

THE AMAZON BIOME IN THE FACE OF MERCURY CONTAMINATION

An overview of mercury trade, science,
and policy in the Amazonian countries

A publication by:



Gaia Amazonas

With the support of:



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and policy in the Amazonian countries

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EXECUTIVE OVERVIEW

The management of mercury has been an important global environmental health concern during the last half-century. Mercury is a natural element that is used in a wide variety of processes and products, such as dental amalgams, chlor-alkali and non-ferrous metal production, measuring devices, cosmetics, as well as in the process of gold mining amalgamation. The World Health Organization declared mercury as one of the six most dangerous substances for health due to its high toxicity and the risks it poses to human health and the environment. Mercury is considered a persistent contaminant, and it can travel through atmospheric and ocean currents as well as in fish, wildlife, and even human bodies. At the present time, it can be found in practically the whole world. Mercury bioaccumulation in the food chain is the main route of mercury exposure in humans through the consumption of contaminated fish. Furthermore, mercury cannot be destroyed which is why it must be regulated throughout its entire life cycle to ensure proper global management, from its origins in cinnabar mining to the environmentally sound storage of mercury waste products.

During the past two decades, mercury contamination in countries of the Global North has decreased at the same time that it has increased in the Global South. This is a result of illegal and informal gold mining (IIGM)¹, which is the primary cause of anthropogenic mercury emissions and releases into the atmosphere, soils, and water bodies. IIGM has shifted from historically significant zones in the United States, Canada, Australia, and South Africa, to a growing number of mainly middle- to low-income countries in the Global South, including countries in the Amazon Biome. In effect, the Amazon Biome has experienced a mining boom fostered by a sustained rise in international gold prices that began in 1979 and increased 500% just in the last 15 years. Since then, IIGM operations have expanded throughout the Amazon River basin, causing profound environmental and social consequences on the land and in local communities. Mining activities frequently use mercury during the gold production process, which contributes to a large extent in the emission of mercury vapors or spills.

1. While the Minamata Convention and other sources refer to this concept as artisanal and small-scale gold mining (ASGM), this term hides the reality that not all illegal and informal mining activities that use mercury in the Amazon Biome are small-scale or artisanal. On the contrary, mechanized and semi-mechanized operations occur that cannot be classified as small-scale. In general, the economic, technical, and social reality of mining in each country is so varied that technology and size criteria are limited. This is why the author of this report chose to classify mining activities based on their legality and formality as more general descriptive variables, while recognizing that aforementioned complexity in national and local contexts.

This report provides a general assessment and a preliminary source review of studies, norms, policies, and available information about the problem of mercury in countries in the Amazon Biome, mainly as a result of its use in IIGM. This report does not provide formulas for solving the problem in the region in general nor in specific countries in the Amazon Biome. On the contrary, it attempts to respond to the more modest need of serving as a resource to make progress in understanding and better addressing the mercury problem on a domestic and regional level. Nationally, responses should be designed according to each context and the level of progress on solutions that have been implemented to date in the country. Similarly, it is hoped that this document will help to consolidate a regional space for discussion, analysis, knowledge production, and advocacy that can serve to create a joint strategy of prevention and response to the problem of mercury use in IIGM in the Amazon Biome. This report may be useful for public officials, researchers, journalists, activists, local communities, and in general people who are interested in the different angles of the situation of mercury in Latin America and the in the Amazon Biome specifically.

The following section provides an overview of the conclusions of the report's three assessment focuses: trade, science, and mercury policies.

Trade dynamics

Primary mercury mining does not occur in the Amazon, which is why practically all of the mercury that is emitted or released in the region is imported from other areas, mainly from Europe, the United States, and more recently from countries like Mexico and Indonesia. Commercial statistics indicate a general pattern of total mercury imports declining in the last few years (despite certain recent surges that subsequently waned), while exports have continued to rise. In contrast to the global trend of falling mercury imports (that decreased from 2600 metric tons in 2010 to 1200 metric tons in 2015), the Amazonian countries reported an increase in total mercury imports from 308.76 metric tons in 2008 to 431.56 metric tons in 2015. This occurred because of an increase in imports to Colombia, Peru, Bolivia, and Ecuador in the last decade. In the case of exports, the Amazon Biome countries follow the global trend of declining mercury exports. Inter-regional trade in mercury in the Amazon has increased notably in the last few years, especially after the export ban on mercury from the European Union in 2011 and the United States in 2013.

Information regarding imports and exports is incomplete because not all of the mercury that is imported is used in IIGM activities, although in countries like Colombia and Ecuador, an estimated 90% or more of imported mercury is used in IIGM. In Brazil and Peru, that same figure

is less than 50%. The amounts of mercury imported by countries in the Amazon Biome that imported mercury during the period from 1994-2018 in metric tons were: Peru (1899.81), Colombia (1749), Brazil (1040.6), Bolivia (809.47), Guyana (802.6), Ecuador (403.9), Venezuela (42.87), Suriname (6.3), and French Guiana (1.84). Bolivia, Brazil, Colombia, Peru, Guyana, and Ecuador reported data during that whole time period; Venezuela only reported data up until 2009; Suriname and French Guiana only reported imports up until 1995.

Few reports exist on the illegal mercury trade in Latin America in general and in particular in the Amazon Biome, but some press reports and government seizures refer to its existence. The unusual rise in registered imports are proxies for possible intra-regional hubs of unreported informal trade. A better understanding of situations like transnational migrations of miners and other groups of people throughout the Biome could shed light on some the trends of the illegal mercury trade and other illegal markets in the region.

INFORMATION ON HEALTH AND ENVIRONMENTAL IMPACTS

Three types of impacts related to mercury and mining can be observed in the Amazon. Mercury emissions and releases from IIGM activities can be a result of mercury waste that is dumped on land and in water bodies. They can occur when gold and mercury amalgams are burned. Finally, mercury is emitted when naturally occurring mercury-rich sediments or soils are disturbed during the dredging of alluvial sediments or when forest cover is removed.

IIGM emits on average 828 metric tons of mercury annually worldwide according to data from the 2018 Global Mercury Assessment. The previous analysis in 2013 estimated that on average 727 metric tons was emitted. In Latin America, emissions from IIGM make up 71% of the total regional emissions. The countries with the highest rates of mercury emissions from IIGM activities are Colombia (60 mt/year), Bolivia (45), Peru (26), Brazil (23), Ecuador (18), and Guyana (11), followed by Suriname, Venezuela, and French Guiana each with 6 metric tons per year. On average, 199 metric tons of mercury out of the total 727, are emitted annually into the atmosphere from IIGM zones in the nine countries of the Amazon Biome. In other words, approximately 27% of global mercury emissions from IIGM originate in the Amazon, which represents 78.5% of the total emissions in all of South America. In 2018, the global emission rate was updated (from 727 to 838), but national figures still have yet to be revised. If emissions were to have declined, the percentage of 27% of emissions that come from the Amazon could also have decreased. It is important to mention that emission data does not differentiate between subnational

areas, therefore the specific amount of emissions of mercury from the Amazon region of each of the countries in the Biome cannot be calculated.

Emissions from large-scale gold production makes up only 5% of the global total of emissions. Since the focus of this report is on IIGM, it does not evaluate what portion of that 5% originates in large gold mining projects in the Amazon, but this would be an important point to clarify in future investigations. In all of South America, 313 metric tons of mercury are released into soils and water by the IIGM sector, which corresponds to 35% of total releases by IIGM globally. In contrast to the data on emissions, these statistics do not differentiate how much of the 313 metric tons of mercury releases in South America come from countries in the Biome. IIGM is not the only source of mercury emissions and releases. Mercury is naturally found in Amazonian soils. Moreover, land use change as a result of the expanding agricultural frontier, deforestation, and mining all increase erosion and cause mercury releases. Some studies have shown that biomass combustion is also an important source of emissions; this was not accounted for in the UNEP Global Mercury Assessment in 2013 but was included in the updated 2018 version. The 2018 Assessment (UNEP, 2019) calculated this figure for the first time: 52 metric tons or 2.33% of the global total. Nevertheless, regional data does not exist for what percentage of this amount originates in the Amazon.

These gaps in emissions information are related to the insufficiency of national and regional atmospheric mercury monitoring networks in countries in Latin American and the Caribbean that emit high levels of mercury in gold mining processes. Only three fixed monitoring stations that register data for periods greater than ten years exist in South America: one in Manaus, Brazil, the Global Mercury Observation System (GMOS) built in 2007 in Nieuw Nickerie, Suriname, and the last in Bariloche, Argentina, thousands of miles to the south of the Amazon Biome. Similarly, water monitoring programs are insufficient. Mercury contamination is easier to detect in water before bioaccumulation occurs and affects the food chain. In general, the Amazon is underrepresented in global monitoring and knowledge production networks on mercury. Nevertheless, some local and regional research efforts have been carried out and they cast light on the relationship between several environmental and human matrices. This report compiles general information on the studies that have been implemented on the Biome and national levels.

In spite of the existing gaps in information and lack of technical scientific capacity to fill them, enough evidence is available to visualize the magnitude of the problem. The sources of mercury emissions and releases in the Amazon Biome are both natural and anthropogenic, but studies show that higher concentrations of mercury can be found in water, fish, and other matrices in IIGM zones. This suggests that IIGM

activities have increased the natural concentrations of this metal through the removal of forest covers and the extraction of alluvial sediments, as well as a result of the dumping and spillage of waste products during the gold production process or by amalgam burning. The vast majority of data on mercury found in fish in South America was calculated in areas affected by IIGM. This is consistent with the finding of mercury levels that are higher than the WHO standards in at least one area in the Amazon Biome countries. In some nations like Brazil, Peru, and the Guianas, this pattern can be found in several regions. The amount of studies that have been carried out in areas where IIGM is not present are limited, however many studies concur that it is important that these sites be researched in order to determine the scope of atmospheric transportation or bioaccumulation in different food chains.

The quantity of studies that have been developed in each country is asymmetric. Brazil is the nation where the largest amount of research has been conducted on mercury, especially in the Amazon region -- indigenous peoples of the northern arch have the highest risk of exposure. After Brazil, Peru is the second most studied country. These investigations have been able to identify critical points that require urgent attention and intervention in the Amazon Biome. Madre de Dios is the most contaminated area in Peru and it is one of the most contaminated regions in all of the Biome. The Yanomami territory on the border of Brazil and Venezuela is another critical point for mercury contamination in the Biome. Information from the Guianas is not as complete as what is available for countries like Brazil, Peru, or Bolivia, but studies suggest that this sub-region is not isolated from the effects of mercury use in IIGM. The Beni and Madre de Dios River basins are also critical points for mercury pollution. The Colombian Amazonian rivers and the people that live on their shores also have presented alarming rates of mercury contamination. In conclusion, the problem of mercury has been investigated to a greater extent in some countries, however evidence shows that certain critical points require an immediate response.

Data on emissions confirms the central role of the Amazon Biome not only in international mercury trade markets, but also in global contamination trends that are related to the use of this metal mainly in IIGM activities. After Colombia, Bolivia is the second highest emitter of mercury in mining activities in Latin America, with an average of 133.1 metric tons of mercury emitted annually. Close to 47% of these emissions are a result of IIGM activities. Bolivia has a national emissions inventory and important academic studies on the effects of mercury on the environment and health have been carried out in the country. On the other hand, Colombia emits 47 metric tons of mercury into the atmosphere each year, of which at least 30 metric tons are a result of IIGM (although some sources report up to 180 tons emitted per year). Information on the

effects of mercury on the environment and human health in the country's Amazonian regions is still emerging, but the few studies that have been carried out suggest alarming rates of mercury contamination in fish and people, especially in indigenous communities.

It is important to consider that even though studies on the topic suggest that mercury bioaccumulation is less severe in land environments than in aquatic systems, the natural tendency for flooding in several Amazonian ecosystems can alter these dynamics. Nevertheless, this report identifies that there is still a significant gap in knowledge not only in regards to the atmospheric transportation of mercury from the Amazon, but also with respect to mercury release and re-release patterns in soils. Several papers have also concluded that it is more beneficial to conduct chemical studies on water together with biological matrices, nevertheless, the vast majority of studies do not do this; just 10% of a sample of 300 articles from Brazil included this comprehensive focus. This suggests that more communication and collaboration between national science and technology systems in countries of the Amazon Biome would be positive and cost-effective.

Unfortunately, up until now the subject of mercury has not been included in research agendas or advocacy on deforestation and land use change to the same extent that it has with regards to mining. Evidence suggests that large dam construction and operations in the Amazon can increase the levels of mercury exposure in local communities. The topic of mercury should be urgently included in discussions on dams, energy, and climate change in the Amazon.

POLICY RESPONSES

Information gaps in addition to a lack of technical and scientific information in several countries in the Biome has led to unequal and fragmented mercury regulations in each country. All of the laws that were emitted prior to the Minamata Convention are in the process of being reevaluated and adapted to the agreement's requirements. The Convention's signature in 2013 invigorated legal regulations, inter-institutional articulation, and the establishment of common goals based on the Convention's commitments. With the exception of Venezuela, all of the countries with territory in the Amazon Biome, including France, have signed and ratified the Minamata Convention and are in the process of creating their National Action Plans as stipulated by Article 7 of the Convention. All of the countries in the Biome are implementing Minamata Initial Assessment (MIA) projects.

Countries like Colombia, Guyana, Peru, and Bolivia have made progress in Fair Trade gold certification programs. Nevertheless, up until now

none of these programs have been implemented in the Amazon regions of these nations, because the necessary conditions to do so have not been met. A wider, participatory and informed discussion needs to take place on the convenience and implications of these types of measures in IIGM zones in countries in the Biome.

Complaints of mercury contamination in the Yanomami tribes in Brazil and Venezuela have been presented to the UN Special Rapporteur on the Rights of Indigenous Peoples and the UN Special Rapporteur on the Right to Health. It is foreseeable if this problem worsens that some organizations will seek to present a demand to the Inter-American Commission on Human Rights regarding the lack of an effective domestic-level response by countries like Brazil, Peru, and Venezuela. Cautionary measures have already been employed by the Inter-American Commission on Human Rights (IACHR) for the Tres Islas community in Madre de Dios in Peru.

In spite of the progress of each country with regards to legal and policy responses to the problem of mercury use in IIGM, the conclusion of this report is that resolving the situation in the Amazon Biome will not be possible without a collaborative, articulated, cooperative effort between all of the countries in the Biome, the ACTO, and other regional cooperation bodies like the CAN, in addition to participation of civil society and all of the stakeholders affected by this problem. Except for certain limited exceptions, joint programs between countries of the Amazon Biome to combat the problem are still limited or nonexistent. Furthermore, domestic legislature has not been effective in countering the growing illegal market of mercury in Latin America. Since 2018, different civil society organizations in Colombia, Peru, Bolivia, Ecuador, and Guyana have begun to work jointly to address this problem. This collaboration will be fundamental on the path towards building regional studies, evaluations, assessments, and strategies.

A regional policy for the Amazon Biome is the shortest and least expensive route towards a long-term solution that will prevent the devastating consequences of mercury use in IIGM on the Amazonian ecosystems and the health of its inhabitants, as well as for all people in Latin America in general. Even though control and regulation policies are important and necessary to counteract the powerful mercury contraband market that has grown in the region, if another disaster like what occurred in Minamata (the Japanese bay home to one of the world's most serious mercury contamination crises in the 1950s) is to be averted in the Amazon, more comprehensive measures of prevention, information generation, and in general improved livelihood alternatives, employment opportunities, and development policies that favor local populations and their participation are needed.

The way in which countries in the Amazon Biome design and implement their National Action Plans according to Article 7 of the Minamata Convention will determine the type of solutions that should be enacted in the short and medium terms, as well as their eventual effectiveness to reduce mercury emissions and releases in the Amazon Biome and in Latin America in general. Even though market mechanisms are included as a suggestion in the guide for elaborating National Action Plans, it appears that the first projects that have been derived from the Convention, like GEF GOLD, place significant importance on these types of options. Market mechanisms are not incompatible with other elements that the National Action Plans should include. Nevertheless, countries in the Amazon Biome should consider that the emphasis of implementing market mechanisms threatens to relegate to the background other components that require active government participation. In other words, the market on its own will not resolve the problem of mercury in the Amazon or prevent another Minamata disaster from occurring.

The potential for success of the Minamata Convention in the Amazon depends on a balance between the interest of several stakeholders to promote mercury-free gold markets on the one hand, and the urgent need to reduce emissions, formalize miners, protect communities from exposure, and prevent the trafficking of illegal mercury on the other. Without this, the possibilities to stop, fix, and prevent mercury contamination in the Amazon Biome are limited. A strong and active determination by governments, civil society, and regional cooperation spaces like the ACTO and CAN, as well as cooperation from the Minamata Convention's Secretariat is needed.

INTRODUCTION

The objective of this report is to provide an evaluation on how the countries of the Amazon Biome² are addressing the situation of mercury contamination as a result primarily of illegal and informal gold mining (IIGM). This report may be useful for public officials, researchers, journalists, activists, local communities, and in general people who are interested in different angles of the mercury problem in Latin America and specifically in the Amazon Biome. Rather than providing new knowledge, this report compiles and organizes information available on mercury in the region from the commercial, scientific, public policy, and regulatory point of views. Particularly, this report attempts to respond to the following three groups of questions:

1.

How are countries in the Amazon Biome involved in the global and regional mercury supply, trade, and demand flows? What are the characteristics of legal and illegal mercury markets and their inclusion in gold mining and other sectors in each country and on a Biome level?

2.

What kind of information is available in countries in the Amazon Biome regarding the trends and impacts of mercury emissions and discharges in the eco-region? What are the most significant environmental effects of mercury use in IIGM and its impacts in Amazonian communities?

3.

What have countries in the Amazon Biome done to confront these problems? What routes for further action will become available as a result of the presentation of current conditions by this report?

2. The Amazon Biome is composed of eight countries (Brazil, Bolivia, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela) and one overseas territory (French Guiana).

The report is divided into five sections. The first section (I) discusses the context of the problem of mercury use in the Amazon Biome. The second section (II) analyzes the dynamic of mercury supply, trade, and demand in the Biome's countries. The third section (III) provides a preliminary review of available information on the multiple impacts of mercury use on the environment and the health of local communities in the countries in the Biome. The last two sections present an assessment of the institutional responses to the issue, including current norms and policies: the fourth section (IV) discusses international law on mercury and its relevance and impact on the landscapes and populations of the countries in the Amazon Biome, while the fifth section (V) examines institutional responses on a regional Pan-Amazonian level and provides an overview of the reality of each country's situation. The report culminates with a section of conclusions (VI).

REPORT METHODOLOGY

The report's analysis was conducted after compiling and assessing policies and legal instruments in place in each country. It also reviewed the most up-to-date specialized studies, reports, and literature, databases on international mercury trade, as well as secondary sources that help to characterize mercury markets. Biome level reports were collected and analyzed, including databases, specialized literature, gray literature, policy documents, constitutions, laws, and other legislative instruments such as international treaties, soft law instruments, and secondary sources like press releases and organizations' statements. Field work was not conducted.



CHAPTER I.

CONTEXT: THE PROBLEM OF MERCURY IN MINING IN THE AMAZON BIOME

A. THE ADVENT OF A GLOBAL ENVIRONMENTAL PROBLEM

Mercury is a natural element that is used in a large range of processes and products, like dental amalgams, carbon combustion for energy production, chlor-alkali production, thermometers and other measuring equipment, cosmetics, and in the amalgamation process for gold mining (UNEP, 2013). The sound management of mercury has been a global environmental concern in the last fifties years, due to its high toxicity and the risks it poses for human health and the environment. The adverse environmental and health effects of mercury gained public attention for the first time in the 1950s and 60s, after a series of mercury releases from an acetaldehyde plant in Japan's Minamata Bay that led to the documentation of a serious health condition in the bay's inhabitants that became known as Minamata disease (Yang, 2015).

These events provoked a wide range of research and studies into the risks of mercury contamination on global environmental health (UNEP, 2013). The so-called Minamata Bay disaster also motivated many local and regional efforts, especially in developed countries, to curb anthropogenic mercury releases to prevent their adverse effects. Once in the environment, mercury is transported by atmospheric and oceanic currents, thereby entering organisms like fish, wildlife, and humans; mercury is thought to be found in almost all of the world's environments. Mercury bioaccumulation in the food chain is one of the main ways in which humans are exposed to the metal, especially by consuming fish that are contaminated with the substance (Yang, 2015). Furthermore, mercury cannot be destroyed, which is why globally the entire mercury life cycle must be regulated in order to prevent its consumption, from its origins in cinnabar mining up until the proper environmental storage of mercury waste. Concern regarding mercury has risen in the last fifteen years, mainly because of information that has been discovered regarding three main aspects of its biogeochemical cycle: its permanence in the environment, the long-distances it is transported from its point of origin, and its bioaccumulation and biomagnification capacity.

B. MERCURY IN ILLEGAL AND INFORMAL GOLD MINING IN LATIN AMERICA

Illegal and informal gold mining (IIGM) and coal-fired power plants are the main sources of anthropogenic mercury emissions in the environment. These emissions are added to the already existing naturally found levels of mercury in the atmosphere, soil, fresh water sources, and the ocean (Selin, 2009). The majority of anthropogenic mercury emissions and releases have occurred since the nineteenth century and are associated with the industrial revolution as a result of coal burning, basic metal smelting facilities, and gold mining booms in various places in the world (UNEP, 2013). These same sources of mercury emissions and releases persist today because of fossil fuel based energy production that drives the industrial and economic growth of Asia and South America which in turn causes a greater demand for metals that are supplied by an expansion of IIGM in Asia, Latin America, and Africa (UNEP, 2013). Mercury emissions in Europe and the United States have declined in the last three decades, mainly due to the implementation of filter technologies (scrubbers) at the end of the tubes used to control sulfur and particulate materials in coal burning plants in addition to the passing of specific laws that regulate mercury emissions from medical waste incineration and urban garbage incineration (Selin, 2009). On the other hand, mercury emissions and releases have increased in the Global South in the previous two decades (UNEP, 2013). This trend is closely related to the fact that gold mining has shifted away from historically important sites in the United States, Canada, Australia, and South Africa, to a growing number of low and middle-income countries in the global south (Luning, 2017: 73).

Mercury use and emissions as a result of IIGM has become a main area of concern worldwide in the past two decades in the global south. The UNEP estimates that in close to seventy countries in Asia, Latin America, and Africa, up to 16 million people work in this sector, of which at least three million are women and children (UNEP, 2012; Veiga *et al.*, 2014). The livelihoods of another 100 million people indirectly depend on IIGM (UNDP, 2017). These figures are not exact and the possibility of substantial under-reporting is likely given the activity's informal nature. IIGM emits and releases mercury during the separation process. Gold is separated from other materials using techniques like washing or gravimetric concentration with mills or sluices. Miners combine mercury with the heavy particles that contain gold from sands, soils, and sediments. This produces an amalgam of the two metals that subsequently is placed in a metal pan or shovel and heated using a blowtorch to evaporate the mercury. Only the gold is left behind, because its boiling point is higher than that of mercury. During the process some mercury is emitted into

the atmosphere, especially when a retort is not used. Mercury is highly volatile at room temperature and it can easily pass from a liquid to a gaseous state. This is why inadequate storage in tropical climates can easily cause contamination. Additionally, some of the mercury is lost in spills, or during improper transportation and storage, or handling practices that cause it to enter the soil or water systems. Elemental mercury found in contaminated soils or water systems can later become volatile and enter the air, adding to the existing atmospheric mercury contamination worldwide (BEI & IPEN, 2014).

