an important part of the ASGM NAP. To be effective, formalization must encompass a wide variety of initiatives, including the incorporation of miners into the development of legal protocols, the monitoring and enforcement of the legislation, and sustained support necessary to help miners meet legal requirements. Some specific actions include the allocation of land for ASGM, assisting miners with self-organization, strengthening the supply chain, ensuring gender equality, managing conflicts with LSGM, and promoting economic coexistence with ASGM and LSGM, among others.

Despite nominal efforts to formalize the artisanal sector, fewer than 1% of artisanal miners are formalized in South America. In many cases, miners may lack the technical know-how or the necessary capital to comply with formalization requirements. Even if the demands are feasible, the formalization process can be so complicated and time-consuming as to be daunting for artisanal miners. Therefore, it is crucial that governments make programs available to help miners navigate the complex bureaucratic and legal requirements.

Learn more:
- IGF Global Trends in Artisanal and Small-Scale Mining (ASM): A review of key numbers and issues (see section 7)

189 IGF, 2017
190 UNITAR & UNEP, 2018
191 Marshall and Veiga, 2017
3.3 Monitoring and Community Education

Monitoring ASGM's impacts on environmental and human health is a longstanding and important means of addressing the negative impacts of gold mining. Article 19 (“Research, Development, and Monitoring”) of the Minamata Convention emphasizes the need to conduct mercury studies in vulnerable populations while Article 22 (“Effectiveness Evaluation”) identifies health monitoring as an important way to evaluate the effectiveness of the Convention. Parties are also asked to share monitoring data with stakeholders and vulnerable populations, as well as to lead educational events on the dangers of mercury exposure (Article 18). The World Health Organization (WHO) has emphasized an urgent need to train local health-care providers, such as nurses, physicians, and community health workers, to recognize ASGM hazards to human health and the environment.

One particularly important example in the Amazon region is monitoring and education programs relating to fish consumption. Researchers may conduct analyses of aquatic organisms to determine which species pose the greatest risks to human health and then use these results to guide dietary education programs. Such programs have seen success, but must be balanced with other considerations, such as cultural identity and dietary needs. Environmental and health monitoring can also be presented to miners as evidence of harmful practices. However, miners are often distrustful of these diagnoses, or are aware of the risks but lack economic alternatives.

Learn more:
- UNEP Global Review of Mercury Monitoring Networks
- UNEP Estimating mercury use and documenting practices in artisanal and small-scale gold mining (ASGM): Methods and Tools
- A State-of-the-Science Review of Mercury Biomarkers in Human Populations Worldwide between 2000 and 2018

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192 Ibid
193 WHO, 2016
194 Basu et al, 2018
195 Veiga and Fadina, 2020
3.4 Improving Mining Techniques

One way to reduce mercury contamination and environmental degradation from ASGM is to train miners in more responsible mining practices. Annex C of the Minamata Convention recommends that governments begin by eliminating “Worst Practices” in ASGM, including whole-ore amalgamation, open-air burning of amalgams, burning of amalgams in residential areas, and cyanide leaching without prior mercury removal.

The most common means to reduce or eliminate mercury in ASGM is to introduce gravimetric mining methods, which work by using the high density of gold to remove lighter particles and increase gold concentration in the ore. Gravity methods include any combination of panning, sluicing, shaking tables, concentrators and centrifuges. Another way to reduce mercury releases is to provide miners and gold shop owners with retorts, which can condense and recover over 95% of mercury vapor during the amalgam burning process. However, even when a technique is more responsible and profitable, other factors may hinder miners’ adoption of new methods, including the socio-cultural context of the mining area, legal barriers, and support from local authorities or organizations.

There are also ways to reduce the burden of gold mining on the rainforest and climate. Geological knowledge of gold deposits can help miners minimize unnecessary deforestation and work more efficiently, as well as guide government decisions on the allocation of mining areas. Miners may also be required to conduct an environmental impact assessment (EIA) and/or environmental management plan (EMP) to identify and prevent environmental damage. An essential part of an EMP is mine closure. In tropical areas such as the Amazon, this may include reforestation and ecological restoration. However, for rehabilitation to be feasible, miners typically must be formalized (legal) as well as have access to substantial capital or external support, though efforts have been made to make rehabilitation more frugal.