Recent estimates put annual gold quantities produced by IIGM in the range of 400 metric tons, close to 15% of the primary mining production globally (Fritz, Maxson, & Baumgartner, 2016). The UNEP's Global Mercury Assessment from 2013 reported that annually 727 metric tons of mercury is emitted into the atmosphere by IIGM operations worldwide, and 800 metric tons are released into the soil and water bodies (UNEP, 2013). The updated report from 2018 states that emissions rose to more than 800 metric tons and releases to more than 1200 (UNEP, 2019). IIGM activities represent 37% of anthropogenic emissions and it is the world's largest source of intentional metal use. The same assessment reported that 5% of emissions comes from large-scale gold mining, which is why emphasis is placed on IIGM since it is responsible for more than a third of total emissions.

In 2010, 15% of global atmospheric emissions from anthropogenic sources of mercury was produced in Latin American and the Caribbean, whereas 48% of emissions came from Asia (mainly from thermoelectric plants in India), 17% from Africa, 11% from Europe, and 3% from North America. That same year, close to 263 metric tons of mercury (90%) was produced in South America alone. A major source of emissions in Latin America is from mercury used in IIGM, which represents 71% of total emissions, followed by non-ferrous metal production (11%) and large-scale gold production (7%) (UNEP, 2014).

C. THE STATE OF THE AMAZON BIOME

The Amazon Biome has experienced a mining boom fostered by a sustained rise in international gold prices that began in 1979 and increased 500% just in the last 15 years. Since then, IIGM operations have expanded throughout the Amazon River basin, causing profound environmental and social consequences on the land and in local communities. Historical evidence suggests that this second gold fever (the first occurred during the colonial era) began in the Brazilian Amazon at the end of the 1950s. Since the middle of the twentieth-century, hundreds of thousands of illegal and informal miners have been involved in the Brazilian gold

boom, which is why it has been compared to the huge gold rushes of the nineteenth-century in California or Witwatersrand, South Africa (Cleary, 1990). After the more accessible placer gold was depleted at the end of the 1980s, and as a result of the agrarian development model and the Brazilian dictatorship, many *garimpeiros* (informal Brazilian miners) emigrated to the outside edge of the Brazilian Amazon, and eventually crossed the border to look for new mining sites in Guyana, Suriname, Venezuela, and Colombia (Lopez, 2014; Rubiano, 2014; De Theije & Heemskerk, 2009).

Different processes in each country produced distinctive paths for IIGM on a national level (for example in countries where mining already existed in other regions like the Andes in Colombia, Peru, and Bolivia) and on the scope of each country's Amazon region. Currently, IIGM can be found in dozens of countries in the region, mainly in the Andean-Amazonian countries and in the Amazon basin, as well as in Central America; at least 500,000 miners take part in artisanal mining processes from Mexico to the Southern Cone. This sector significantly affects the demand and trade of mercury in the region (UNEP, 2014). The majority of mining activities in the Amazon are partly-mechanized and concentrate on alluvial deposits that are exploited using water pumps, dredges, and mini dredges, although in some areas of the Andean Amazon or the Guiana Shield, deposits are exploited using dynamite and jackhammers.

While the mining techniques used throughout the Amazon tend to be similar to what is employed in African and Asian tropical forests (Hilson, 2009), the environmental and social consequences of gold mining differ according to the different sociopolitical and ecological context and dynamics of each country. For example, in contrast to Brazil and Peru, informal gold mining in the Colombian Amazon is still limited compared to the size of the industry in other countries (SPDA, 2014), as well as in comparison to the size of the sector in other parts of the same country. For example, in relation to other regions like the Pacific, Antioquia, and southern Bolivar, the size of the mining operation in the Colombian Amazon is marginal in terms of gold production, amount of people involved, and other indicators like deforestation. This could be due to the lack of available information. The Amazonian departments were not included in the national mining census of 2011, and even though the report is being updated, its preliminary results have not been made known (Statement by Monica Grand from Ministry of Mines, *Foro Semana*, March 13, 2018). Perhaps, this is why when studies compare informal or illegal mining in Amazon countries with that of Colombia, the local case studies are not representative of the Amazon but of other regions like the Chocó or Antioquia (see GOMIAM, 2014 and SPDA, 2014).

Historically relevant explications related to the development and spatiality of mining activities in Colombia provide some insight. Gold

mining expansion to the Amazon region is complexly interconnected with the distinct sub-regional manifestations of armed conflict, drug trafficking, coca farming and strategies for its eradication or substitution, rural colonization processes, indigenous territoriality, and other sociopolitical, economic, and cultural dynamics. The beginning of the surge in gold mining in the Colombian Amazon in the 1980s and its subsequent unequal consolidation in different areas like southern Guainía, Vaupés, and several points along the Caquetá and Putumayo Rivers is the product of two processes. On the one hand are migration patterns of mining investors and workers to new regions outside of the country's traditional mining regions (Antioquia, Bolívar, Cauca, and Chocó) in search of new business and work opportunities that accompanied the expansion of the mining frontier in previously unexplored zones or places where mining had been carried out for brief periods during the colonial era; some of these miners migrated from the Brazilian Amazon. On the other hand, once the mining frontier had expanded to new lands in the tropical rainforests of the Amazon, other wider problems like agrarian conflict, urban and rural poverty, subnational changes in the armed conflict dynamic, came together to motivate thousands of people to see mining as a way to achieve their autonomy (Castillo & Rubiano, 2019). In this way, the settlers and migrants that reactivated gold mining activities in the Colombian Amazon were followed by thousands of urban and rural poor and people looking for improved livelihood opportunities.

The expansion of mining in the Amazon region has not been homogenous in all of the Colombian sub-regions nor has it be free of conflict. The majority of mining activities in the Colombian Amazon have focused on removing alluvial sediments with dredges and mini-dredges, with the exception of informal vein mining in low altitude elevations in the Guyana Shield in southern Guainía and Vaupés. Similarly, since the 2000s, illegal armed groups like the FARC, the ELN, and paramilitary groups have adopted gold mining as a source for income, complementing other illegal activities like extortion and coca trafficking (in spite of the fact that the FARC has now demobilized, some dissident groups still operate in the Amazon region). In other parts of the country like northeast Antioquia and the Lower Cauca River basin, as well as in some parts of the Amazon, guerrilla and criminal gangs extort miners and members of local communities connected to mining activities, establishing controls on local and regional gold trade (Rettberg & Ortiz, 2016). Likewise, voluntary or coerced agreements between mine owners, normally from other regions, and indigenous communities in the mid and Lower-Caquetá River have left local communities at an impasse for how to cope with the expansion of mining in their lands and its effect on local production systems, their autonomy, and even their health and food (Lopez, 2014; Olivero *et al.*, 2016). The infiltration of criminal influences in gold production chains

in the Amazon is undeniable, yet this is a relatively recent development (approximately since 2000) and its real scope is still unknown.

As can be seen, mining in the Colombian Amazon has a complex historical trajectory with sub-regional variations. It is connected to wider problems like poverty, inequality, the internal armed conflict, agrarian change, population dynamics, and national and cross-border migration. Furthermore, unlike Brazil where a wide range of studies have been conducted on the topic, up until recently mining in the Colombian Amazon was a blind spot in local investigations both in studies by social sciences and environmental sciences. In comparison with social and environmental studies on gold mining in regions like Antioquia, Chocó, Cauca, Santander, and Bolivar, much less information is available on the Colombian Amazon. In spite of the fact that warnings on the effects of mining in Amazonian lands and communities were published in 1993 (Andrade *et al.*, 1993), recent intensification of these activities has called the attention of organizations, activists, and experts which has helped to increase research on this problem in the last few years (Tropenbos, 2013; Mendoza, 2012; Lopez, 2014; Rivera & Pardo, 2014; Tropenbos-ICAA, 2016; Olivero *et al.*, 2016).

The way that gold mining has developed and caused social, economic, environmental, and cultural consequences in Colombia and the Amazon region is telling of the challenges of conducting a comparative study on the use of mercury in gold mining and its effects in the Amazon Biome. This is because the situation not only affects the ecoregion's various socio-political contexts differently, but also because of the limitations of available information, the ability to produce knowledge in a short period of time with limited resources, and the inability to conduct field work. In spite of these constraints, this report prioritized the need to understand and respond to the effects of the expansion of gold mining in the all of the Amazon, principally as it relates to contamination and other effects associated with the use of mercury.

Chapter III will discuss most updated information available for each country as well as the Biome in general. The following chapter will concentrate of how the Amazon is integrated in global and regional mercury trade markets, which intends to respond to the report's first evaluation question: where is mercury supplied from and how does it arrive to be used in IIGM in the Amazon Biome?



CHAPTER II.

**MERCURY SUPPLY, TRADE,
AND DEMAND DYNAMICS
IN THE AMAZON BIOME**





Global mercury demand for products and processes has risen in the past ten years, largely due to the rise in demand for mercury in illegal and informal gold mining and vinyl chloride monomer production (UNEP, 2017: 11). Several countries in the Amazon Biome where mining has increased in the past few years, such as Colombia, Bolivia, and Peru, have boosted demand for mercury. This section presents an analysis of the different sources of demand, trade, and use of mercury in countries in the Amazon Biome. This section will try and answer the following questions: How do the countries in the Amazon Biome form part of the global and regional production, trade, and demand flows of mercury? What are some of the characteristics of legal, informal, and illegal mercury markets and how do they fit into each country's mining sectors and on a Biome level? What are the main countries that export mercury to the Biome, how much of this ends up being used by IIGM, and how does this affect Amazonian communities and territories? How does mercury move within the Biome?

This assessment is founded on historical import and export data of legal mercury that is reported to the UN International Trade Statistics Database (UN Comtrade). These figures are an important tool to better understand how the Amazon Biome is connected to the global mercury trade and how the intraregional market is composed. Nevertheless, these should be interpreted with caution. As the UNEP mentions (2017), the UN Comtrade database, as well as trade reports on mercury import and exports, have limitations. These figures do not always discriminate between mercury trade, mercury components, or products with added mercury, and when they do they are not always precise. Global trade tariff codes are designed according to commercial standards, and consequently they do not always incorporate criteria like relevance for environmental or health management, the distinction between products and mixtures, or between these and elemental mercury. Sometimes mercury is reported as an export in products where it has been added or in measuring instruments, therefore mercury import figures should not be interpreted as only containing metallic mercury; they may also include products where mercury has been included or mercury mixtures.

Another limitation in international trade data is that it only includes the legal markets and therefore only a part of the demand and trade in mercury can be examined. Illegal mining is left out because it is almost impossible to measure (UNEP, 2017: 42). Furthermore, except in rare cases where estimates are available like in Brazil, Colombia, Ecuador, and Peru, it is hard to know how much of the mercury that enters each country ends up being used in the Amazon region. In spite of the constraints in using import data, this report uses these figures as a proxy variable proposed by the UNEP (2017: 9) to estimate the magnitude, changes, and main actors of the international mercury trade. This assessment concentrates

on countries in the Amazon Biome as recipients of imported mercury during the last two decades. There is no primary mercury production in the Amazon, but part of the imported mercury is re-imported within South American countries.

The rest of this subsection includes an analysis of the situation of the Biome and of each country using available information on contraband mercury. The chapter finishes with a summary of key points. This same structure will be employed in the subsequent chapters with slight adaptations.

A. SITUATION IN THE BIOME

SUPPLY

Primary mercury mining does not exist in the Latin America and Caribbean region, in particular the countries in the Amazon Biome (UNEP, 2014: 6). Even though some secondary production occurs and mercury is present as a byproduct of large-scale gold mining or as waste from silver mines, almost all of the mercury used in the Amazon region is imported from mercury-producing countries. Demand for mercury in Amazonian countries is met by formal and informal global and intra-regional import and export flows. The first factor for assessment is to ascertain from where and how mercury is brought into countries and to describe the legal and illegal markets where it is traded.

According to the legal trade flows reported by the nine Amazonian countries which are compiled by the UN Comtrade database, the main providers of mercury to the area between 1997 and 2017 were the United States, Spain, Mexico, and Germany. The supply of mercury by the United States, Spain, and Germany comes from mercury recovered from byproducts and other mining operations, as well as from oil and gas processes, and mercury recycling from products that have added mercury or other waste products that contain mercury. In Mexico, mercury supply comes from primary cinnabar extraction (UNEP, 2017: 21). It is important to mention that during the period from 2013 to 2015, the UNEP reports (2017: 21) that these countries produced more mercury annually than the global average of 25 metric tons.

TRADE AND MERCURY FLOW

The UNEP (2017: 25-26) in its report on global mercury supply and demand, identified discrepancies in the amounts of imports and exports in several countries between 2013 and 2015. The report identified some countries that claimed to have imported *less* mercury than what the exporting countries reported. The United Kingdom declared the existence of discrepancies in 200 metric tons, Germany and Poland of more than 50 metric tons, and Indonesia of 40 metric tons. Countries in the Amazon Biome also reported discrepancies in their trade exchange reports. Colombia and Bolivia are among the countries that declared lower mercury imports than what exporting countries reported. Colombia declared 9 metric tons and Bolivia 3 metric tons of mercury less than what exporting countries claimed to have sent. The report also states that during this period, some countries reported to have imported *more* mercury than what the exporting countries claimed. For example, Singapore and Ethiopia presented a discrepancy of 130 metric tons each. Brazil, Peru, and Guyana are the three countries in the Amazon Biome that reported imports of *more* mercury than the amounts stated by the exporting countries: Brazil and Peru present discrepancies of less than 5 metric tons, and Guyana of 10 metric tons.

The export data from 2013-2015 demonstrates that several countries reported that they exported *less* mercury than what the importing countries declared was sold to them. This for example is the case of the United States (170 mt), Turkey (30 mt), Germany (30 mt), and the United Kingdom (20 mt). The countries that reported that they exported *more* mercury than what importing countries claimed include Spain (623 mt), Singapore (160 mt), Switzerland, Hong Kong, Canada, and the United Arab Emirates (each with a discrepancy of around 60 mt), and Mexico and Argentina (15 mt each). It is difficult to establish the motive behind the discrepancies in each country using the general figures: one would have to study every business transaction and each shipment, which would be logistically and empirically impossible. Furthermore, each shipment's information is retained by customs agents as confidential trade documents which are not available to the public (UNEP, 2017).

The global trade flows show that mercury imports and exports have decreased in the last six years (UNEP, 2017: 42). In 2010, around 2600 metric tons of mercury were imported and 3200 metric tons were exported, whereas in 2015 global imports were less than 1200 metric tons and exports less than 1300 metric tons. According to the UNEP (2017: 42), this reduction suggests that there are less connections in the mercury supply chain, and that probably the final recipients are specific sectors like IIGM or vinyl chloride producers. One hypothesis claims that mercury has been illegally traded from surplus mercury imports in countries like Peru, Colombia, and Bolivia during different time periods, and that these are

presumably moved to each country's interior or neighboring nations for its use in IIGM (UNEP, 2017: ix).

Recent legislation by the European Union (2011) and the United States (2013) has prohibited mercury exports with the aim of limiting mercury use in IIGM, among other things (UNEP, 2014; Fritz *et al.*, 2016). Similarly, the Minamata Convention was adopted in 2013 (which will be explained in detail in Chapter IV). These provisions have led to an important shift in the main mercury trading centers in the countries in the Amazon Biome: retailers from the United States and Spain who were key actors in 2010 are no longer in business (UNEP, 2017: ix). This has transformed the magnitude and directionality of the global mercury trade flows. The Minamata Convention included several provisions to control the supply, trade, and demand of mercury, which is why additional changes or an intensification of the existing changes can be expected in the next five to ten years as the Convention enters into force and in accordance with how many countries adopt it and effectively implement it (UNEP, 2017: 20).

TRADE DYNAMICS BETWEEN AMAZONIAN COUNTRIES AND THE WORLD

This section will discuss the trade dynamics between countries in the Amazon Biome and other countries throughout the world, as well as the intra-regional trade flows in 2008 and in 2015.³

2008

In 2008, a total of 308.8 metric tons of mercury were imported by Amazon countries, excluding French Guiana and Suriname who did not provide data. This represents a little less than a ninth of total global mercury imports that year (2600 mt). During that same time period Peru and Brazil reported a total of 86.5 metric tons of mercury exports, whereas the rest of the Biome's countries did not claim any exports in 2008 (UN Comtrade, 2018).

In 2008, the United States and the European Union had not yet prohibited mercury exports and the panorama of the global mercury trade between the Amazon Biome and the rest of the world focused on the

3. These years were chosen because the figures coincide with the UNEP's data and discourse (2017) in the recent "Global Mercury: Supply, Trade, and Demand" report.

EU, the US, and Mexico. According to an assessment by the UNEP (2017: 32), in that year the EU, as the main exporter, sent approximately 100 metric tons each to Colombia and Peru, and around 20 tons to Guyana. For its part, Mexico sent mercury to Colombia (10 mt), Peru (20 mt), and Brazil (between 1 and 3 mt). The US, to a lesser degree exported mercury to Colombia (around 5 mt), and between 1 and 3 metric tons each to Guyana and Brazil.

Map 1. Mercury imports to countries in the Amazon Biome in 2008



2015

In 2015, the mercury trade to the Amazon Biome countries was drastically different in comparison to 2008, after the EU and the US prohibited mercury exports and the Minamata Convention restricted mercury imports and exports for only certain permitted uses and when a trade agreement between countries exists. Mexico became the main provider of mercury to Bolivia and Colombia, with an estimated 100 metric tons each, and to Peru with approximately 10 metric tons (UNEP, 2017: 30). Mexican exports reached 300 metric tons both in 2014 as well as in 2015, benefit-

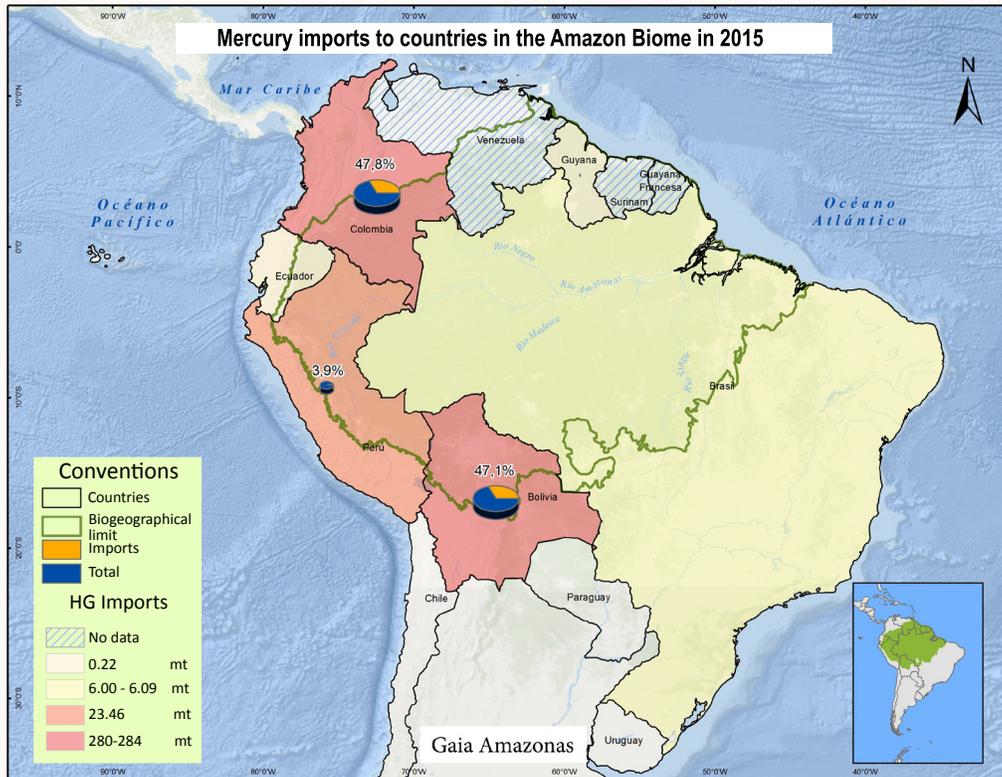
ting primarily the IIGM sector in Latin American countries (UNEP, 2017: 6). Nevertheless, and in spite of the restrictions, trade flows of between 1 and 3 metric tons can still be observed between the US and Brazil, and of around 50 metric tons from the EU to Guyana (UNEP, 2017: 30).

In 2015, Amazonian countries, excluding Venezuela, Suriname and French Guiana who did not present reports, imported a total of 431.56 metric tons of mercury. Not only does this amount represent an increase in the total quantity of mercury imported in 2008 (308.8 mt), but it also represents a little more than a third of the global total of 1200 metric tons of mercury imported in 2015. In 2015, Colombia and Peru exported a total of 9.2 metric tons, but no information is available for the rest of countries that year (UN Comtrade, 2018).

In contrast with worldwide mercury import figures (that dropped from 2600 metric tons in 2010 to 1200 metric tons in 2015; UNEP, 2017), Amazonian countries reported an increase in total mercury imports from 308.76 metric tons in 2008 to 431.56 metric tons in 2015. This increase is a result of the surprising upturn in Colombia, that doubled its imports between 2008 and 2015 and Bolivia that went from 0.02 to 142.9 in 2015 and then to exceeding 224 metric tons the following year. Ecuador also went from importing 11 metric tons in 2008 to 111 in 2015. Peru is an atypical case because its imports decreased in 2017 to 11 metric tons (less than a tenth of what it imported in 2008), yet while the majority of countries in the Biome exported next to no mercury, between 1999 and 2017 Peru exported 955 metric tons, with an average annual rate of 146 metric tons. In other words, Peru exported 82% of all of the mercury exported in the Biome between 1994 and 2017.

The countries in the Biome reported a similar trend to the global tendency of decreasing their mercury exports. In 2008, a total of 86.5 metric tons of mercury was exported by countries in the Amazon Biome to the rest of the world (including to countries within the Biome), while in 2015 only 9 metric tons were exported. In 2017, only 0.2 metric tons were reported as exports in all of the Biome, even though that same year 216 metric tons were imported. It follows that in the past few years, some of the traded mercury remained in countries in the Biome and eventually was converted into atmospheric emissions or releases into soils and water.

Map 2. Mercury imports to countries in the Amazon Biome in 2015



In spite of the fact that little is known about the intra-regional dynamics of illegal trade in Amazonian countries, as will be discussed in greater detail in section C of this chapter, mercury emissions and release figures suggest that mercury demand for IIGM in the Amazon has remained consistent and has even increased. This can be inferred because in the last fifteen years, mercury supply to the region from imports has been constant (even though it has varied between countries) while mercury emissions in the Biome have risen, which will be discussed in chapter III.

INTRA-REGIONAL TRADE DYNAMICS IN AMAZONIAN COUNTRIES

Import and export trade flows reported by official sources (UN Comtrade and national databases) as well as secondary information (press releases from the countries' main newspapers) suggest that Amazonian countries do not only import mercury from countries in the north and other continents, but also from within the region. This suggests that mercury stocks in Amazon countries have been increasing. Considering that IIGM is the activity that uses the greatest amount of mercury in Latin

America, it is important to mention that the trade and exchange dynamics of illegal and informal gold mining are intimately related to those of mercury, although they are not necessarily the same. Even though some local mercury suppliers are also connected to the gold value chain, similar to some gold traders, this is not always the case. The legal and illegal mercury trade markets involve different actors, dynamics, and circulation routes (Fritz, Maxson, & Baumgartner, 2016), although they sometimes overlap with gold trade actors and flows in some areas and regions. There are several connections between actors from the gold value chain and the mercury value chain: some obtain mercury from gold traders; some buy it from legal distributors who are authorized to sell it for other uses; some are able to purchase it from mercury users in other industries; and still others recycle it, even though this is still quite rare in Latin America.

Presently, it appears that mercury is being sold from Mexico to Peru and then to the rest of the Biome through a burgeoning illegal market in countries like Bolivia (Gonzalez, February 18, 2018) and Colombia (Garcia *et al.*, 2017). In the wake of diminishing imports from the European Union and the United States, Mexico became the main provider of mercury to Latin America until Peru stopped importing it in 2015. In the same year, while exports from Mexico to Peru dropped, exports from Mexico to Bolivia increased. Between 2014 and 2015, exports from Mexico to Peru decreased from 94 to 9 metric tons, while in the same period exports from Mexico to Bolivia increased from 24 to 138 metric tons. While some sources indicate that IIGM in Bolivia has risen, it is improbable that mercury demand has multiplied by six in one year in that country alone (Gonzalez, February 18, 2018), which is why it appears that excess mercury is being sold in transnational contraband networks to other countries in the Amazon Biome.

Nevertheless, governments have little knowledge of this reality. Very little is known except for limited journalistic reports, inference on the anomalies in the legal international trade flows, and a few investigations. What is certain is that these illegal mercury markets fluidly cross borders between Colombia, Bolivia, Peru, Brazil, and Ecuador. The national authority in the Amazon border regions of these countries is tenuous, binational coordination mechanisms are weak (if not inexistent), and other markets for illegal goods are possibly connected. This has facilitated the trafficking of mercury and informal miners in cross-border areas (SPDA, 2015: 5). According to a report by WWF Colombia and the *Foro Nacional por Colombia* (2017: 40), Peru is the distribution hub for contraband mercury in South America, both by land and water. This fact is supported by Peru's formal export registries to five Amazonian countries between 1998 and 2015, which show that Colombia received 3.5 metric tons of mercury from Peru, 2.4 from Bolivia, 1.8 from Ecuador, 1 from Brazil, and 0.7 from Guyana (UN Comtrade, 2018). In 2015, the Peruvian National Superin-

tendence of Customs and Tax Administration reported the confiscation of more than a ton of illegally traded mercury in the Bolivian border area close to Juliaca.⁴

Effectively, intra-regional mercury trade tendencies indicate that a significant amount of legally imported mercury that passes through these countries ends up being used in irregular IIGM activities, particularly in Colombia, Brazil, and Peru. According to the Colombian Police in 2017, at least 50% of the legally imported 118.8 metric tons of mercury was diverted to illegal and informal mining. After it is imported, the metal is transported to mining areas, where it is siphoned off into soda bottles or gasoline canisters to evade controls (*El Tiempo*, April 9, 2017). In 2015, Peru reported the confiscation in Puno of close to one ton of mercury that had entered the country legally but was intended for use in IIGM (*Andina*, September 1, 2015). Recently in Brazil, the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), seized 1,7 tons of imported mercury from Turkey that was going to be sent to the illegal *garimpeiros* gold miners in the Amazon in 2017⁵, and then another 0.5 ton in 2018. The IBAMA determined that the Quimidrol Company was responsible for importing the metal, which is registered as the country's largest mercury importer, and who had faked the sale and shipping of the mercury to a shell company of fuel products located in Mato Grosso.⁶

In Guyana, French Guiana, and Suriname there is a lot of uncertainty regarding the illegal mercury trade, and data is particularly scarce in the case of French Guiana (Legg, Ouboter, & Wright, 2015). Since 2006, the Ministry of Industries and Commerce in Suriname has required a license in order to import mercury, but since 2016 none have been emitted, and therefore it can be concluded that all of the mercury that enters the country from abroad is illegal (Artisanal Gold Council, 2016: 49). Similarly, Guyana imports mercury to be used inside the country and it seems that the changing source of countries that provide the metal has not caused significant changes. The United States and Spain were Guyana's main suppliers until 2013. Subsequently, mercury was received from China and according to some sources, *garimpeiros* from Brazil and Venezuela also transport small quantities of mercury for use in IIGM (Artisanal Gold Council, 2016: 49).

4. El Comercio Newspaper, September 1, 2015.

5. <https://g1.globo.com/sc/santa-catarina/noticia/ibama-apreende-17-tonelada-de-mercurio-no-porto-de-itajai.html>

6. <https://www1.folha.uol.com.br/cotidiano/2018/02/ibama-apreende-430-kg-mercurio-destinados-ao-garimpo.shtml>

Mercury demand and use

According to estimates by the UNEP (2014: 6), products with added mercury that are consumed in Latin American and the Caribbean represent close to 10% of the global total, including items such as dental amalgams and measuring instruments. This is a significant figure that should be analyzed, however these applications are responsible for the majority of mercury use in the Amazon Biome. In 2015, South America was the region where more mercury was used for IIGM in the world, with an average of 680 metric tons and much lower quantities in the rest of applications, for example: chlor-alkali production (35 mt), batteries (18 mt), dental amalgams (13 mt), measurement and control devices (8 mt), and other applications (13 mt), for a total of 794 metric tons (UNEP, 2017: 81). Recent estimates by the UNEP (2017: 50) of mercury consumption in IIGM show that even though marked decreases throughout the world have occurred, for example in China, this has been accompanied by significant increases in mercury use in IIGM in countries like Guinea, Myanmar, Sudan, and three countries in the Amazon Biome: Peru, Suriname, and Ecuador.

Since mercury for IIGM is only supplied legally in countries where this type of mining is permitted, and considering that several Amazonian countries have prohibited mercury use in IIGM, i.e. Brazil, Colombia, and French Guiana (Fritz *et al.*, 2016), mercury is frequently obtained from sectors where it is legally used in applications like dental amalgams (Fritz *et al.*, 2016). Moreover, global fluctuations in the price of gold contribute in large extent to the spread of IIGM and therefore the use of mercury: the greater the price paid by the final customer, the greater the incentive for miners (SPDA, 2015: 139). For example, in the case of Peru between 2005 and 2011, the SPDA (2015: 252) found that historically increases in the price of gold have correlated to an increase in illegal mining.

B. COUNTRY-LEVEL SITUATION

After the introduction of the previous section on the overall situation of supply, trade, and demand dynamics of mercury in the Amazon Biome, this subsection will present an assessment of each country. Prior to going into detail, it is important to provide a clarification regarding the methodology used to analyze mercury import data: this information was taken from the UN Comtrade annual database on mercury supply, demand, and trade using the 2805.40 tariff code (mercury). Data from the 2852 tariff code (organic and inorganic mercury compounds) was not included. In this way, this report follows the methodology of the UNEP report (2017) on mercury supply, demand, and trade, which only uses the 2805.40 code, since it considers that the trade in other compounds involves different actors.



1. BOLIVIA



Three known cinnabar deposits exist in Bolivia: one located between Peñas and Huarina (Maria Paz mine), one on the border between the Oruro and La Paz departments (El Triunfo mine), and one in the Lliqui mountains on the Tumusla River (Emilia mine). All three of these are very small and are not currently being actively mined (Carrillo, 2013). Given the lack of cinnabar deposits and the inactivity of primary extraction from existing deposits, all mercury used in Bolivia is imported.

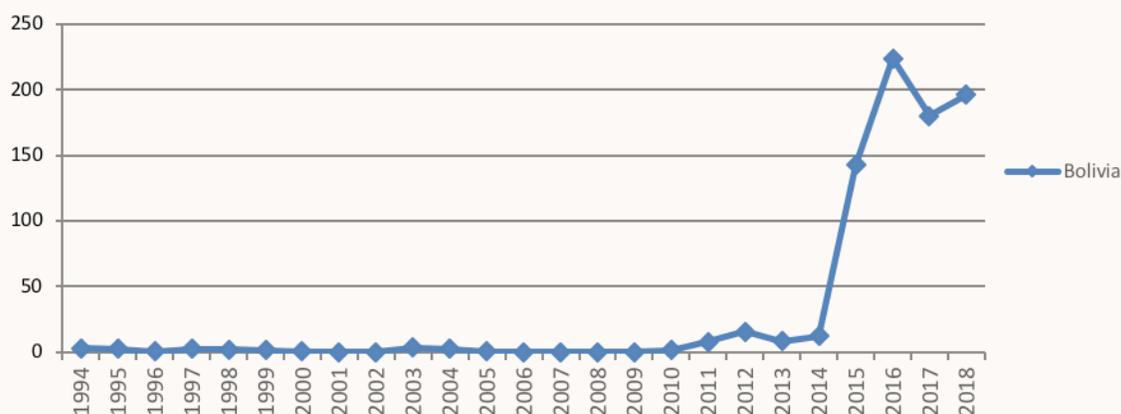


• Annual imports of mercury



Prior to 2010, Bolivia did not import more than two metric tons during any given year (with the exception of 2004 when 2.66 mt were imported). In spite of this, from 2011 on, several upward variations took place in 2011 (9 mt), 2012 (16 mt), 2013 (9 mt), 2014 (12 mt), and significant increases occurred in 2015 (140.1 mt) and in 2016 (238 mt).

Bolivia Mercury Imports 1994-2018



Source: Data from UN Comtrade.

• Imports of mercury by country



The countries that sent Bolivia significant amounts of mercury during the period from 1994 to 2018 were: Mexico (529.5 mt), Spain (11.3 mt), Germany (9 mt), India (6.7 mt), and the United States (6 mt). According

to UNEP (2013), a discrepancy of three metric tons existed between 2013 and 2015 in the reports provided by exporting countries and Bolivia's declaration of imports.

In the last few years, Bolivia has taken on a central role in the regional mercury trade. The significant increase in mercury imports in 2015 was a result of the decision to import mercury from Mexico that Peru had decided to stop importing. Between 2012 and 2015, Mexico was the main supplier of mercury to Peru up until it stopped being imported from Mexico. A pattern of increasing mercury exports from Mexico to Bolivia while the exports from Mexico to Peru decline can be observed: between 2014 and 2015, exports from Mexico to Peru decreased from 94 to 9 metric tons, while exports from Mexico to Bolivia grew from 24 to 138 metric tons, almost half of what was imported that year according to the previous table. As noted by Gonzalez (2018), gold mining in Bolivia has expanded during the past decade, but it is improbable that it grew six times in just one year. This unusual rise in imports, together with police seizure records of mercury on the border with Peru, suggest that Bolivia is an important route for illegal mercury trade in Latin America.

• Exports of mercury by year and by country



In the UN Comtrade database, Bolivia only reported exports of mercury in 1998 for a total of 24 kilograms to the United States and one export of 198 kg to Peru in 2017.

With regards to the illegal mercury trade, newspapers in the country report that mercury can be obtained in many weakly controlled border areas as well as in cities like La Paz, Cobija, Trinidad, Santa Cruz, Oruro, and Potosí (Carrilo, 2013). An SPDA report declared that the mercury that is used in gold mining in Bolivia “enters without control or registration along the country’s extensive borders, especially from neighboring countries that are experiencing a growth in small-scale gold mining like Peru (1047 km) and Brazil (3423 km). The price ranges from US\$250 and US\$300 for a kilogram of mercury, and it can be bought without regulation in any border area, in mining areas, as well as in important cities like La Paz, Cobija, Trinidad, Santa Cruz, Oruro, and Potosí” (SPDA 2014: 49).



The majority of gold processing mines in Bolivia are small-scale and because of the grinding system used (small mills and hammers), they are easily moved which makes them hard to monitor. The SPDA reports that in Bolivia some plants like the one in San Simon use an average of 400

grams of mercury per metric ton of processed material, and only 10% of the mercury used is recovered, leading to alarming rates of environmental contamination: 1.9 mt/month and 15.3 mt/year. Applying these rates to the estimated annual gold production in Bolivia (384 kg), for every one kilogram of gold produced, 36 kilograms of mercury are released into the environment. This is probably one of the highest rates in the world. The environmental situation in San Simon is startling, especially when considering the closeness to protected areas such as the Lower Paraguá Permanent Production Forest and the Noel Kempff Mercado National Reserve and National Park (SPDA 2014: 51).

According to WWF and IDR (2016), and Bolivia's National Energy Account (MHyE, 2011), the Madre de Dios region in Peru, adjacent to Bolivia, is undergoing intense mining activity. Elemental mercury is used in the gold mining process and mercury that is released is moved by erosion from soils into the river bed sediments which are transported downstream by the Madre de Dios River. Consequently, much of the contamination spreads to Bolivia, resulting in an international and cross-border problem. There are also mercury releases in the area of Bolivia's northern Amazon into the Beni River which joins the Madre de Dios River close to the Riberalta town in the border area between the Beni and Pando departments (IIAP, 2011).



2. BRAZIL



Supply

No official or secondary information is available regarding mercury production in Brazil or if it is generated as a byproduct of non-ferrous metal extraction. Therefore, it is presumed that all mercury used is obtained through imports.



Trade

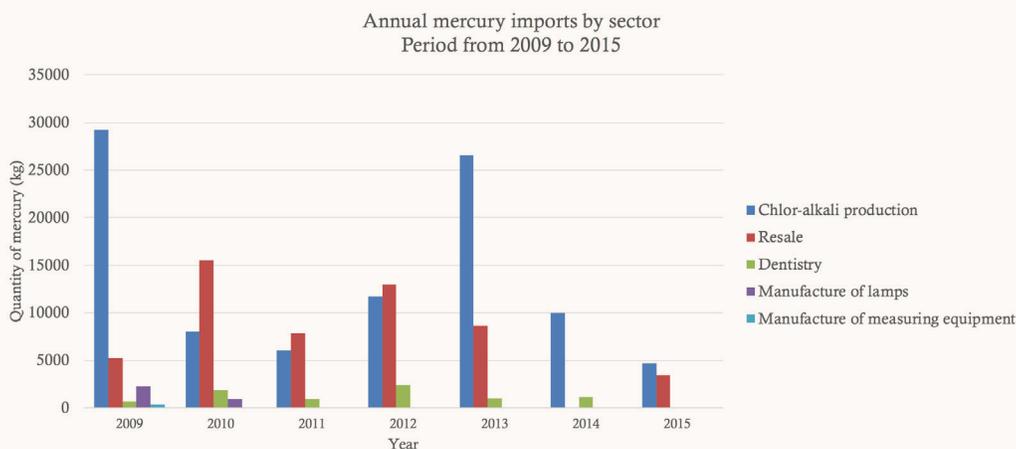
• Annual imports of mercury



In general, the national data on mercury imports do not coincide with the UN Comtrade reports. This is the country with the highest levels of discrepancies in mercury import records in the Biome in the last twenty years.

According to IBAMA (2017), the annual mercury imports by destination from 2009 to 2015 are presented in the following graph.

Annual mercury imports by sector in Brazil, 2009-2015

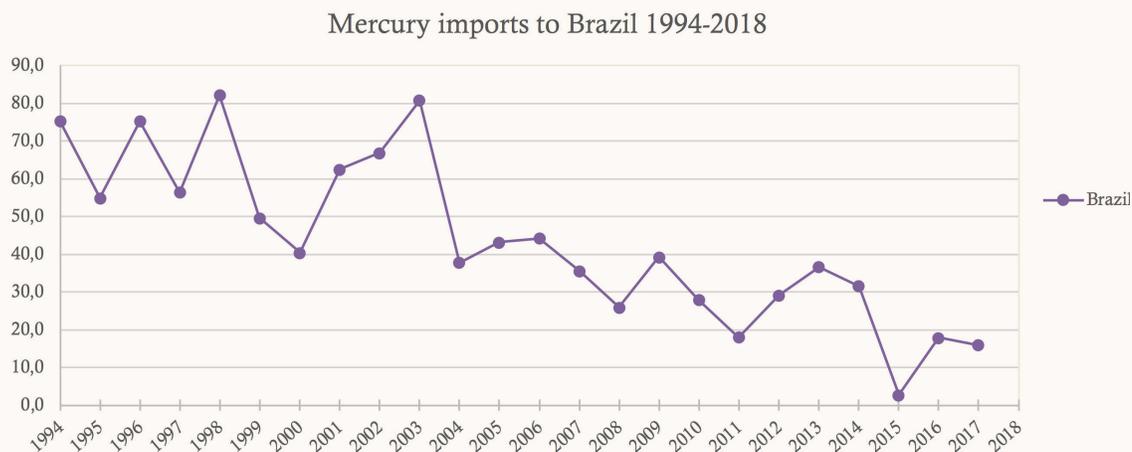


Source: IBAMA (2017)

Annual imports of metallic mercury by sector

Year	Chlor-alkali production (kg)	Resale (kg)	Dentistry (kg)	Manufacture of lamps (kg)	Manufacture of measuring equipment (kg)
2009	29,249	5,211	636	2,284	345
2010	8,004	15,525	1,891	882	0
2011	6,003	7,832	875	0	0
2012	11,730	12,938	2,378	0	0
2013	26,566	8,625	960	0	0
2014	10,005	0	1,136	0	0
2015	4,658	3,450	0	0	0

Source: IBAMA (2017)



Source: Data from UN Comtrade.

According to the IBAMA (2017), Brazil imported 8.1 metric tons of mercury in 2015, which is in contradiction to the UN Comtrade data that shows that in the same year the country reported 280 metric tons of imported mercury. In previous years, on average Brazil imported 61 metric tons until a surge occurred in 2014 and 2015 in imports. According to Mercury Watch (2006), the Brazilian Environmental Ministry’s Chemical Security National Commission reported that between 1998 and 2001, Brazilian mercury imports averaged 58.8 metric tons per year. It is not clear why imports increased in 2014 and 2015, but since the information is presented by UN Comtrade, it has been reproduced here as is.

• Imports of mercury by country 

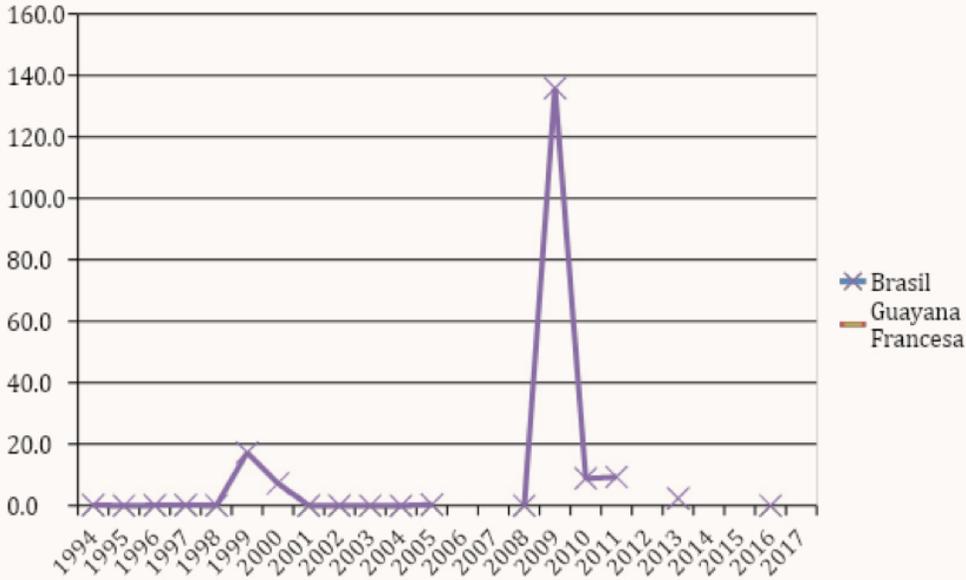
In Brazil, sector-level information is available which allows for a deeper analysis of the quantity of elemental mercury that is imported and could be diverted to IIGM. According to the UNEP (2017), Brazil is one of three countries in the Amazon Biome that reported more mercury imports than what the exporting countries reported: the inconsistency is less than five metric tons.

The main countries that Brazil imports manufactured mercury from are: Russia (44%), Spain (24%), Central African Republic (5%), and Finland (4%). Mercury chemical compounds are supplied from Chile (61%), Germany (19%), and Switzerland (19%). According to UN Comtrade, the three countries that supplied mercury to Brazil in all of its forms, from 1996 to 2018, were: Spain (121.3 mt), Russia (182.1 mt), and Finland (60.7 mt). According to the UNEP (2017), Brazil is one of three countries in the Amazon Biome that reported more mercury imports than what the exporting countries reported: the discrepancy is less than five metric tons.

• Exports of mercury by year



Mercury exports from Brazil on average have not surpassed 20 metric tons annually. Nevertheless, sudden increases occurred in 1999 (20 mt) and 2009 (135.8 mt).



Source: Data from UN Comtrade.

• Exports of mercury by country



In the period between 1997 and 2016, the four countries to which Brazil exported the greatest amounts of mercury were: Spain (130.63 mt), Argentina (51.45 mt)⁷, Bolivia (0.55 mt), and the United States (0.34 mt).

Demand

According to the government, in 2012 (the year in which data was not provided to the UN Comtrade), Brazil imported 27 metric tons of mercury, 18.9 of which (70%) was used in the chlor-alkali industry in Bahia. It is estimated that of the total mercury imported, only 2% is used in mining activities (SPDA 2014: 92). However, the SPDA report also estimates that

7. The Alice-WEB of the Brazilian Ministry of Exterior Relations reported exports to Argentina (99%) of: 17 metric tons in 1999, 7 metric tons in 2000, and 25 kilograms in 2001.

close to 3,000 metric tons of mercury have been used in IIGM in the Brazilian Amazon, where for approximately twenty years, oxidation and methylation processes have occurred water sources and river sediments (SPDA, 2014). This suggests that a robust unregistered, informal market exists, although little is known about it.

3. COLOMBIA



Since Colombia does not produce mercury, it relies on imported mercury for use in different sectors. Even though a small cinnabar mine existed in the coffee region, this produced very little mercury and has been inactive for several years (Ministry of Mines and Energy, UPME & University of Cordoba, 2014).