Learn more:
- UNEP Illustrated Guide to Mercury Free Artisanal and Small-Scale Gold Mining
- EPA Guide to Artisanal and Small-Scale Gold Mining Without Mercury
- World Bank Report on Forest-Smart Mining: Artisanal & Small-Scale Mining in Forest Landscapes (ASM)

EPA, 2018
Veiga and Hinton, 2002
World Bank, 2019
Asia Foundation, 2016
3.5 Designating Protected Areas and Indigenous Rights

On average, protected areas harbor less miners than do unprotected areas.\textsuperscript{200} As a result, effective forest protection, particularly the designation and strengthening of protected areas and indigenous territories, is a key means of reducing the negative impacts of illegal gold mining. At the same time, as we have seen, illegal mining affects numerous natural parks in the Amazon and about 6\% of indigenous land directly overlaps with active mining concessions or illegal mining activities.\textsuperscript{201} One means of mitigating illegal incursions is to establish a multi-use protected areas, which enables mining in a regulated and controlled fashion. Regardless of the type of protected area, effective enforcement and good governance are crucial to mitigating destructive mining practices.\textsuperscript{202}

Globally, indigenous-managed lands tend to coincide with critical ecosystems and harbor equal or greater biodiversity than conventional protected areas, in large measure due to successful environmental stewardship.\textsuperscript{203, 204} It is important that indigenous groups are provided with adequate legal protections, which grant them their inherent rights and the capacity to effectively protect their land. According to the World Resources Institute, the legal rights most crucial to protecting indigenous communities against unwanted mining include land rights, which guarantee autonomous land management; the right of free, prior, and informed consent, which ensures indigenous groups are consulted and participate in development plans on their land; mineral rights, which provide greater control and benefits from any mineral developments; and the right of first refusal, which guarantees indigenous groups the opportunity to profit from resource development before a third party. In addition to the provision of rights, government and NGOs can help indigenous groups deter unwanted mining by building capacity in monitoring, negotiation, and legal literacy.\textsuperscript{205}

Learn more:

- Convention on Biological Diversity - Aichi Target 11
- UN-REDD - Forest Governance
- UN Declaration on the Rights of Indigenous Peoples
- WRI Undermining Rights: Indigenous Lands and Mining in the Amazon

\textsuperscript{200} World Bank, 2019
\textsuperscript{201} Vallejos et al., 2020
\textsuperscript{202} World Bank, 2019
\textsuperscript{203} Garnett et al., 2018
\textsuperscript{204} Schuster et al., 2019
\textsuperscript{205} Vallejos et al., 2020
3.6 Alternative and Diversified Livelihoods

Violence and coercion are rarely effective measures in reducing the ASGM sector or mitigating the negative impacts of destructive mining. If there are no economic alternatives, evidence suggests that miners will continue mining outside the legal framework and will even return to the protected area from which they were evicted.206

In order to sustainably reduce the environmental and human health burden of ASGM, some agencies advocate projects that offer alternative livelihoods and economic opportunities. In the Amazon, programs include shifting miners towards sustainable agriculture, such as cacao production,207 or the conversion of mining pools into profitable fish farms.208 While some initiatives, such as the GEF Small Grants Program, have seen success in introducing alternative livelihoods,209 critics point out that artisanal and small-scale miners provide an important global service, as well as a local means of income that can eventually diversify and strengthen marginalized communities.210 211 More recently, groups have championed “diversified livelihood” strategies, which complement mining with other sources of income, particularly agriculture.212

Learn more:
IGF Global Trends in Artisanal and Small-Scale Mining (ASM): A review of key numbers and issues (see section 5)
Pact and the University of Delaware’s Mapping Artisanal and Small-scale Mining to the Sustainable Development Goals (ASM-SDG Policy Assessment)
GIATOC Case Study: Illicit Gold Mining in Peru (shifting from mining to cacao)

206 World Bank, 2019
207 GIATOC, 2017
208 Otchere, 2004
209 UNDP, 2019
210 Siegel & Veiga, 2010
211 de Haan et al., 20209
212 IGF, 2017
Conclusion: the big picture of gold mining in the Amazon
According to sources consulted for this paper, there are a minimum of 940,000 artisanal and small-scale gold miners working in Amazon countries (excluding Venezuela), and the maximum well exceeds 1 million. However, it is important to note that there is considerable uncertainty with estimates of total miners and some figures cited are not current. Furthermore, in countries such as Colombia, Bolivia, and Ecuador, where much of the gold mining sector is concentrated in the Pacific and Andean regions, only a small portion of miners may be working in the Amazon biome. Using data from D.H. Bebbington et al. (2018), the World Resource Institute estimated over 500,000 small-scale miners working in the Amazon but did not include Venezuela in the estimate.

Criminal and guerilla groups play a dominant role in regulating the flow of gold, especially in Peru, Colombia, and Venezuela. However, this does not signify that illegal miners necessarily belong to these groups. Rather, miners are very often exploited, sometimes receiving only a small share for their gold while having to pay a fee, or vacuna, to the controlling group, often under threat of torture or death.

Along with the substantial number of livelihoods dependent on Amazon ASGM, Amazon countries in 2019 officially reported producing 377.5 tons of gold in 2019, worth about $16.8 billion according to the 2019 closing price of gold at $1,393.34/oz. This figure is likely a significant underestimation due to rampant illegality and poor production controls. In several Amazon countries, ASGM constitutes a significant portion of GDP, as is the case with Guyana where ASGM represents about 14% of the total. Until there are alternative equitable and sustainable economic opportunities available, ASGM will remain an important economic solution for impoverished peoples in the Amazon.

World Bank, 2019
This paper identified deforestation hotspots in the Amazon biome from gold mining in Madre de Dios in Peru (65,000 hectares from 2010-2017); the Tapajós River Basin in Brazil (18,300 hectares from 2001-2013); and the forests of the Guianas (60,000 hectares from 2000-2015 in Suriname; 57,000 hectares from 2010-2017 in Guyana). The actual amount of deforestation from gold mining in the Amazon over the last two decades exceeds these totals, as data gaps exist and research for this paper was not exhaustive. Although one source estimated deforestation from illicit mining in Southern Venezuela reaching as high as 280,000 hectares since 2010, this area was excluded as a hotspot because data is sparse and less certain.

When comparing these figures to other sources of Amazon deforestation, it is important to note that the impact of ASGM is considered worse than other land-use activities on a per hectare basis, due to its depletion of soil nutrients, deterioration of water quality, and transformation of riverways (see introduction).

When accounting for proportional amounts of Amazon forest, estimates of mercury emissions in the Amazon were particularly high in Suriname and Peru, reaching 50 tons and 185 tons per year respectively. Though not exclusively attributable to ASGM (see introduction), elevated mercury levels from fish consumption are widespread in the Amazon, particularly in indigenous communities, which report on average 7.5 times higher than background levels in the general population.  

Map of the Amazon biome with gold ovals indicating approximate areas of deforestation hotspots discussed in this paper.  

*Basu et al., 2018*
Primary on-the-ground solutions to reduce the negative impacts of destructive gold mining include international agreements, such as the Minamata Convention on Mercury; raising awareness through environmental and health monitoring; promoting cleaner mining practices; formalizing miners to bring operations under government control; designating protected areas and strengthening indigenous rights; and creating alternative and diversified livelihoods.

This paper is the first in a two-part series, the second of which will provide an in-depth analysis of gold trade and propose a set of "downstream" market and policy solutions. This multi-stakeholder approach is crucial, as it reduces the burden on miners to change and incentivizes more equitable and sustainable opportunities.
Illicit and unregulated gold mining is one of the fastest growing and most dangerous threats to the Amazon today. Multistakeholder engagement will be needed to create a responsible and transparent supply chain for gold from the ground to the consumer.


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TRACKING AMAZON GOLD

PART 1: ON-THE-GROUND IMPACTS AND SOLUTIONS

APRIL 2021

This report was prepared by Charlie Espinosa and Kelsey Beyeler for the Amazon Aid Foundation. Special thanks to Charles Lyons, Christina Miller, Maggie Gabos, Sarah DuPort, Ben Vauter, and Susan Keane for assistance with the revision of this report. Layout by Ben Eppard.