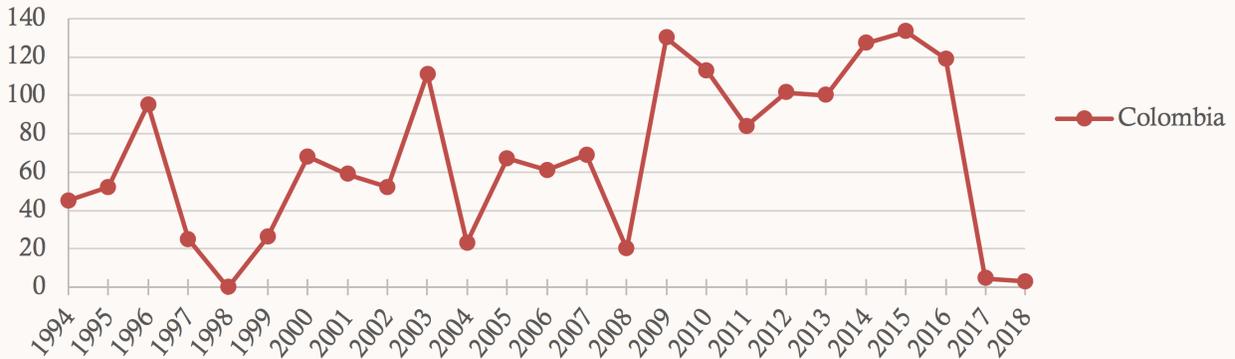


The legal mercury trade in Colombia is supplied by Kyrgyzstan, Spain, Mexico, the Netherlands, the United States, Germany, Russia, China, Italy, and the United Kingdom. The main points of entry are Cartagena (83.4%), Buenaventura (12.8%), Medellin (3.1%), Bogota (0.6%), and Barranquilla (0.1%) (WWF Colombia & Colombian National Forum, 2017). According to the National Tax and Customs Office (DIAN), 1,020 metric tons of mercury were imported to the country between 2003 and 2013, of which 96.3% entered by sea and 3.7% entered by air (García *et al.*, 2017).

• Annual imports of mercury

Between 1996 and 2006 in Colombia, the most mercury imported was during 2008 (138 mt). The amount of imports has fluctuated since then: first it decreased in 2011 (84 mt) and then it rose in 2015 (130 mt), close to the high point of 2008. During the past three years (2015-2017), Colombia has substantially reduced mercury imports, due to new internal regulations that came into effect in 2013 and that have progressively restricted imports. However, it is important to note that in eight of the last twelve years, imports exceeded 100 metric tons, which is a significant amount.

Mercury imports to Colombia 1994-2018



Source: Data from UN Comtrade.

• Imports of mercury by country. Main mercury suppliers to Colombia.



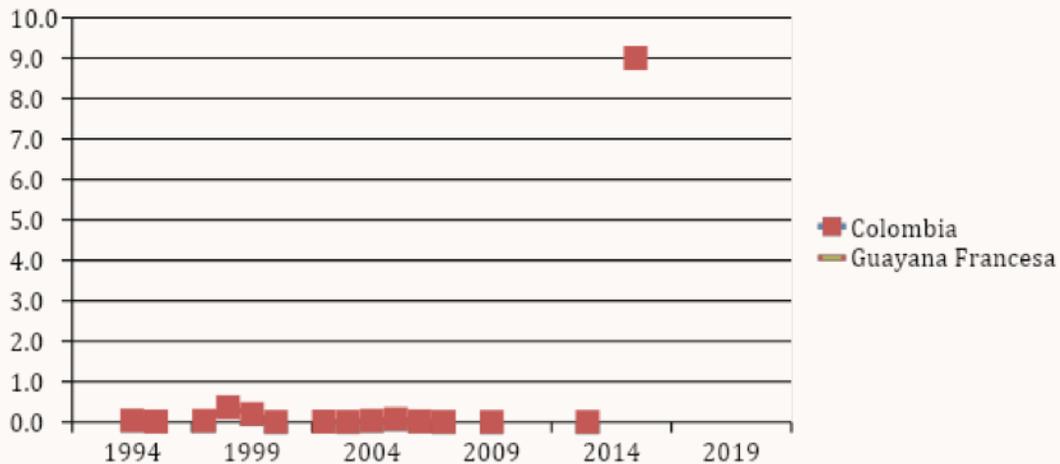
According to Garcia *et al.* (2017), mercury shipments that enter through Cartagena are originate from the following countries: Spain (31.9%), Mexico (22.9%), the Netherlands (21.2%), the United States (11.7%), Germany (9.2%), and Russia (1.4%). The discrepancy with the UN Comtrade report may be due to the fact that the mercury imports from Mexico enter through the Buenaventura port on the Pacific coast. According to the UNEP (2013), between 2013 and 2015 an inconsistency of nine metric tons existed between what the exporting countries and Colombia reported to have imported.

Different figures exist according to the database that is analyzed. According to the UN Comtrade, the principle countries from which Colombia imported mercury between 2007 and 2013 were Mexico, Spain, the Netherlands, the United States, Germany, Argentina, Australia, Belgium, Brazil, Chile, Peru, Singapore, Sweden, and Switzerland. While the Legiscomex database declared that the main suppliers of mercury to Colombia between 2003 and 2013 were Italy, the United Kingdom, France, Germany, the Netherlands, Spain, Hong Kong, China, Japan, Kyrgyzstan, Russia, the United States, Peru, and Mexico (Ministry of Mines and Energy & University of Cordoba, 2014). Additionally, in Colombia the exact quantity of mercury used by the mining industry cannot be calculated, not only because these figures do not include the illegal mercury trade, but also because up until 2016 the government did not require companies that imported the metal to report how it would be used (Ministry of Mines and Energy, *et al.* 2014).

Garcia *et al.* (2017: 40) use the Colombian National Customs and Taxes Administration database to report that part of the illegal mercury trade in South America has its origins in China, proceeding from dismantled chlor-alkali plants and primary mercury production. This arrives in the region via Peru, where a mercury contraband market exists that distributes the metal to neighboring countries and the rest of South America. The report's authors assert that other viable sources include the recovery of mercury as a byproduct in non-ferrous metal mining in the United States and artisanal mining. When illegal mercury enters Colombia by way of Peru it is mainly distributed along the Putumayo and Nariño Rivers to arrive at the different gold mining sectors, specifically Mallama, Barbacoas, Magüi Payán, and Roberto Payán (García *et al.*, 2017: 41). Aside from anecdotal evidence of mercury purchases in some Andean mining areas in the Nariño department (Rubiano, forthcoming), more precise geographical information about mercury availability or the local and regional supply of the metal is unavailable.

• Exports of mercury by year 

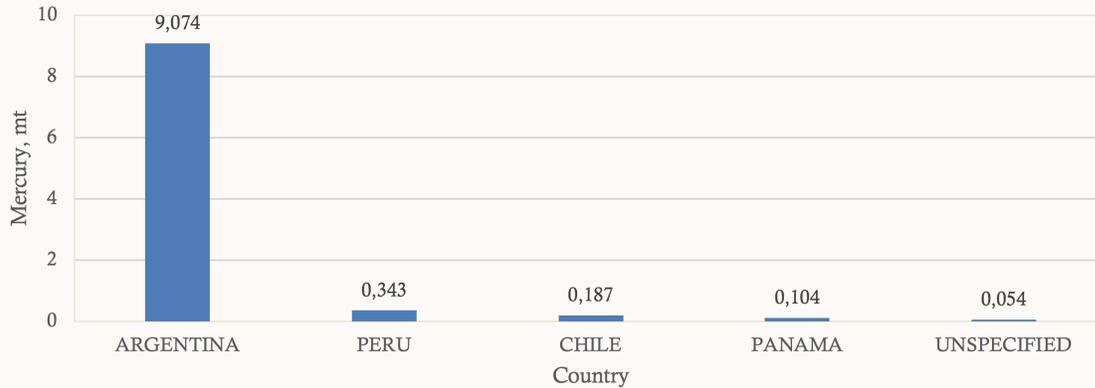
From 1997 to 2013, Colombia exported less than one metric ton of mercury each year, excluding a sharp rise in 2015 when the country exported 18.148 metric tons.



Source: Data from UN Comtrade.

• Exports of mercury by country 

Colombia Main Hg Exports 1996-2016



Source: Data from UN Comtrade.



Colombia does not produce mercury, but it imported between 54 and 130 metric tons each year between 2006 and 2010. The government estimates that close to 98% of the imports in this period were used in IIGM. The National Mercury Inventory of Colombia declared that 47 metric tons of mercury are emitted each year into the atmosphere, thirty of which are the result of gold mining activities (OCDE/CEPAL 2014). An assessment done by ONUDI's Global Mercury Project team in Colombia suggests that mercury releases into the environment may be even higher than what the government estimates, up to 150 metric tons a year only from IIGM (ONUUDI 2012). The Institute of Hydrology, Meteorology and Environmental Studies (IDEA) and the Mining and Energy Planning Unit (UPME) estimate that between 150 and 298 metric tons of mercury are released each year in Colombia. The National Water Study conducted in 2014 by IDEAM estimated that in 2012, 179 municipalities in fifteen departments received mercury discharges in water bodies of 202 metric tons (cited in Garcia *et al.*, 2017: 56).

In a study of the chain of mercury in Colombia, the Ministry of Mines and Energy *et al.*, (2014), reported that the country does not have official figures regarding mercury use, and specifically that:

(...) of the 71.4 metric tons of mercury imported in 2007, only 1.28 metric tons were used in the manufacturing sector, according to the DANE. This suggests that more than 98% of imported mercury is used in other activities, including mining. Nevertheless, official figures are not available. It

is known that contraband mercury is used for artisanal and small-scale mining, primarily from Peru and Ecuador, but needless to say, the exact figures are unknown (p.252).



4. ECUADOR



Supply

Ecuador does not produce mercury either through primary extraction, recycling processes, or chlor-alkali production (Ministry of Environment of Ecuador, 2008), therefore all the mercury in the country is imported.



Trade

• Annual imports of mercury



In general, Ecuador's mercury imports have been relatively low, except for 54.4 metric tons and 35 metric tons in 2001 and 2002, respectively. In 2010 and 2011, 19 and 17 metric tons respectively were imported, but subsequently quantities have decreased.

Mercury imports to Ecuador 1994-2018



Source: Data from UN Comtrade.

According to SPDA (2014), of the 8.2 metric tons of mercury that entered Ecuador in 2005, the Ecuadorian Customs Corporation reported that 99.7% was used in amalgamation for gold mining. Ecuador's Central

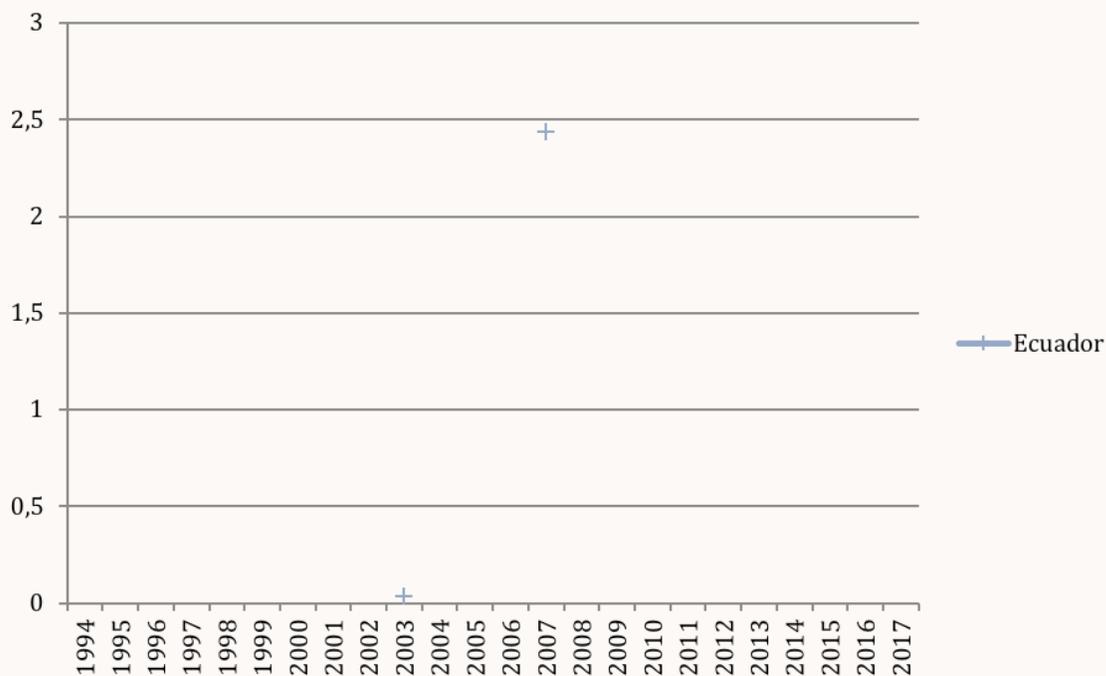
Bank declared that during subsequent years, import quantities increased: 2006 (11.6 mt); 2007 (12.3 mt); 2008 (13.6 mt); 2009 (11 mt); 2010 (19.2 mt); 2011 (17.2 mt); however, imports decreased in 2012 and 2013 to 4.5 and 3.5 metric tons respectively. Nevertheless, the Central Bank registered increased imports again in 2014 with 28 metric tons, and in 2015 with 20 metric tons.⁸ However, the UN Comtrade reported that an abnormal and significant increase took place in 2014 of 112 metric tons. Data for the last few years is not available, which casts uncertainty on the causes of the 2014 spike and how transnational illegal mercury trade networks operate in Ecuador.

• **Imports of mercury by country** 

The five main mercury suppliers to Ecuador during the period from 1996 to 2015 were: Germany (94.36 mt), Spain (58.491 mt), Belgium (32.8 mt), the United States (24.78 mt), and the Netherlands (21.37 mt).

• **Exports of mercury by year** 

Ecuador only reported mercury exports in 2003 (0.037 mt) and 2007 (2.449 mt), according to data provided by the UN Comtrade.



Source: Data from UN Comtrade.

8. <https://es.mongabay.com/2017/03/rios-mercurio-la-mineria-ilegal-contamina-la-zona-norte-esmeraldas-ecuador/>

• Exports of mercury by country 

Ecuador only reported mercury exports in 2003 and 2007. In 2003, 0.037 metric tons were exported to the United States, and in 2007 2.5 metric tons were sent to Peru.

 Demand

Mercury is used in artisanal and informal gold mining in the cities of Zaruma, Portovelo, Piñas, and Camilo Ponce Enriquez, as well as in the mining areas of Nambija and Bella Rica (Ministerio del Ambiente de Ecuador, 2008). Up until 2009, the country did not import more than 9.5 metric tons of mercury, but evidence suggests that between ten and twenty metric tons of mercury is used annually in IIGM (Velasquez-Lopez *et al.*, 2007: 231). Miners in the Portovelo-Zaruma region have disclosed that the mercury they use is sometimes obtained illegally from Peru. In Ecuador, the price for one kilogram of mercury is US\$40, which according to Velasquez-Lopez *et al.* (2007), is low compared to other countries like Brazil, where the price is US\$150 per kilogram. Reports have shown that it is possible to buy illegal mercury in the Zamora province, particularly in the Yanzatza canton. The local price per liter is estimated to be US\$400.⁹ Press releases denounce the presence of illegal mercury brought in from Peru and Colombia. The leader of a mining association in Morancay asserts that the flow of contraband mercury is close to “two tons each month. The price of a container of mercury has multiplied by four times its previous cost of US\$1000.”¹⁰

 5. Peru

 Supply

Even though Peru has several cinnabar deposits, it does not produce primary mercury.

9. <http://www.elcomercio.com/tendencias/mercurio-se-zamora.html>

10. <http://www.expreso.ec/actualidad/mercurio-prohibido-pero-en-venta-BY230047>



• Annual imports of mercury

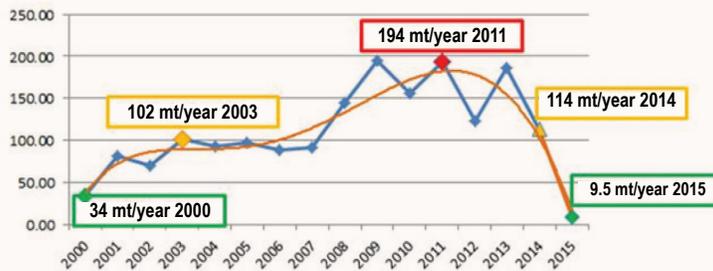
Mercury imports to Peru 1994-2018



Source: Data from UN Comtrade.

Peru is one of South America’s main mercury importers. It receives on average approximately 97 metric tons per year, principally to meet demand in the Madre de Dios region (Brack *et al.*, 2011, cited in WWF & IRD 2016). Mercury imports in Peru have grown substantially since 2009 when they doubled from 152 metric tons to 307 metric tons in 2008, and rose to 328 mt in 2009. After a substantial decrease in 2011, during three successive years imports rose to between 120 mt and 200 mt annually. However, during the past three years imports have again dropped significantly. In general, the UN Comtrade data coincides with the national records. According to Gonzalez (2018), close to half of Peru’s mercury imports ended up in Madre de Dios where artisanal gold miners consume between 44 and 50 metric tons of mercury each year.¹¹

MERCURY IMPORTS (mt)
YEARS 2000-2015



Source: http://www.minam.gov.pe/wp-content/uploads/2015/10/cuadernillo_minamata.pdf

11. <https://yaleglobal.yale.edu/content/treaty-does-not-stop-illicit-mercury-trade-south-america>

Peru stopped importing mercury in 2015. Up until this year, the National Superintendence of Customs and Tax Administration (SUNAT) was already implementing control mechanisms on mercury trade as an audited chemical product, establishing the suppliers and consumers' registry system, tax routes, and information exchange for importers and exporters.¹²

• Imports of mercury by country

The majority of mercury suppliers to Peru from 1998 to 2015 were the United States (1.171 mt), Spain (773 mt), Mexico (446 mt), the Netherlands (142 mt), and Kyrgyzstan (20 mt). According to the UNEP (2017), Peru is one of three countries in the Amazon Biome that reported more mercury imports than what the exporting countries reported: the inconsistency is less than five metric tons though.

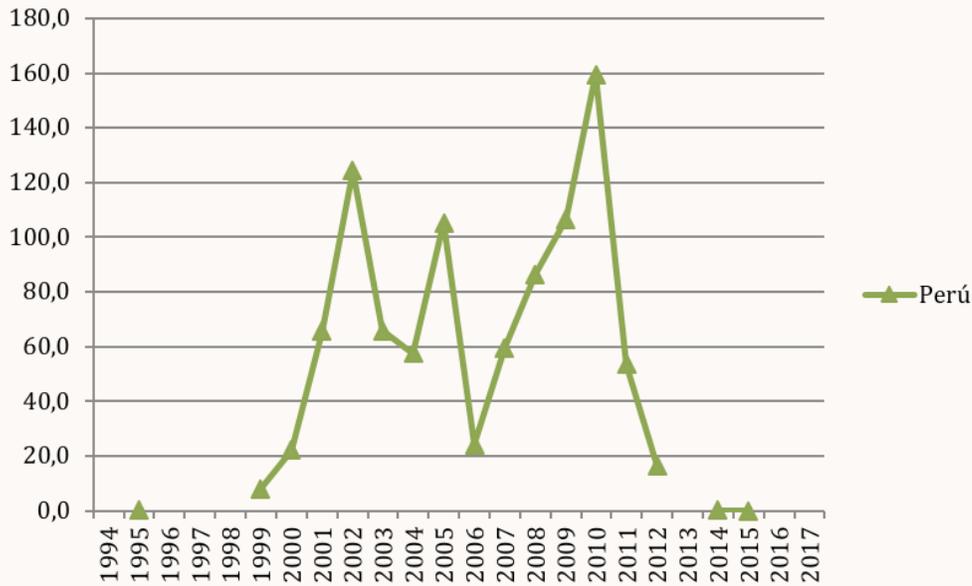
Peru has played a central role in the regional mercury trade, especially during the last few years. According to the UN Comtrade figures, Mexico has become the main provider of mercury to Peru since 2012, as a result of the reduction in imports from Europe and the United States in the two previous years. Mexico continued to lead from 2012 to 2015, when Peru stopped importing mercury. Nevertheless, Gonzalez (2018) and this report have shown that while imports between Mexico and Peru waned, they increased between Mexico and Bolivia. In 2014 and 2015, Mexican imports to Peru dropped from 94 to 9 metric tons, while imports to Bolivia rose from 24 to 138 metric tons in the same period. In general, imports to Bolivia from all countries exponentially increased during this year, as was shown above.

Reports also suggest a growing illegal mercury market on the border between Peru and Bolivia. For example, in August 2015, Peruvian authorities seized an illegal shipment of more than one metric ton of mercury close to the border region. These signs indicate that mercury may still be entering Peru from Mexico by means of Bolivia through an emerging black market (Gonzalez, 2018).

• Exports of mercury by year

Mercury exports from Peru have been varied in quantity from 1999 to 2012, with a registered increase during the 2000s, with the exception of 2004, reaching a maximum of 160 metric tons in 2010. Nevertheless, a marked decrease occurred in the following years in 2012 with 33.13 metric tons and in 2015 with exports of only 4.83 metric tons.

12. Refer to http://www.minam.gob.pe/wp-content/uploads/2015/10/cuadernillo_minamata.pdf



Source: Data from UN Comtrade.

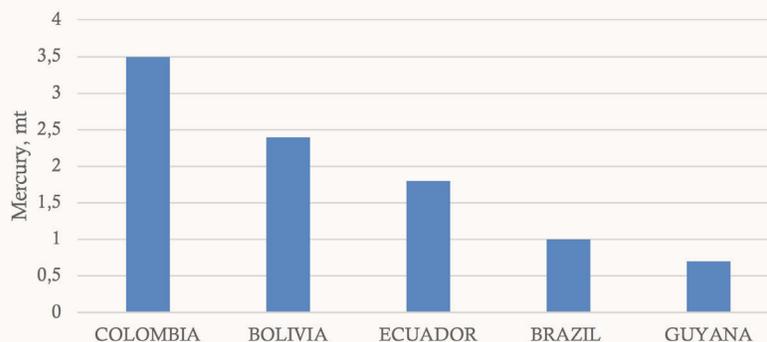
• Exports of mercury by country

Between 1998 and 2015, the four countries that Peru exported the greatest amount of mercury to were the United States (658.7 mt), Spain (256 mt), the Netherlands (30.6 mt), Singapore (7 mt), and Colombia (3.5 mt).

• Exports of mercury to Amazonian countries

According to WWF Colombia and Colombian National Forum (2017), Peru is the center of the illegal mercury market trade in South America, which is transported by land and by water. The legal records show exports to five other Amazonian countries. From 1998 to 2015, Colombia received 3.5 mt, Bolivia 2.4 mt, Ecuador 1.8 mt, Brazil 1 mt, and Guyana 0.7 mt.

Peru Exports to Amazonian Countries



Source: Data from UN Comtrade.



Peru uses mercury mainly for gold mining in small-scale and artisanal operations in the Madre de Dios, Puno, and Puerto Maldonado districts, where the majority of the country's artisanal mining is located (Ministry of Environment of Peru, n.d.). Elsewhere, mercury imports are also used in the country's two chlor-alkali plants that still use mercury cells, as well as for dental amalgams even though these have decreased given the alternatives that exist for dental procedures (Ministry of Environment, 2016).



6. Venezuela



Neither official nor secondary information exists regarding mercury primary production or as a byproduct of non-ferrous metal mining in Venezuela.

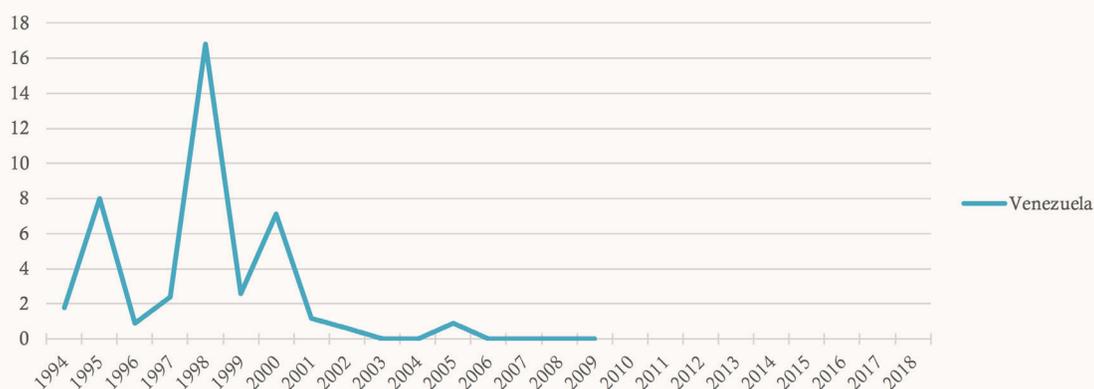


• Annual imports of mercury



Between 1996 and 2009, Venezuela received small quantities of mercury imports that did not exceed five metric tons a year, except in 1998 and 2000 when imports of 17 and 7 metric tons (respectively) were reported.

Mercury imports to Venezuela 1994-2018



Source: Data from UN Comtrade.

• Imports of mercury by country

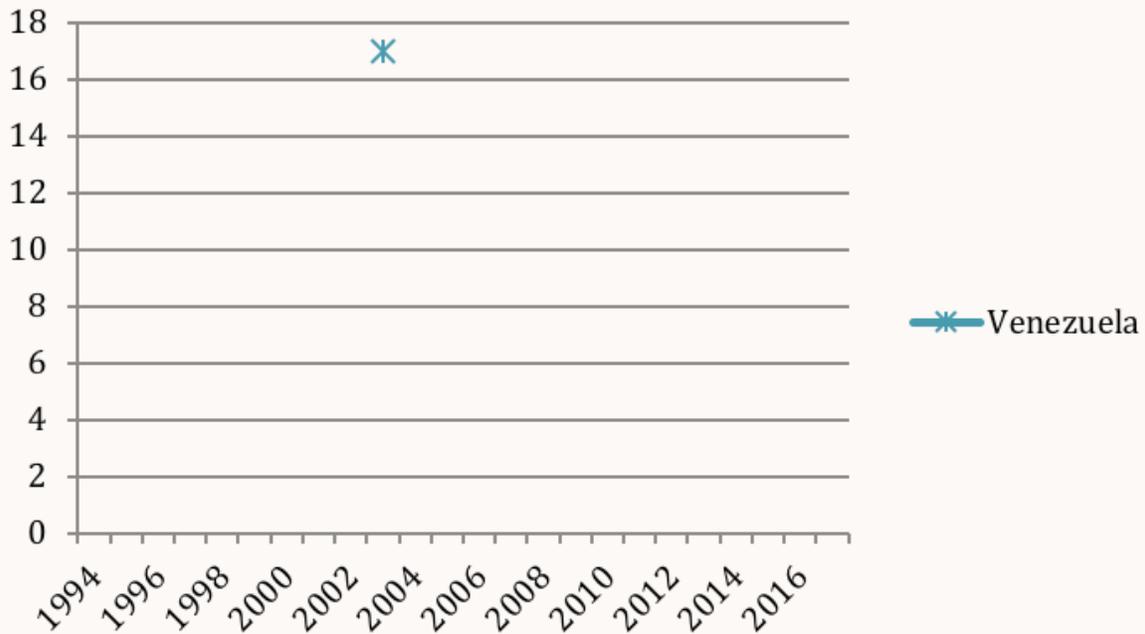


The five countries with the highest imports of mercury to Venezuela from 1996 to 2009 were the United States (19.59 mt), Spain (6.98 mt), Mexico (4.86 mt), China (0.75 mt), and Hong Kong, China (0.29 mt).

• Exports of mercury by year and by country



According to the UN Comtrade data, Venezuela only reported exports in 2003 when 17.02 metric tons were sent to the United States.



Source: Data from UN Comtrade.

 Demand

In Venezuela, mercury is used in IIGM in a variety of sites in the Bolivar and Amazonas states (Red ARA, 2013). Similarly, the metal is used by the oil and petrochemical industries in caustic soda plants (El Universal, October 21, 2013).

7. Guyana



Supply

Neither official nor secondary information is available on mercury primary production or as a byproduct of non-ferrous metal mining in Guyana.



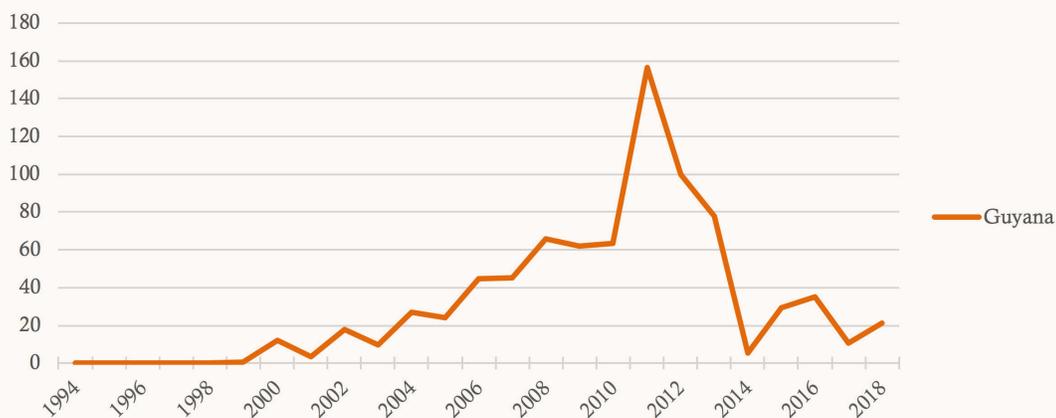
Trade

• Annual imports of mercury



From 1996 to 2011 in Guyana, a sustained increase in mercury imports can be observed until 2011 when a substantial decrease occurred, from nearly 160 metric tons to less than five in 2014. During the last three years, imports have not exceeded 40 metric tons.

Mercury imports to Guyana 1994-2018



Source: Data from UN Comtrade.

• Imports of mercury by country

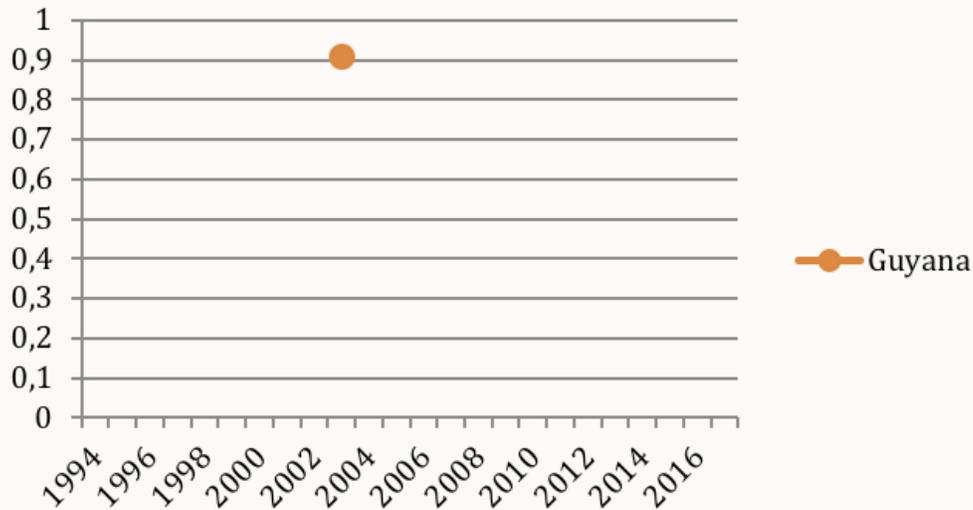


The countries that sent Guyana the greatest amounts of mercury from 1999 to 2016 were: United Kingdom (2.12 mt), Curacao (1.9 mt), Hong Kong, China (1.7 mt), and Peru (0.7 mt). According to the UNEP (2017), Guyana is one of the three countries in the Amazon that reported greater quantities of imports than what exporting countries declared: the discrepancy is of less than ten metric tons. One report estimates that between 2008 and 2013 Guyana imported 504 metric tons of mercury, while French Guiana and Suriname did not import any (Gomes, Kelle, &

Williams, 2016), which suggests a theory of mercury contraband among the Guiana Shield countries.

• **Exports of mercury by year and by country** 

The UN Comtrade data shows that Guyana only reported an export flow of mercury in 2003 for 0.915 metric tons to neighboring Suriname.



 **Demand**

Mercury in Guyana is used in IIGM and it is mainly purchased by miners and mine operators in the country’s capital, Georgetown. Close to 20% of mercury bought in Georgetown is resold in mining districts like Puerto Kaituma, Bartica, and Mahdia (Legg, Ouboter, & Wright, 2015).

 **8. FRENCH GUIANA**

 **Supply**

Neither official nor secondary information exists regarding mercury primary production or as a byproduct of non-ferrous metal mining in French Guiana.



The UN Comtrade does not contain any data on mercury imports to French Guiana. According to Legg, Ouboter, & Wright (2015), the magnitude of mercury trade in the Guiana Shield is unknown. Data on French Guiana is particularly scarce because mercury use in gold mining is illegal. The UN Comtrade data does not report figures on mercury imports nor exports in French Guiana for any year. Nevertheless, evidence suggests that IIGM in French Guiana uses clandestine mercury imported from neighboring countries. Between 2008 and 2013, Guyana imported 504 metric tons of mercury, but during that same period there are no official import records for Suriname and French Guiana. As in the rest of the Biome, mercury emissions in French Guiana are associated with the IIGM sector from neighboring countries and because of transnational mercury contraband (Gomes *et al.*, 2016).



Mercury is used in French Guiana in IIGM especially in the border area, and gold that is mined is sold in Suriname (Artisanal Gold Council, 2016).



9. Suriname



Suriname does not produce mercury, but it does produce mercury from mining byproducts like bauxite and gold. The Suralco bauxite mining company, a subsidiary of a giant American mining company, ALCOA, collects mercury that is released during mining processes (Artisanal Gold Council, 2016).

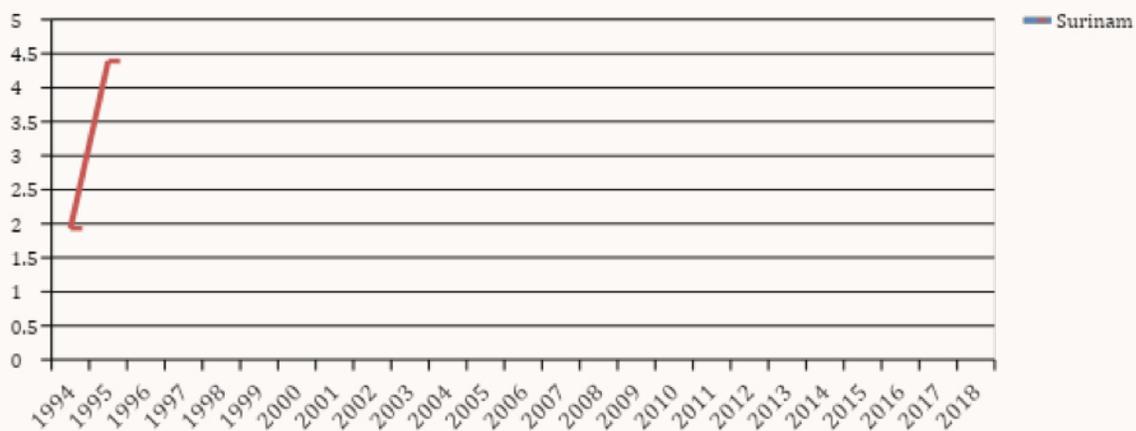


- Annual imports of mercury



Based on the UN Comtrade data, Suriname only reported mercury imports in 2010, 2011, and 2013. However, as previously noted, some sources estimate that from 2008 to 2013, Guyana imported 504 metric tons of mercury while French Guiana and Suriname did not import any (Gomes *et al.*, 2016), which supports the hypothesis of a mercury contraband network between the Guiana Shield countries. Indeed, some press articles refer to the arrest of smugglers and a mercury trade from Guyana to Suriname while other sources cite the European Union as a potential origin of illegal mercury to the country (Artisanal Gold Council, 2016). Local press reports that mercury is easily smuggled from neighboring countries to Suriname given the permeability of the region's borders. European Union inspectors also indicate that contraband is sent from the EU countries in various ways, for example mercury hidden in other shipments or as an element in dental amalgams, thermometers, and barometers, etc. It can be mislabeled when shipped and therefore not correctly declared to customs. Nevertheless, this could be detected using the relative weights of the goods it is shipped with to confirm. (Veening, Bultuis, Burbidge, & Strupat, 2015).

Mercury imports to Surinam 1994-2018

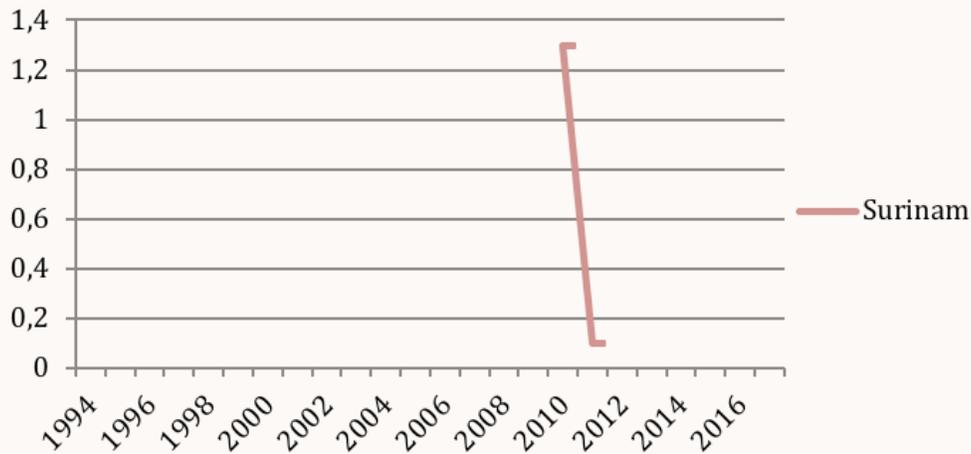


Source: Data from UN Comtrade.

• Exports of mercury by year and by country



Suriname reported mercury exports only in 2010 to the Netherlands for 1.3 metric tons and in 2011 to the United States for 0.10 metric tons.



Source: Data from UN Comtrade.



Mercury in Suriname is used in IIGM, especially in the eastern-central region in the so-called Greenstone Belt, the area where most mining occurs. Nonetheless, according to the Artisanal Gold Council (2016), it is reasonable to assume that the majority of mercury used in IIGM enters the country from abroad.

C. BLACK-MARKET MERCURY, TRANSNATIONAL MIGRATION, AND TRADE NETWORKS RELATED TO IIGM

As previously mentioned, sparse but accurate information exists regarding the illegal mercury trade in Latin America, notably for countries in the Amazon Biome. This is the case of Bolivia, where evidence is available on the illegal market for mercury in cities like La Paz, Cobija, Trinidad, Santa Cruz, Oruro, and Potosi, as well as cross-border flows along the limits with Peru and Brazil. Illegal mercury can be purchased in several border areas as well as in mining zones. These markets form part of a cross-border network of metal trade, some of which is diverted from legal and illegal imports. This is similar to what happens in Ecuador, where miners in the Portovelo-Zaruma region state that the mercury they use is sometimes illegally obtained in Peru. Furthermore, as was discussed in the previous section on Colombia, a report from this country suggests

that the illegal trade in mercury throughout South America originates in China and arrives in the region by way of Peru. The latter country serves as a contraband mercury distribution center to neighboring countries and the rest of South America. In Suriname, the media has reported how smuggled mercury is easily obtained from neighboring countries as well as from the European Union. Ecuador reports that mercury illegally enters from Peru and Colombia.

In spite of the fact that the existence of an illegal mercury market is clearly evident, very little is known about its dynamic, routes, and actors. However, a hypothesis has been confirmed by several media outlets in various countries that the mercury used in IIGM originates from an irregular deviation of the metal from legal uses. In 2015, two journalists from the Colombian newspaper, *El Tiempo*, visited ten chemical depots in the center of Bogota and they discovered that it was possible to purchase mercury in three of these. The price per kilo in these warehouses oscillated between 390,000 and 800,000 Colombian pesos (between US\$136-280). They found that it could be purchased even cheaper through internet for 300,000 pesos. Even though mercury is usually sold in small bottles, the journalists reported that it can be sold in the form of mercury bullets that weigh approximately 34 kilograms and cost between 11 and 13 million Colombian pesos (US\$3,800-4,500). The journalists stated that:

“The price is so high because the mercury is imported from Mexico. Therefore, its value depends on the exchange rate and according to what it will be used for. If you tell the seller that you need it for gold mining, normally he will sell it cheaper. Mercury has other less common uses: for example, the vendors claim that some people buy it to use in witchcraft or to make homemade explosives”¹³.

Apart from a few isolated reports, sufficient information does not exist about how the IIGM sector is able to divert legally imported mercury from its permitted uses. Even though information is lacking, it is important to mention a phenomenon associated with IIGM in Amazonian countries in order to better understand the illegal mercury market in Latin American and its regional expressions: the transnational migration of people associated with IIGM on several levels. When a person emigrates, they bring with them contacts and knowledge of their networks, especially if they plan on continuing in the same line of work. Studies on the dynamics of migration can provide a glimpse to better understand the transnational network of gold and mercury trade.

The transnational migration of miners has been documented in almost all of the countries of the Biome, but the migration trend with the

13. <http://www.eltiempo.com/archivo/documento/CMS-16460373>

most information is of Brazilian miners (called *garimpeiros*) to neighboring countries. This process was preceded by several waves of internal migration. There are many studies that describe the failure of agrarian colonization in the Amazon promoted during the Brazilian dictatorship in the mid-twentieth century that led to an intensification of IIGM activities in Amazonian forests because of the government's mass migration campaign (Cleary, 1990; Hecht and Cockburn, 2008). As a result of the infrastructure program that led to the Trans Amazon highway being built (BR-230), as well as other roads that connected the Amazon to important cities in the north, the government promoted a land occupation program in the Amazon forest using the saying "give land without people to people with land", ignoring the presence of almost 200,000 indigenous peoples that already inhabited the Brazilian Amazon (MacDonald, 2016). The migration of hundreds of thousands of people to the country's interior expanded the mining frontier and brought new knowledge, machinery, and commercial networks to the region. Large mining deposits were developed, like the Serra Pelada mine that attracted more than 80,000 miners to exploit more than 90,000 kilograms of gold in a decade (De Theije & Bal, 2010). Other instances of *garimpeiros* migrations were shown to stimulate urbanization in the north of Brazil (Kolen *et al.*, 2017).

Several studies have shown how factors like the porosity of national borders in Amazonian countries, the similar ecological conditions, and the lack of an effective state territorial control, have favored the displacement of mining activities from one country to another without any kind of control or oversight of the amount of people, resources, machines, or inputs like mercury, have been involved. One case that has received a lot of coverage is that of Brazilian miners in Suriname. The total amount of Brazilians involved in IIGM activities in the neighboring country is greater than 80%. Since 1990, more than 20,000 Brazilians have migrated to Suriname looking for work, many of them in IIGM. The majority of these migrant miners (almost 70%) are impoverished, have low levels of education, and come from the north of Brazil from areas like Maranhao (De Theije & Bal, 2010). Evidence also suggests that a large amount of miners moved from French Guiana in the early 2000s to Suriname because of the restrictive laws implemented in the former country against IIGM activities (Bare *et al.*, 2017: 6). Historic migration flows of Brazilian miners were also documented in Colombia in the Guainía and Vaupés departments during the 1980s, resulting in conflicts and agreements with local communities that were less intense than what occurred on the Suriname-Brazil border, but were similarly decisive in consolidating several mining areas along the Colombia-Brazil border (Rubiano, 2014; Lopez, 2014).

Cross-border migrations of Brazilian miners are not confined to the border areas of Brazil's neighboring countries. During the past five years in Colombia, the presence of foreigners, especially Brazilians, Peruvians,

and Venezuelans, in mining areas in the Chocó, Antioquia, Nariño, Amazonas, Guainía, and Putumayo departments has been documented. Several news articles have reported that miners have resorted to tactics like registering a civil union or marriage to a Colombian, adopting a parentless child, or forging identification documents to legalize their irregular migratory status. According to an investigation by Colombia's Migration Office, the Police, and the Army, a practice called "become a Colombian in three days" exists where two people are paid to serve as witnesses before a judge or local registrar to swear that a person was born in the country and therefore is able to receive legal identification documents. In 2015, thirty-five foreigners, twenty-eight from Brazil, were caught this way and in 2014, twenty-six people were apprehended; the Colombian Migration deported fourteen of them. An article by the *El Tiempo* newspaper stated that:

"Those who understand the new phase of illegal mining, bolstered by machinery and protection by armed groups, say that the Brazilians are receiving a good deal because they can stay in the middle of the jungle for several months extracting gold. They tend to ask for less money than the Colombians. It is common to find Peruvians on the dredges, who serve as both crewmembers and cooks.

In the southeast, there are camps with up to 12 dredges that are supported by motorboats for supplies, and workshops that let them work 24 hours a day. Many have satellite phones to receive alerts when the authorities carry out operations. Investigations show that while usually these people smuggle the gold out of the country or divide the profits with illegal groups, one group of foreigners set up companies to legalize the money they made. Colombian Migration and the Prosecutors Office are scrutinizing several companies in Medellín that operate under Brazilian ownership.

Reports from the municipality of Los Andes, Nariño also describe how foreigners are being hired to work in the area conformed by Barbacoas, Maguí Payán, and Roberto Payán in the Pacific jungles. In Huila, authorities are looking for two South Koreans that were penalized in 2011 for illegal mining in Campoalegre, Rivera, and Yaguará." (*El Tiempo* 2015)¹⁴

As can be seen, international migration for IIGM activities in the Amazon has a regional scope involving people from practically all over the Biome. The fact that companies are being created to legalize money obtained from illegal gold mining indicates that gold trade and supply networks in the continent are partially maintained by a series of front companies. This suggests an intricate network of these businesses' sup-

14. <http://www.eltiempo.com/archivo/documento/CMS-16460388>

porters in local trade channels. In all of these processes, the presence of migration is essential. Anecdotal evidence suggests that the transnational supply of mercury in the Amazon Biome might be connected to other flows and value chains of other illicit commodities - e.g. illegally extracted gold, drugs, weapons, etc. However, sufficient information to prove this is not available and what may exist is subject to reservation, at least in the case of Colombia where the Prosecutor General's office carried out charges against at least ten mercury importers that have resold the metal to illegal IIGM operators (*El Tiempo*, 2017). Furthermore, front companies should be distinguished from family investments or small-scale companies that have been documented in Suriname and are financed by Brazilian miners associates to carry out IIGM operations (De Theije & Bal, 2010).

D. AGGREGATE DATA ON IMPORTS IN THE AMAZON BIOME

The aggregate data on imports in all of the countries of the Amazon Biome from 1994 to 2018 is detailed in the following table.

Table 1. Metric tons of mercury imports in the Amazonian countries (1994 to 2018)

Año	 Bolivia	 Colombia	 Perú	 Brasil	 Venezuela	 Guyana	 Ecuador	 Surinam	 French Guiana	Annual Total*
1994	3.0	43.7	73.0	75.9	1.5		13.8	1.9	1.6	214.4
1995	2.5	51.5	31.1	54.5	8.5		8.0	4.4	0.3	160.6
1996	0.5	95.2	25.8	75.3	0.9	0.0	17.9			215.6
1997	2.4	24.9	41.9	56.4	2.5	0.0	4.6			132.7
1998	2.0	0.0	45.4	82.2	16.9	0.0	9.5			156.0
1999	1.7	26.2	42.3	49.7	2.6	0.7	11.4			134.6
2000	0.4	68.1	31.1	40.5	7.2	12.1	8.2			167.6
2001	0.2	58.8	72.8	62.5	1.3	3.3	54.5			253.3
2002	0.0	52.7	63.4	66.8	0.7	18.5	35.1			237.2
2003	3.3	111.1	93.7	80.8	0.0	9.8	10.6			309.3
2004	2.7	23.1	84.0	37.8		27.0	12.7			187.3
2005	0.4	67.3	87.6	43.3	0.9	23.9	8.1			231.4
2006	0.1	61.5	84.6	44.2		44.7	11.5			246.6

2007	0.3	71.4	92.7	35.7	0.0	40.3	12.2			252.5
2008	0.0	79.0	132.2	23.9	0.0	60.0	13.6			308.8
2009	0.0	130.4	180.3	38.0	0.0	62.2	10.9			421.7
2010	1.7	113.3	142.6	26.3		63.5	19.2			366.6
2011	8.0	84.0	175.7	16.7		156.3	17.1			457.8
2012	15.8	101.3	111.0	27.0		100.3	4.4			359.9
2013	8.5	99.9	169.3	36.1		77.8	7.7			399.3
2014	12.2	127.2	102.3	30.2		5.3	1.9			279.1
2015	142.9	133.2	11.7	3.5		29.3	111.0			431.6
2016	224.2	118.8		18.1		35.3				396.4
2017	180.4	4.6	5.2	15.3		10.5	0.0			216.0
2018	196.5	2.0				21.9				220.4
TOTAL	809.5	1749.1	1899.8	1040.6	42.9	802.6	403.9	6.3	1.8	6756.5

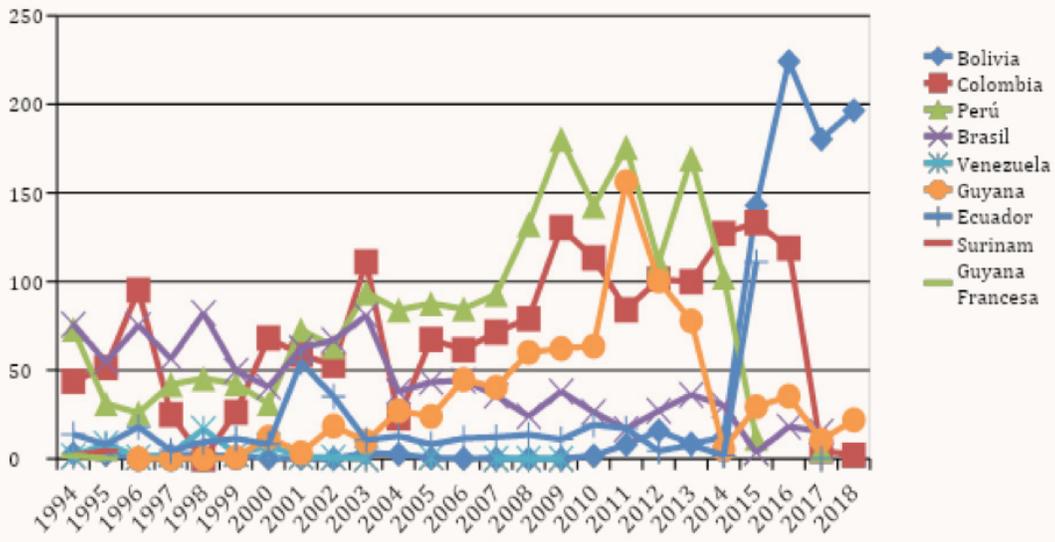
Source: Data from UN Comtrade (2019)

The previous table based on UN Comtrade data, shows the amounts of mercury imported by Amazonian countries from 1994 to 2018: Peru 1899.81 mt, Colombia 1749 mt, Brazil 1040.6 mt, Bolivia 809.47 mt, Guyana 802.6 mt, Ecuador 403.9 mt, Venezuela 42.87 mt, Suriname 6.3 mt, and French Guiana 1.84 mt. Bolivia, Brazil, Colombia, Peru, Guyana, and Ecuador reported data during the whole period; Venezuela only reported data in 2009; Suriname and French Guiana only reported data up until 1995.

The grand total for all imports in the Biome was 6756.5 metric tons of mercury from 1994 to 2018. This report does not include the total amount of worldwide mercury imports from all countries; the UNEP (2017) report only calculated this information for the years of 2008 and 2015. Nevertheless, according the available figures it is notable that while worldwide mercury imports decreased, they increased in countries in the Biome.

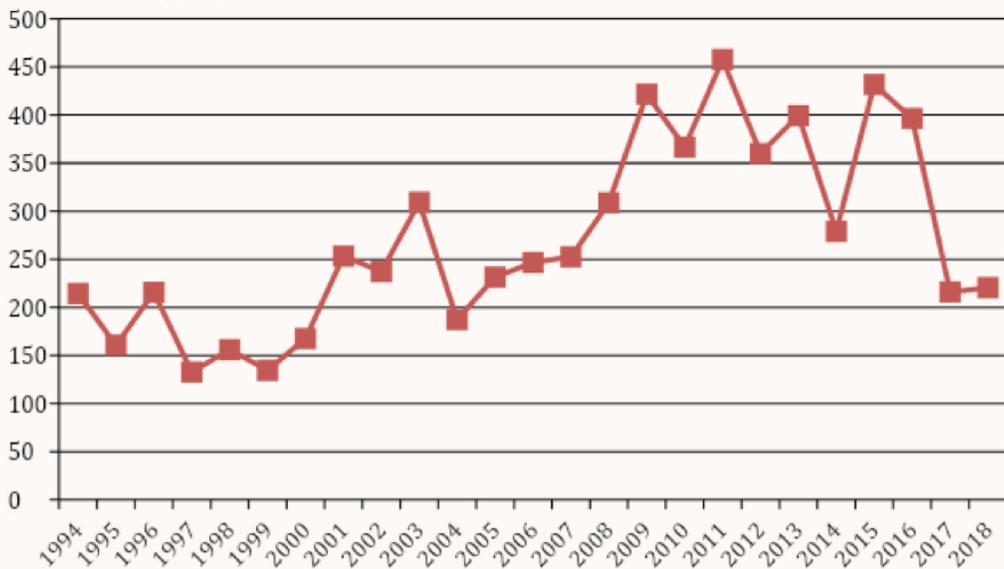
The following graph illustrates the aggregate totals of mercury imports for the countries that reported data from 1994 to 2018.

Mercury imports in the Amazon Biome by country (1994 to 2018) (mt/year)



An upward trend in mercury imports to the Amazon Biome can be observed from 1999 to 2011 in the graph of aggregate imports in the Biome’s countries. After this date, a trend for diminishing imports can be seen with a noticeable rebound in 2015 and subsequently the same pattern of decline. However, as this report has emphasized, it is important to consider the existence of sub-regional illegal markets that divert mercury from the legal commercial trade flow, and about which little is known.

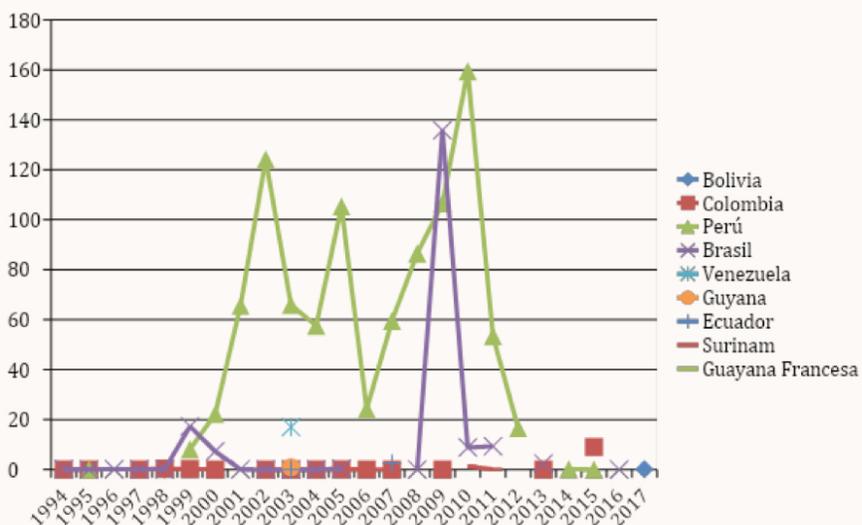
Aggregate Mercury Imports in the Amazon Biome (mt/year)



The following table on mercury exports shows that only three countries in the Biome consistently report data. The rest of the countries did not report data or did not export mercury.

Table 2. Mercury exports from Amazon countries in metric tons per year (1994 to 2017)

Año	Bolivia	Colombia	Perú	Brasil	Venezuela	Guyana	Ecuador	Surinam	French Guiana	Annual Total*
1994				0.2						0.2
1995			0.1	0.0						0.1
1996				0.1						0.1
1997				0.2						0.2
1998	0.0		0.4	0.1						0.5
1999			8.1	17.3						25.6
2000			22.2	7.3						29.5
2001			65.5	0.1						65.6
2002			124.2	0.0						124.3
2003			65.9	0.0	17.0	0.9	0.0			83.9
2004			57.6	0.0						57.6
2005			105.3	0.3						105.7
2006			24.1							24.1
2007			59.5				2.4			61.9
2008			86.5	3,79						86.5
2009			106.6	135.8						242.4
2010			159.5	8.8				1.3		169.6
2011			53.4	9.3				0.1		62.8
2012			16.5							16.5
2013				2.4						2.4
2014			0.1							0.1
2015			2,41							9.0
2016				0.0						0.0
2017	0.2									0.2
TOTAL	0.2	9.8	955.1	182.0	17.0	0.9	2.5	1.4		1168.9



E. SUMMARY OF IMPORTANT POINTS

- Mercury emitted in Latin America and the Caribbean region is imported from other parts of the world, mainly Europe, the United States, and more recently from Mexico and Indonesia.
- In contrast to the global trend of falling mercury imports (that decreased from 2600 metric tons in 2010 to 1200 metric tons in 2015), the Amazonian countries reported an increase in total mercury imports from 308.76 metric tons in 2008 to 431.56 metric tons in 2015. This occurred because of an increase in imports to Colombia, Peru, Bolivia, and Ecuador in the last decade. In the case of exports, the Amazon Biome countries follow the global trend of declining mercury exports. Inter-regional trade in mercury in the Amazon has increased notably in the last few years, especially after the export ban on mercury from the European Union in 2011 and the United States in 2013.
- The quantity of mercury imported by countries of the Amazon Biome in the period from 1994 to 2018 was: Peru 1899.81 mt, Colombia 1749 mt, Brazil 1040.6 mt, Bolivia 809.47 mt, Guyana 802.6 mt, Ecuador 403.9 mt, Venezuela 42.87 mt, Suriname 6.3 mt, and French Guiana 1.84 mt. Bolivia, Brazil, Colombia, Peru, Guyana, and Ecuador reported data during the whole period; Venezuela only reported data in 2009; Suriname and French Guiana only reported data up until 1995.
- Information on imports and exports is partial, because not all the mercury is used in IIGM, even though in some countries like Colombia and Ecuador it is estimated that 90% of imported mercury ends up being used in IIGM. In Brazil and Peru, that figure is closer to 50%.
- Few reports on the illegal mercury trade in Latin America are available in general, and in particular for the Amazon Biome, but instances of confiscation sheds light on its existence.
- A better understanding of the transnational migration of miners throughout the Biome will allow for a closer look at the workings of the illegal mercury market.
- There is a risk that the illegal mercury market will grow and become more consolidated as the countries of the Biome continue to reduce their mercury import quotas, if controls and a comprehensive strategy on the use of mercury, or of IIGM in general, does not occur.



CHAPTER III.

ENVIRONMENTAL AND HEALTH IMPACTS OF MERCURY EMISSIONS AND RELEASES





It is well documented how in the past few years IIGM in Amazonian countries has increased in terms of impacted areas, amount of people involved and reliant on revenue from this activity, hectares of deforested lands, and revenue from gold production (SPDA, 2014; Proyecto GOMIAM, 2014). A recent interactive map from the Amazon Geo-Referenced Socio-Environmental Information Network (RAISG, 2018), identified more than 2,300 “points” of illegal mining, 245 areas, and at least 30 rivers where IIGM can be found in six Amazonian countries.¹⁵ Even though certain gaps in information exist, there have been attempts to estimate and measure the environmental and social impacts of IIGM and figures have been calculated that present a general picture of the situation. Although the role of IIGM has been decisive in the increase in mercury emissions and releases, the biochemical cycle of this material is closely related to other anthropogenic phenomenon like deforestation, land use change, climate change, and hydroelectric dams.

This section will provide a general (non-exhaustive) panorama of information available on the effects of mercury on the environment and human health in light of IIGM expansion in Amazonian forests. The questions that this chapter will try to answer are: What information exists in and about countries in the Amazon Biome about the environmental and health impacts of mercury emissions and releases in this eco-region? What are the most relevant impacts on the environment and communities in the Amazon as a result of the expansion of IIGM and its emissions of mercury? The following section will discuss different angles of scientific evidence about mercury in the countries in the Biome with relation to these questions, followed by an analysis of information on a Biome and national level. The chapter finalizes with a brief summary.

A. MERCURY'S BIOCHEMICAL CYCLE: GLOBAL FIGURES

GLOBAL EMISSIONS AND RELEASES IN THE AMAZON BIOME

UNEP's Global Mercury Assessment, updated in 2018 and published in 2019, estimates that annually 838 metric tons of mercury are emitted into the atmosphere by IIGM operations throughout the world in 2015

15. The map does not include Guyana, French Guiana, or Suriname, and even though it includes Colombia, surprisingly it does not include data on the country. The map and report can be found here: <https://mineria.amazoniasocioambiental.org>

(UNEP, 2019).¹⁶ This suggests that mercury amalgam combustion during IIGM is responsible for 38% of the total anthropogenic mercury emissions, followed by coal combustion (in thermoelectric plants, although not exclusively) with 21% of emissions. Other emissions are caused by the production of non-ferrous metals (15%), cement production (11%), waste with added mercury (7%), biomass combustion (3%), ferrous metal production (2%), and other lesser sources (2%).

Table 3. Estimated global mercury emissions by sector

Emission source	PNUMA (2008)		Pirrone <i>et al.</i> (2010)		PNUMA (2013)		PNUMA (2019)	
	t.a ⁻¹	%	t.a ⁻¹	%	t.a ⁻¹ (min-max)	%	t.a ⁻¹ (min-max)	%
Coal (all uses)	880	45,5	810	38,5	474 (304-678)	24.0		
Biomass combustion							51.9 (44.3-62.1)	2.33
Fuel and natural gas					9.9 (4.5-16.3)	1.5		
Foundries and mined metal production								
Primary ferrous metal production	55	2,9			4.5 (20.5-241)	2.0	29.8 (19.1-76.0)	1.34
Non-ferrous metal production (Al, Cu, Pb, Zn)	132	6,9	310	14,7	193 (82-660)	10.0	228 (154-338)	10.3
Large-scale gold production	111	5,8			97.3	5.0	84.5 (72.3-97.4)	3.8
Primary cinnabar mining	9	0,5			11,7 (7.3-26.4)		13.8 (7.9-19.7)	0.62
Cement production	189	9,8	236	11,2	173 (65.5-646)	<1.0	233 (117-782)	10.5
Oil refinery					16 (7.3-26.4)	4.0	14.4 (11.5-17.2)	0.65
Contaminated sites					82.5 (70-95)			
Illegal and informal gold mining - IIGM	350	18,2	400	19,0	727 (410-1040)	37.0	838 (675-1000)	37.7
Chlor-alkali production	47	2,4	163	7,7	28.4 (10.2-54.7)	1.0	15.1 (12.2-18.3)	0.68
Waste from consumer products	120	6,3	187	8,9	95.6 (23.7-330)	5.0	147 (120-223)	6.6
Cremation (dental amalgams)	26	1,4			3.6 (0.9-11.9)	>1.0		
TOTALS*	1919		2106		1960 (1010-4070)	100	2220 (2000-2820)	

Source: adapted from Ministry of Foreign Relations and Ministry of Environment and Water, 2015.

*Note: Eleven sources include the same emission sources. Some emission categories were not included so the totals reported do not coincide with the total values.

16. The UNEP report applies averages calculated using different methods that have considerable ranges of variability. Some authors have evaluated the level of uncertainty of the relative contributions of emissions and have indicated that there is a level of uncertainty of up to 30% per emission sector. Applying these levels of uncertainty, it has been stipulated that Latin America is responsible for 50% of emissions ((Pacyna *et al.*, 2010). Nevertheless, the 2018 Global Mercury Assessment noted a reduction in this uncertainty in the region (UNEP, 2019).

On a regional level, the UNEP reported that the largest source of atmospheric mercury emissions in Latin America is IIGM with 340 metric tons, which represents 81% of the region's total 409 metric tons of emissions (UNEP, 2019: 12). The UNEP data from 2013, based on information from 2010, shows that the countries in the Amazon Biome with the highest rates of mercury emissions from IIGM activities are Colombia (60 mt/year), Bolivia (45 mt/year), Peru (26 mt/year), Brazil (23 mt/year), Ecuador (18 mt/year), and Guyana (11 mt/year), followed by Suriname, Venezuela, and French Guiana (each with 6 mt/year). In other words, according to 2010 data, at least 199 metric tons of mercury are emitted into the atmosphere annually from mining areas in the Amazon Biome countries. If the annual total of emissions from IIGM is 838 metric tons according to new 2018 data from UNEP, then between 24% and 27% of global mercury emissions comes from countries in the Amazon Biome.¹⁷ This also assumes that countries in the Amazon Biome are responsible for more than 75% of total emissions in South America.

Table 4. Mercury consumption in IIGM and associated atmospheric emissions in 2010

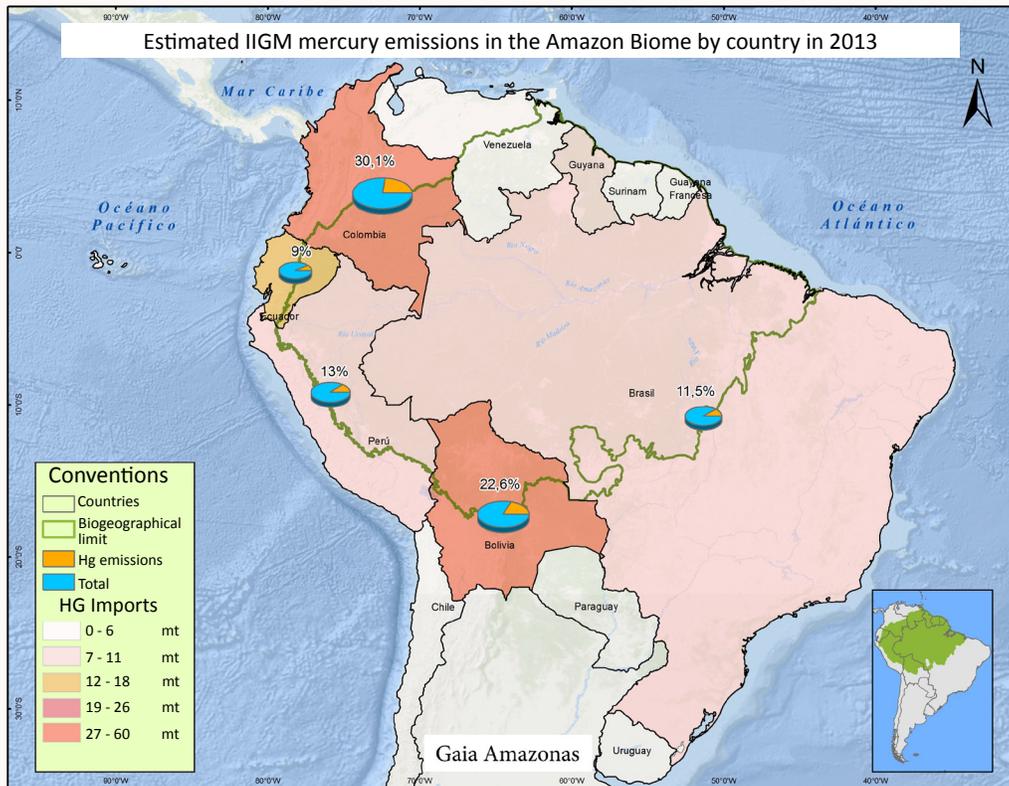
Country	Data quality ¹⁸	Use of mercury in IIGM (metric tons)			% of Hg applied to amalgam of concentrated sands ¹⁹	% of Hg applied to non-concentrated material ²⁰	Year of most recent data	Emission factor ²¹	Measure of emissions in metric tons per year
		Min	Mid	Max					
Colombia	3	90	180	270	17	83	2012	0.33	60
Bolivia	4	84	120	156	25	75	2012	0.38	45
Peru	4	49	70	91	25	75	2010	0.38	26.2
Brazil	4	31.5	45	58.5	50	50	2007	0.50	22.5
Ecuador	3	25	50	75	20	80	2007	0.4	17.5
Guyana	3	7.5	15	22.5	100	0	2008		11.2
Venezuela	3	7.5	15	22.5	25	75	2005		5.6
Suriname	3	3.8	7.5	11.3	100	0	2008		5.6
French Guiana	3	3.8	7.5	11.3	100	0	2008		5.6
TOTAL		302	510	718					199.2

Source: AMAP & UNEP (2013: 99 & ss.)

17. It is important to consider that emission data does not discriminate by subnational areas, which is why it is hard to determine how much of the emissions from the Biome's countries are derive from activities actually in the Biome.

18. Level 1 = presence/absence, lack of quantitative information, error may be greater than $\pm 100\%$; level 2 = some indication of the amount of Hg used, estimated average error of $\pm 75\%$; level 3 = quantitative data that has not been significantly updated in the last five years, error $\pm 50\%$; level 4 = recent quantitative data, error of $\pm 30\%$.

Map 3. Estimated IIGM mercury emissions in the Amazon Biome by country in 2013



Mercury emissions from large-scale gold mining amount to 5% of the global total. Given the present report's focus on IIGM, it does not analyze thoroughly what proportion of the 5% comes from large gold mining projects in the Amazon, but it would be important to clarify this point in a future investigation.

Another metric that is useful in sizing up the role of mercury contamination associated with IIGM in countries in the Amazon Biome are mercury emissions per capita (metric tons emitted each year per total amount of inhabitants). WWF Colombia and the NGO *Foro Nacional por Colombia* in their 2017 report on mercury use in this country employed this per capita measurement. According to this investigation, Colombia

19. Concentrated sands have been separated using gravimetric concentration to isolate gold particles from lighter minerals. It is a best practice promoted in IIGM by the Global Mercury Project and the Minamata Convention.

20. Mercury is frequently applied to materials extracted from mines before using methods like gravimetric concentration. This of course implies a greater use of mercury because this is a less selective method.

21. The emission factor of amalgamation on concentrates = 0.75 (1/1.3); the emission factor for amalgamation on the complete mineral = 0.25 (1/4). In areas where amalgamation of concentrates occurs, 75% of the mercury that is used is emitted into the atmosphere. Operations that use mineral amalgamation on whole minerals release a higher level of Hg into aquatic and land systems.

is the country with the highest mercury releases per capita rate in the world: between 50 and 100 metric tons of releases, which is equivalent to 1.6 kilograms released per inhabitant. Peru releases 1.0 kilogram per inhabitant, while Brazil (with 36-60 metric tons and a population of 205 million people) releases 0.2 kilograms per inhabitant (Garcia *et al.*, 2017). According to this report, these three Amazonian countries emit more mercury per capita than China (245-600 mt/year and 1371 million inhabitants) and Indonesia (130-160 mt/year and 257 million inhabitants), that emit respectively, 0.3 and 0.6 kilograms per person.²² If the same calculation is used but with emissions and using updated data from the UNEP on average annual emissions (UNEP, 2013) and updated population figures, the corresponding amounts per country would be as follows:

Table 5. Mercury emissions per capita in the Amazon countries

Country	Annual Hg emissions in metric tons	Total population by country	Kg of Hg emitted per capita
Bolivia	45 (133*)	10.888.000	4,13 (12,21)
Colombia	60 (180*)	45.500.000	1,31 (3,95)
Brazil	23	202.450.649	0,11
Ecuador	18	16.298.217	1,07
Peru	26	31.826.018	0,82
Venezuela	6	31.028.337	0,18
Guyana	11	761.000	14,7
French Guiana	6	187.000	30,5
Surinam	6	524.000	10,7
TOTAL	199	344.327.221	

*All data in the table is from 2010 presented by UNEP (2013). More recent data for Bolivia and Colombia, in parenthesis, is available.

The highest rates of mercury emissions per capita belong to French Guiana, Guyana, and Suriname. Even though they are the countries that emit the least amount of mercury among the nine countries, they also have populations that do not exceed one million people. For example, Suriname emits ten times less mercury than Colombia, but it has 1% of the population that Colombia does. For this reason, the mercury emission per capita rate is high: 30.5 kilograms per inhabitant in French Guiana, 14.7 in Guyana, and 10.7 in Suriname. In order, the per capita rate of the

22. The authors indicated that “mercury releases are calculated assuming the total mercury used in small-scale gold mining is equivalent to the amount of mercury released into the environment” (Garcia *et al.*, 2017: 38).

other countries would be: Bolivia (4.13 kg/inhabitant), Colombia (1.31 kg/inhabitant), Ecuador (1.07 kg/inhabitant), Peru (0.82 kg/inhabitant), Venezuela (0.18 kg/inhabitant) and Brazil (0.11 kg/inhabitant)²³. Considering that emissions data in Bolivia was updated in 2016 (the new figure is 133 metric tons of atmospheric emissions on average per year), an updated figure of per capita emissions would be 12.21, making it the highest per capita emitter in the Amazon. The data for Colombia can also be updated, using the more recent measurement of 180 metric tons or 3.95 kg of emissions per capita. In general, these calculations are telling of the magnitude of the problem in countries like Colombia, Bolivia, and Ecuador, as well as in Guyana, Suriname, and French Guiana.

The 2018 UNEP's Global Mercury Assessment, with regards to releases into water and soils, reports that in 2015 IIGM activities released 1220 metric tons, more than twice as much as the other sectors included in the inventory. According to data from the 2013 Assessment, 313 metric tons were released by the IIGM sector in all of Latin America, which corresponds to 35% of the total 881 metric tons of global releases by IIGM in 2010 (AMAP & UNEP, 2013: 72).

Table 6. Mercury releases into soils and water in metric tons by region

Sub-region	Mercury releases into soils and water (mt)
Australia, New Zealand and Oceania	3.5
Central America and the Caribbean	6.54
CIS and other European states	10.3
East and Southeast Asia	454
European Union (28 countries)	-
Middle East	-
Northern Africa	-
North America	-
South America	313
South Asia	0.37
Sub-Saharan Africa	93.7
TOTAL	881

Source: (AMAP & UNEP, 2013: 72).

23. It is important to note that the authors Telmer & Veiga (2009: 142) consider that the rate of emissions in Brazil could be as high as 40 metric tons. In this case, the mercury emissions per capita in this country would be 0.2 kg, coinciding with the WWF Colombia and *Foro Nacional por Colombia* report.

The global rate of releases climbed to 1220 in the 2018 Assessment (using data from 2015) and the contribution of South America rose from 313 to 340 metric tons. These new figures represent a decrease in the total releases from the South America region from 35% to 28.3%, which is still significant. South America is region with the second highest levels of mercury releases into soils and water after East and Southeast Asia. It is important to note that the 2018 Global Mercury Assessment reported releases specifically from the IIGM sector. The releases from IIGM were distributed by region is as follows: South America (53%), East and Southeast Asia (36%), and Sub-Saharan Africa (8%) (UNEP, 2019: 32).

METHYLMERCURY BIOACCUMULATION AND BIOMAGNIFICATION

Liquid elemental mercury is used to amalgamate with gold particles in IIGM, which makes these heavier and easier to gather after separating sands from larger rocks using gravimetric concentration, especially in alluvial deposits, or crushing mills, in the case of vein deposits. The amalgam is then burned with a blowtorch, which evaporates the mercury and leaves the solid gold. This causes mercury vapors to be released into the atmosphere, or be inhaled directly by miners, neighboring communities, and more distant populations that receive emissions through the air or water, or by consuming mercury contaminated meat or fish (EPA, 2011; UNEP, 2013). The tailings generated by gold processing are generally dumped into rivers and streams with little or consideration about the eventual environmental health effects.

The atmospheric emissions and releases into soils and water of mercury as a result of its use in IIGM have been widely documented. As the contamination comes into contact with different types of food chains, it causes bioaccumulation and biomagnification processes. Bioaccumulation is the progressive accumulation of a contaminant in an organism by ingesting food or absorption through cell membranes. Biomagnification happens with the concentration of contaminants increases in food webs, from lower to high trophic levels (Scarlat, 2013). After mercury has been dumped directly into a water source, it can adhere to sediment particles in the water and be transported dozens and even hundreds of kilometers down river. Different types of bacteria in water contribute to the methylation of inorganic mercury and convert it into methylmercury, the organic and most toxic form of the element. Once it has methylated, mercury bioaccumulates in living organisms and then biomagnifies over time as it circulates through greater levels of the trophic chain, causing its toxicity to increase up to ten times more (Pouilly *et al.*, 2013).

The processes of bioaccumulation and biomagnification function differently in land and aquatic ecosystems. Mercury biomagnification

throughout terrestrial food chains is not very troublesome. By comparison, it is highly problematic in aquatic ecosystems as it can be transformed from inorganic mercury into bioavailable forms, especially methylmercury as explained above. Aquatic fauna is the most vulnerable, and over time fish and marine mammal migrations cause the contamination to spread over long distances in a water basin (Greer, 1993; Sponsel, 2011: 129). The Amazon River basin, from its start in Peru until its outlet in Brazil, covers more than 6.2 million square kilometers, including rivers, tributaries, wetlands, and lagoon systems. Mercury releases have been documented in these areas affecting several food chains throughout the Amazon through bioaccumulation and biomagnification in species like the pink dolphin and fish, as well as in land mammals and birds that eat aquatic species, and in plants. A recent report by WWF (2018), compiles various emblematic studies, like a recent investigation in the Brazilian Amazon that showed how 81% of carnivorous fish contained detectable levels of mercury, the majority of them above the World Health Organization's limit (0.5 µg/g for fish). Another recent report revealed that more than 26% of tested samples from four species of river dolphins in the Amazonas and Orinoco Rivers had levels of mercury that exceeded the WHO limits (WWF, 2018).

Scarlat (2013) presents a synthesis of literature on the most researched sources and routes of exposure in the Amazon, including fish, aquatic mammals, and reptiles. Studies have consistently indicated that methylmercury concentrations in carnivorous fish is higher than in herbivorous fish, sometimes up to seven times greater. Moreover, another reoccurring finding is that mercury levels are higher in detritivore fish (whose diet consists of decomposing organic matter). The study also indicates that little research has been done on aquatic mammals even though the pink dolphin (*Inia geoffrensis*) has been used as an emblematic or "umbrella" species for fundraising for Amazon aquatic ecosystem conservation. Scarlat (2013) reviewed a recent study by Gomez-Salazar *et al.* (2012) conducted in several sections of Amazon rivers that measured ecosystem degradation rates based on ten anthropogenic stress factors. This report concluded that fresh water degradation is higher in zones that are within fifty kilometers downstream of gold mines and that degradation decreases to lower levels after 100 or 200 kilometers downstream. The study also observed that pink dolphin densities are higher in areas with lower levels of degradation and higher water quality. Given their long life and potential for accumulating methylmercury, pink dolphins are a good bio indicator of the state of degradation in fresh water.

Furthermore, studies have also been conducted on reptiles and turtles. For example, Schneider *et al.* (2009) researched mercury concentrations in several turtle species (*Podocnemis unifilis*, *Podocnemis expansa*, *Podocnemis erythrocephala*, *Podocnemis sextuberculata*, *Peltocephalus dumerilianus*, *Chelus fimbriatus*) in the Rio Negro. Vieira

et al. (2010) did the same with caimans (Caiman crocodiles yacare) in the Brazilian Pantanal wetlands. Caimans are also a good bioindicator of mercury concentrations similar to pink dolphins, because of their long lives and their susceptibility to accumulate methylmercury. Both studies found higher mercury concentrations in species from areas with gold mining activities.

HUMAN MERCURY EXPOSITION ROUTES AND SOURCES, AND ITS EFFECTS ON HEALTH

Human exposure to mercury can happen in one of several ways: by inhaling vapors, from skin contact, or by ingesting organic material contaminated with mercury (like fish or plants). The first two forms are more common in populations that handle mercury during mining processes, such as miners themselves or gold purchasers (Veiga, 1997). The last type of contamination affects people and communities that do not necessarily live close to mining zones, but that eat fish. After mercury is emitted or released, it travels through the environment and enters into contact with living organisms: macroinvertebrates, shellfish, fish, birds, and mammals; until it enters the human body, especially by consuming fish or other sources of exposure (Baldigo *et al.*, 2006; Bastos *et al.*, 2015; Scarlat, 2013). Fish, aquatic mammals, and reptiles are the sources and routes of exposure that have been studied the most in the Amazon (WWF, 2018).

A wide range of evidence from all over the world exists regarding the effects of mercury on human health, primarily in countries in the global north. Mercury poisoning causes different manifestations based on age, for example in fetuses, children, or adults. Symptoms are varied and can include skin irritation, fever, headaches, nausea, diarrhea, fatigue, insomnia, irritability, diminished sensorial acuity, blindness, renal problems, memory loss, tremors, brain damage, and other neurological disorders like Minamata disease (Methylmercury Toxicology Effects Committee *et al.*, 2000). Populations with the highest risk of exposure to mercury emissions and releases are pregnant women, neonates, children, and adolescents, and they are the ones who suffer the greatest health effects from this toxin (UNEP, 2013). An important part of biomonitoring studies in humans is concentrated on measuring mercury levels in these populations.

An important area of research in the Amazon Biome has focused on measuring mercury concentrations in fish, since fish constitute the cheapest source of quality protein as well as a basic food for more than two million indigenous peoples in villages, towns, and cities along Amazonian rivers. Contamination of fisheries from mining activities is not only a problem for the aquatic ecosystems that are ecologically disrupted, but

it also endangers lifestyles, nutrition, health and even the cultural integrity of indigenous peoples. For them, fish are important cultural symbols and the fish trade provides important revenue for local communities as well as local and regional food markets (Rodríguez & Rubiano, 2016). Farmers, settlers, Afro-descendants, and other inhabitants of Amazonian cities are also affected when they consume mercury-contaminated fish. However, as will be discussed further in section B of this chapter, the majority of studies have focused on areas where IIGM is carried out and less in places that are more distant where actors in the fishing food chain are further removed.

Nevertheless, information on the effects of mercury-contaminated fish for consumption or for sale in local productive systems is scarce, since its toxicology and effect on environmental health has not yet been investigated. Except for a few reports from local oral accounts in the Colombian department of Amazons (Rodríguez & Rubiano 2016), the social, economic, and cultural consequences on a local level from consuming and selling mercury contaminated fish has not yet been systematically researched and therefore requires greater attention. In general, the scientists that conduct biomonitoring studies do not have sufficient resources to constantly update their data which would allow them to jointly develop a viable route forward in the short and medium term that is culturally appropriate so that the different communities can respond to the fact that their bodies, their descendants, and their surroundings have been contaminated.

AMAZONIAN SOIL, DEFORESTATION, AND MERCURY

An estimated 60% of mercury used in IIGM is spilled on land surfaces while 40% is released directly into rivers (Scarlat, 2013). Even though IIGM has undoubtedly intensified contamination, studies show that the soils of the Amazon basin contain high concentrations of naturally occurring mercury that results from the degassing of the earth's crust. While soils act as temporary mercury sinks (similar to forests with carbon dioxide), they tend to more often than not work as mercury sources that emit into surface water (Stein *et al.*, 1996 referenced in Scarlat, 2013). This is why it is increasingly important to understand the role of deforestation and resulting soil degradation as drivers of mercury enrichment of surface waters in the Amazon macro-basin. Unfortunately, until now the subject of mercury has not been included in research agendas or advocacy on deforestation and land-use change to the same extent that it has been in terms of mining.

Three kinds of impacts associated with mercury and mining can be seen in the Amazon. First, mercury emissions and releases from IIGM are caused by waste that is spilled onto the land and in water bodies;

second, mercury evaporates when gold amalgams are burned; and third, mercury is emitted when naturally mercury-rich soils and sediments are shifted during alluvial fan dredging or when forest cover is stripped. Some studies exist, especially in Brazil, that show how the main source of mercury contamination in local water sources is not necessarily caused by mercury lost during gold amalgamation, but as a result of the alternation and movement of large amounts of sediments that are rich in mercury and from the flooding of lowlands by mining activities (with sluices or dredges) (AMAP & UNEP, 2013: 75).

Another investigation identified that land use change from primary forest conversation to pasture or farm land was a key factor for mercury contamination in the Maderia River basin in Brazil (Lacerda *et al.*, 2012). They found that the soil in primary forests in this region contained up to 112 milligrams of mercury per square meter, while pasture lands only held 76 milligrams. Research has been carried out that suggests that deforestation causes a deteriorating chain reaction that can reach the extent of mercury releases and emissions (Bastos *et al.*, 2006). Similarly, it is important to note that some studies have shown that the construction of large dams in the Amazon is also associated with large mercury releases, as is the case in the Tucuruí dam in Brazil (Arrifano *et al.*, 2017).

In conclusion, the sources of mercury emissions and releases in the Amazon Biome are both natural and anthropogenic. However, evidence shows that mercury concentrations in IIGM areas are higher than the established limits for water, fish, and other standards. This suggests that this form of mining has increased the natural levels of mercury in some regions as a result of deforestation, removing alluvial sediments, through dumping contaminated waste, or from the process of creating and burning amalgams. Likewise, even though bioaccumulation is slower and less likely to occur on land than in aquatic systems, it is important to take into consideration the presence of flooding trends in Amazonian ecosystems that can interfere in this process. Nevertheless, there is a significant lack of research regarding the atmospheric movement of mercury from the Amazon and of the dynamic of mercury releases into Amazonian soils.

B. GEOGRAPHICAL DISTRIBUTION OF KNOWLEDGE OF MERCURY EFFECTS IN THE AMAZON BIOME

Despite the vast understanding about mercury's biochemical cycle, the majority of studies on the effects of this element was conducted in temperate or arctic regions (UNEP, 2013). The amount of information on

the environmental and health consequences of mercury contamination in humid tropical zones like the Amazon is scarce. In general, it is known that mining in rainforests causes deforestation, destroys river beds, disrupts hunting areas, produces toxic waste downstream in towns and cities, contaminates fish and the water, and causes serious health issues (Swenson *et al.*, 2011; Veiga, 2010). However, few studies have been done on the biochemical dynamics of mercury in Amazonian ecosystems and its effects on the environment and human health. This indicates an asymmetry in knowledge between tropical regions, including the Amazon Biome, and in ecosystems in northern zones like the Great Lakes in the United States, the Arctic Circle, and the Scandinavian peninsula, among others (UNEP, 2013). The UNEP has documented how countries in Latin America and the Caribbean emit high levels of mercury as a result of gold mining operations that do not have sufficient regional and national monitoring networks. In fact, only two exist: one in Manaus, Brazil, and the Global Mercury Observation System (GMOS) in Nieuw Nickerie, Suriname (Muller *et al.*, 2012)²⁴. There is also a station in Bariloche, Argentina, thousands of miles to the south of the Amazon Biome (UNEP, 2016: 42).²⁵

Map 4. Geographic distribution of fixed monitoring stations for long-term measurements of gaseous mercury (greater than ten years)



Source: UNEP (2019: 21)

24. <https://www.atmos-chem-phys.net/12/7391/2012/acp-12-7391-2012.pdf>

25. http://www.mercuryconvention.org/Portals/11/documents/2016%20call%20for%20submissions/UNEP%20-%20Global%20Review%20of%20Mercury%20Monitoring%20Networks_Final.pdf

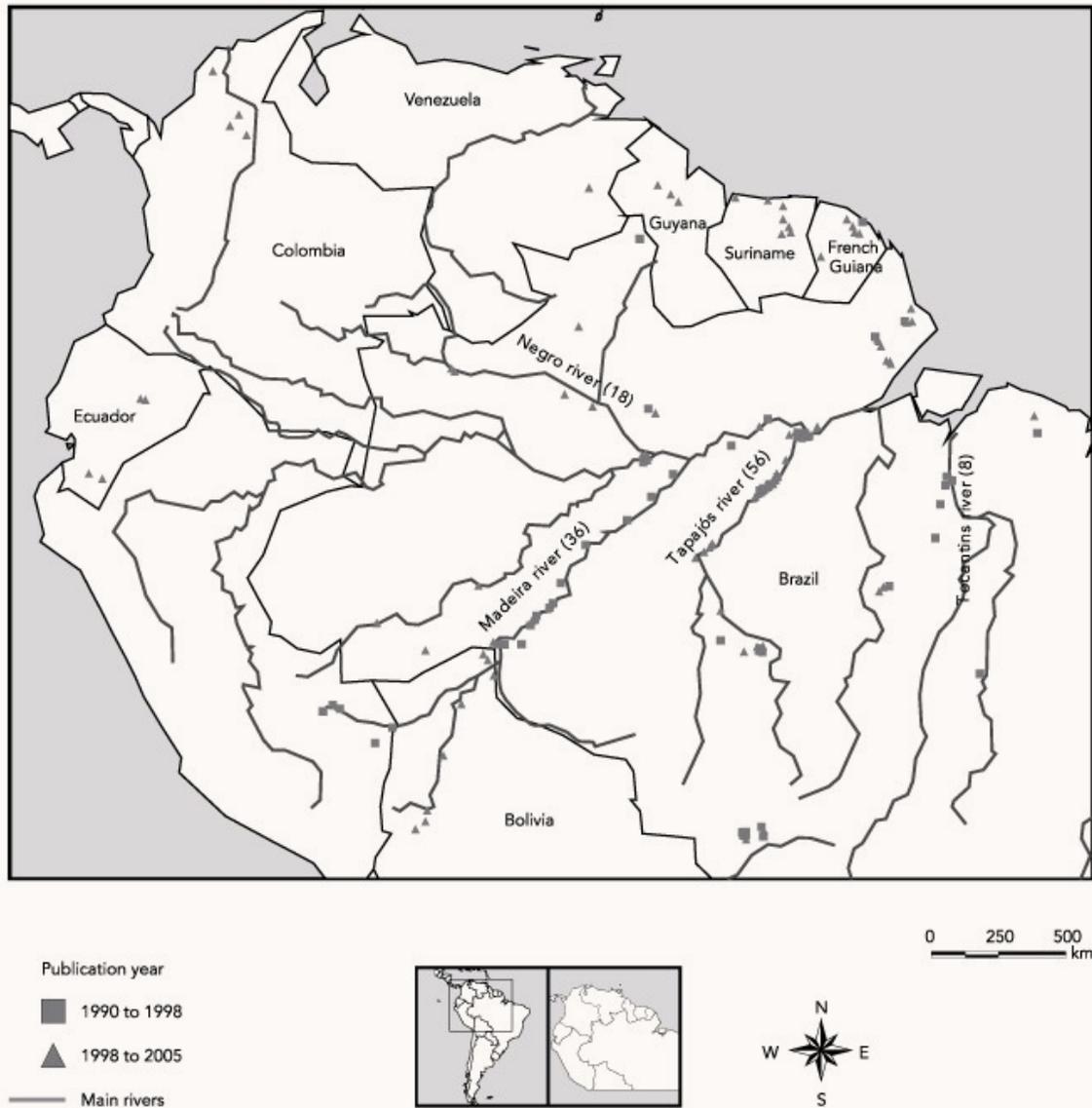
Almost 830 metric tons of mercury are released into the environment by IIGM each year, and as was previously shown, more or less 200 of these are a consequence of IIGM in the nine countries of the Amazon Biome. It is known that at least 25% of global mercury emissions from IIGM originate in the Amazon. And although there are not always records and estimates that discriminate between regions within a same country (for example in Colombia where there are national totals but not for each mining region), it is reasonable to guess that effects that have been documented in some countries in the Amazon basin are also similarly occurring in Amazonian communities, although to different degrees. We must wait to know the scope and magnitude of the real problem in the Amazon regions of countries like Colombia, Venezuela, Bolivia, Ecuador and in the overseas territory French Guiana, as well as to continue to complete a body of existing information on Brazil, Guyana, and Suriname. In Section C, an overview of the available information will be presented by country.

In spite of the gaps in information and the lack of measuring capacity and infrastructure, since the 1980s there has been a slow but steady increase in research on mercury in the Amazon. A systematic and detailed literature review on all of the countries in the Biome exceeds the objectives of this report. Nevertheless, the results of some review articles as well as recent and emblematic studies on the situation from the perspective of sites and matrixes that were prioritized to research the Biome are presented here.

According to a review of published studies in English, Spanish, and Portuguese databases conducted by Hacon *et al.* (2008), investigations on mercury contamination levels in local communities in the Amazon have concentrated mainly on the Brazilian Amazon. Even though from 2006 to 2017 more studies on the subject were published, a preliminary literature review on mercury during this period indicates that while there is more research than before in countries like Peru, Guyana, and Colombia, research on Brazil is still predominate.²⁶ Maps 5 and 6 show the spatial distribution of the investigations conducted:

26. Between 1990 and 2005, a total of 455 publications of mercury contamination in the Amazon basin were undertaken, including 42 theses and dissertations, 28 reports, 19 books, 323 articles published in scientific journals, and 43 extended summaries presented in scientific conferences. The main sampling sites were along the Madeira and Tapajós Rivers in Brazil, the Magdalena River in Colombia, and small rivers and lakes in French Guiana and Suriname. The Brazilian Amazon, with 128 sampling sites, was by far the most researched area, followed by Suriname (7 sampling sites), and French Guiana (6 sample sites), while Peru and Venezuela featured to a very limited extent in mercury investigations of their Amazonian regions (2 sampling sites). In their study, Hacon *et al.* (2008), identified 182 research institutions in Amazonian countries that have published a total of 455 redesigned studies. Of these 182 institutions, 166 are from Brazil, 5 are Colombian, 5 Bolivian, and 3 are in Suriname. The rest of countries (Ecuador, Venezuela, and Guyana) only had one article each published these institutions (Hacon *et al.*, 2008).

Map 5. Sites of mercury investigations in the Amazon according to publication year



Source: Hacon *et al.* (2008)

In addition to the unequal spatial distribution of researched sites, map 5 also indicates that investigation has been insufficient with regards to the region's large rivers that flow from the Andes, such as the Putumayo, Amazonas, Caquetá, and Marañón. The Beni River in Bolivia is the only exception as it has been extensively studied, which will be discussed later on in this paper in the section on Bolivia. Other rivers like the Negro or the Purus have not been studied enough. The upper sections of the Caquetá, Putumayo, and Orinoco are also under-studied, and only in the past four years have investigations on the Colombian part of the Caquetá

and Putumayo Rivers been published. The first study on the mid-Caquetá River in Colombia was just published in 2016 in an indexed international journal (Olivero-Verbel, Carranza-Lopez, Caballero-Gallardo, Ripoll-Arboleda, & Muñoz-Sosa, 2016). In summary and in agreement with a study conducted by Hacon *et al.* (2008), knowledge of mercury levels in local Amazonian communities has mainly focused on the Brazilian Amazon. Even though more studies were published on the subject between 2006 and 2018, a preliminary literature review on databases from these years indicates that while there has been an increase in knowledge production in Peru, Guyana, and Colombia, Brazil still remains the predominant country for this type of information.

Hacon *et al.* (2008) suggests that with regards to the types of studies conducted until now in the Amazon, only 38% of the 326 published articles in indexed journals and peer reviews included samples of mercury levels in environmental matrices (water, sediment, and fish), followed by 31% of studies related to the health of human populations that had been exposed, as well as review articles (14%). Only 6% were related to technological mining improvements, an area where little innovation and few studies have been carried out. An important statistic is that less than 10% of articles included research projects with comprehensive focuses including analyzing samples from environmental matrices (like fish or water) or matrices related to human health consequences (in urine, blood, breastmilk, and especially hair samples). This shows that there is a significant gap in information and knowledge production on the impacts of mercury in the Amazon Biome, especially regarding the lack of comprehensive research plans and projects that evaluate several environmental and human matrices.

It is worrying that only three of the 326 reviewed articles analyzed fauna other than fish. Even though methylmercury exposure in wildlife like pink dolphins, reptiles, and turtles occurs almost exclusively by consuming fish, it is also important that land food chains be researched in the Amazon because of the constant interaction between land and aquatic ecosystems. As Hacon *et al.* (2008) shows, there is insufficient data on mercury concentrations for example in piscivorous birds, mammals, and reptiles. Jimena Díaz, a researcher from the University of California, Berkeley is currently conducting a study on this topic in the Madre de Dios region of Peru, focusing on mercury exposure routes other than fish consumption, like orb-weaving spiders and insects, in order to establish the scale of mercury bioaccumulation and biomagnification in land ecosystems affected by mining activities.²⁷

27. <https://clas.berkeley.edu/research/assessing-toxic-effects-mercury-transfer-aquatic-terrestrial-ecosystems-peruvian-amazon>

In general, the basins that have been most studied in Brazil (Tapajós, Madeira and Tocantins), are also those that have been most heavily affected by gold mining. However, according to the report by Hacon *et al.* (2008), this spatial pattern changed significantly in the last decade. The spatial distribution of studies in the Amazon between 1998 and 2005 is more disperse and located in areas that are upstream from mining zones, like in the case of the Beni and Negro Rivers in Bolivia and Brazil. In general, from 1998 to 2005, research tended to spread from Brazil to other countries and territories like French Guiana, Suriname, Peru, Ecuador, and Bolivia. In spite of the fact that knowledge production in the Biome has been unequal, existing studies evidence the problem and some critical points with persistent mining can be identified. One example is the length of the Tapajós River, where the alluvial mining has occurred since the fifties, and during the nineties more than 60,000 *garimpeiros* expanded the mining frontier more than 150,000 square kilometers. Other regions that Hacon *et al.* (2008) included in the review of literature of important IIGM areas in Brazil were the like the Alta Floresta (Teles Pires River), the Serra do Navio (Tartarugalzinho and Amapari Rivers), and Porto Velho (Madeira River).

Another source of information on the Biome level is the Biodiversity Research Institute's Global Biotic Mercury Synthesis (GBMS) database which compiles worldwide data published on mercury in fish, marine turtles, birds, and marine mammals. The GBMS database hopes to become a standardized and complete platform for evaluating mercury concentrations in the biota to support the Minamata Convention during the ratification and implementation phases (Evers, Buck, Johnson, & Burton, 2017). According to information gathered by the GBMS, the vast majority of data on mercury in fish in South America was collected in areas affected by IIGM. Much of the mercury used in gold mining is released into adjacent water bodies. The GBMS database provides a reference point for historical and current concentrations of mercury in fish in areas affected by IIGM. It can be used as a tool to monitor the effectiveness of future mercury reduction strategies (Evers *et al.*, 2017).

The GBMS database includes 185 references composed of more than 24,000 mercury concentration samples in fish in interior lands and coastal areas in South America (See Figure 2). Their data is updated regularly to reflect new research on mercury in the biota. Several references also document mercury concentrations in humans, especially in riverside rural communities in the Amazon basin. The GBMS database does not include the sources, but the Biodiversity Research Institute (BRI) website has announced that it soon will include a separate database on human health.

Map 6. Total mercury concentrations in fish, marine turtles, birds, and marine mammals in South America

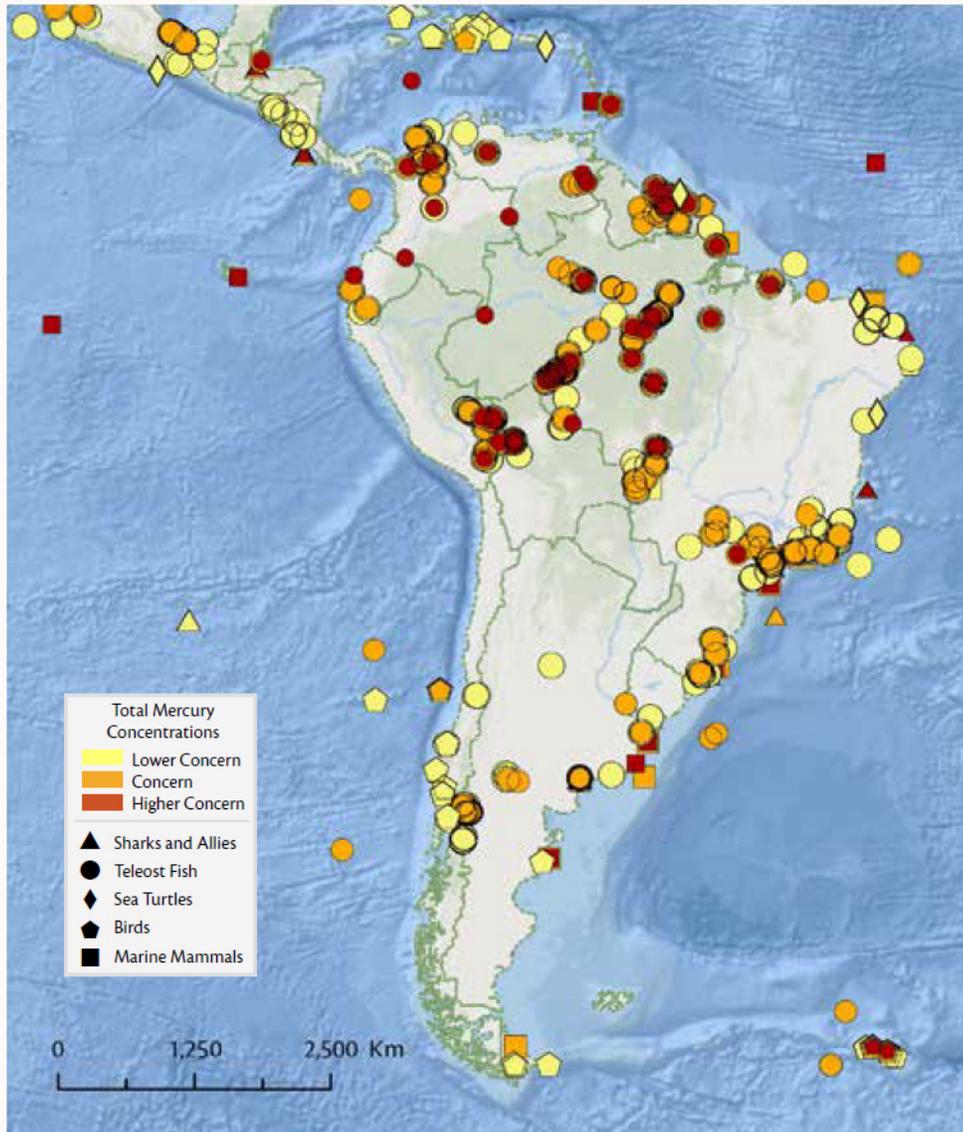


Figure 1. Global Biotic Mercury Synthesis (GMBS)

The data presented here emphasize the global distribution of marine and freshwater fish, sea turtles, seabirds and other avian species that forage in coastal areas, and marine mammals. Thresholds shown are for human health dietary purposes, except for birds which reflect reproductive harm:

Taxa	Tissue	Total Mercury Concentrations (ppm, ww [or *fw])		
		Low	Moderate	High
▲ Sharks and Allies ● Fish ■ Marine Mammals	Muscle	<0.22	0.22 - 1.0	>1.0
◆ Sea Turtles	Eggs	<0.22	0.22 - 1.0	>1.0
◆ Birds	Blood	<1.0	1.0 - 3.0	>3.0
	Body Feathers*	<10.0	10.0 - 20.0	>20.0
	Eggs	<0.5	0.5 - 1.0	>1.0

As can be seen in Map 6, the distribution of samples compiled by the GMBS coincides largely with areas of IIGM and with points and basins studied in the report by Hacon *et al.* (2008). These were previously discussed, as was the tendency for sampled areas to be located in the low and mid-Amazon River basin, rather than in the upper basin or in the Andean-Amazon transition area.

Even though evidence suggests an increase in IIGM activities in the Amazon and Latin America in general, next to no studies on mercury consumption or emissions variations over time exist for this region. However, one recent study applied the UNEP Global Mercury Assessment data to calculate that 199 (or 27.5%) of the 727 metric tons of mercury is emitted annually into the atmosphere from IIGM areas in the nine countries in the Amazon Biome. De La Cruz (2015) provided a regional evaluation of mercury consumption and emissions as a result of IIGM activities in the period from 2001 to 2014 in Amazon countries, using gold production and mercury import data and estimates. The study concluded that annual mercury emissions from IIGM in the Amazon region increased by approximately 155% from 2001 to 2014, from 57.4 metric tons in 2001 to 146.1 metric tons in 2014 (De La Cruz, 2015). During that same time period, a total of 1339 metric tons of mercury was emitted from IIGM activities (not including illegal gold mining emissions) in the eight countries and French Guiana. According to this study, between 2001 and 2014 more than 3420 metric tons of mercury were consumed and released into the environment in the form of tailings or emissions, of which almost 65% came from only three countries: Colombia, Peru, and Suriname.

These figures indicate that mercury emissions as a result of IIGM activities have increased significantly in the Amazon forest. This represents close to 12% of global anthropogenic mercury emissions. The discrepancy between the 199 metric tons estimated by the UNEP and the 149.1 calculated by De La Cruz (2015) is because the former includes measurements that try to estimate contributions from IIGM. The later hypothesizes that emissions from the illegal sector would increase the figure by at least 242 metric tons from the entire Biome.

De La Cruz (2015) also mentions that biomass burning is another important source of mercury emissions into the atmosphere. Similar to IIGM, this activity is prevalent in several Amazonian countries, driven by expanding agricultural and livestock frontiers. Nevertheless, in regards to the amount of tons of mercury emitted, biomass burning is comparatively smaller and has been undergoing a decline (at least up until 2015). According to this assessment, between 2001 and 2014 approximately 105 metric tons of mercury were released into the atmosphere by deforestation activities and biomass combustion. However, during the same period emissions declined from 12.7 metric tons in 2001 to 2.6 in

2014. This reduction in emissions is a result of declining deforestation rates in countries like Brazil (where rates dropped 80%), even though this tendency may have shifted in recent years due to an increase in deforestation in countries like Colombia. In sum, the study concludes that even though this source contributes less than 1% of the average global emissions caused by IIGM activities, the intensification of deforestation could increase this figure (De La Cruz, 2015).

Another source that can be used to compare data with the BRI database is the Environmental Justice Atlas (2018) published by the Environmental Justice Organizations, Liabilities and Trade (EJOLT) project. This is a database of environmental conflicts throughout the world. "Socio-environmental conflicts are defined as mobilizations by local communities (...) which might also include support of national or international networks against particular economic activities, infrastructure construction or waste disposal/pollution whereby environmental impacts are a key element of their grievances" (EJOLT, 2018). The Environmental Justice Atlas contains a map of mining conflicts in Latin America, which can be filtered by resources like gold.²⁸ The database reports on some conflicts associated with IIGM in Amazon countries, but they are very limited compared to the amount of other literature and official information available for each country.

C. OVERVIEW OF INFORMATION BY COUNTRY

The following section will provide a general overview of the available information and studies carried out in the nine countries of the Biome. This synthesis does not seek to be fully exhaustive, but to provide a look at the most recent and cited academic literature and governmental reports on the topic in each one of the countries, and to serve as a starting point for more comprehensive bibliographic reviews.

1. BOLIVIA



Bolivia has become the second highest emitter of mercury from gold mining activities in Latin America, after Colombia. It emits on average 133.1 metric tons of mercury each year (WWF & IRD, 2016), an amount that is greater than what was officially reported to the UNEP a few years

28. <https://ejatlas.org/commodity/gold>

before (which was 45 tons) (see Table 2). According to the *Mercury in Bolivia: Baseline, uses, and contamination* study (WWF & IRD, 2016), between 47% and 70% of these atmospheric emissions come from the IIGM sector. According to SPDA (2014), even though mining activities in Bolivia have to receive an environmental license and legal permit in order to operate, in reality these requirements are not fully achieved: the majority of mining activities carried out in Bolivian territory do not meet both of these conditions.

A report by WWF & IRD (2016), emphasizes that the Bolivian Amazon is vulnerable to mercury contamination for several reasons: "(i) the soils are naturally rich in mercury, exceeding the world average by more than ten times; (ii) its aquatic systems are conducive to transforming mercury into methylmercury (MeHg), which is ten times more toxic to living organisms and highly effective in entering the food chain and consequently into human beings; (iii) the landscape and land use have changed drastically in the last few decades because of the increase in human activities like agriculture, deforestation, and mining, causing an intensification of soil erosion and as a result more mercury emissions; and (iv) local rural populations traditionally consume fish and this is sometimes a community's only source of available animal protein" (22-23). The areas of Bolivia that have reported more cases of contamination and have investigated these types of risks are in the Madre de Dios River and Beni River basins (Alanoca, 2001; Maurice-Bourgoin & Quiroga, 2002; Barberi, 2005).

The Cachuela Esperanza village is located on the shores of an Amazonian river that historically was intensely mined for gold using amalgam artisanal methods. Because of its geographic conditions and its use as a local food source, there is a high risk of methylmercury exposure for the local inhabitants (UNEP, 2002). Evidence exists that shows how the Itenez River basin, located in the eastern-most area of Bolivia, forms part of a system of sub-basins of the Amazon River, and serves as a natural border between Bolivia and Brazil for more than 870 kilometers. Particularly, the middle and lower basins of the Itenez have been subjected to a potential source of contamination by mining in the San Simon highlands (Beni, Bolivia), where large quantities of mercury are thought to be used (15.36 metric tons annually; Hentschel *et al.*, 2000).

Data on mercury contamination also exists for the San Simon highlands, a gold mining zone in eastern Bolivia in the southeast of the Beni department, Itenez province that has been exploited by independent miners since 1742. Mercury contamination in this area is caused at present by close to 500 small mines that emit approximately 15 metric tons of mercury each year (Hentschel *et al.*, 2000). According to WWF and IRD (2016), the Esse Ejja, a nomadic people whose means of livelihood is fishing, are another indigenous group that are impacted by mercury exposure. Vein mining activities also occur in the headwaters of the Beni

River in the La Paz department, in Guanay, Tipuani, Coroico, La Asunta, and Acaupata, where mercury is used and causes contamination in the Rurrenabaque and San Buenaventura villages.²⁹

2. Brazil

Estimates suggest that approximately 130 metric tons of mercury each year are used for gold mining in the Amazon region. Nevertheless, these figures may be an underestimate because studies show that illegal gold mining exists, meaning the amount of mercury used in amalgamation may be probably higher. According to Hacon and Azevedo (2006), and Malm (1998), the mining region of the Brazilian Amazon received at least 2500 metric tons of mercury in the last twenty-five years between emissions and releases, which is equivalent to an average 100 metric tons per year. Other sources suggest that in the last twenty years, close to 3000 metric tons of mercury have been released under precarious conditions into water bodies and river sediments, especially as result of gold mining in the Brazilian Amazon. Over and above these figures, which are difficult to calculate, research indicates that after being used in mining processes in the Brazilian Amazon, mercury is dumped on river banks or into the water and soil, or emitted into the atmosphere during the amalgam and burning process (SPDA, 2014).

Mercury contamination in the Amazon is a common topic for investigation among Brazilian research institutions, including those that are based in the Amazon region where research groups are actively producing scientific data on the topic, especially biomonitoring exercises, and because one of the gaseous mercury fixed monitoring stations is located in Manaus (the only other station in the Amazon biome is located in Nieuw Nickerie in Surinam) (UNEP, 2019). It can easily be seen in literature reviews that Brazil is the country with the largest body of studies on mercury, especially in the Amazon region. According to research carried out by Hacon *et al.* (2008), between 1990 and 2005, a total of 455 publications of mercury contamination in the Amazon River basin were produced: 80% of the studies focus on Brazilian rivers. The Tapajós River basin is perhaps one of the most studied (Berzas Nevado *et al.*, 2010).

In Brazil some populations are exposed to methylmercury contamination, mainly because in the Amazon many dietary habits rely on large quantities of fish (SPDA, 2014: 91). High levels of mercury in hair samples

29. Abrahán Cuéllar Araujo, <http://www.prensaindigena.org.mx/?q=content/bolivia-la-contaminacion-con-mercurio-en-laamazon>

in the general population with levels from ten to twenty $\mu\text{g/g}$ have been observed in the central Amazon in riverside villages along the Tapajós River (Akagi *et al.*, 1995; Dolbec *et al.*, 2000; Pinheiro *et al.*, 2000; Santos *et al.*, 2000). The majority of studies have indicated a strong correlation between the frequency of fish consumption and methylmercury levels in hair samples, confirming that diet is the main route of exposure to methylmercury (Dorea, 2003; Lebel *et al.*, 1997; Malm *et al.*, 1995a; Santos *et al.*, 2000). A study conducted by Berzas Nevado *et al.* (2010) on contamination in fish and mercury exposure associated with mining along the Tapajós River in the Amazon region contains a very complete literature review of studies done in the Tapajós River basin.

In 2014, the Fiocruz Foundation, together with the Yanomami Hutukara Association, the *Instituto Socio-Ambiental* (ISA), and the Yekuana APYB Association, conducted a study that documented how Yanomami and Ye'kwana indigenous peoples in 19 villages in the Papiú and Waikás subregions presented mercury levels in hair samples that ranged from 0.4 $\mu\text{g/g}$ and 22.1 $\mu\text{g/g}$ (the average level of the 239 samples was 6 $\mu\text{g/g}$). This situation is directly related to the release of mercury from IIGM activities in their territories. The indigenous leader Davi Kopenawa, who denounced garimpeiro invasions in Yanomami territory in the nineties (McMillan, 1996), personally presented the report to the UN Special Rapporteur on the Rights of Indigenous Peoples. This complaint was also supported by Survival International, which recently documented the situation of IIGM in the Yanomami and Yekuana indigenous territories.^{30,31} This report was subsequently published in a peer-reviewed journal (Vega *et al.*, 2018).

In 2014, a study reported that the average level of mercury in hair samples in Amazonian villages was 19.1 mg/g , almost double the international standard (SPDA 2014: 90). It is also important to mention that the Brazil National Databank on Contaminated Areas (BDNAC in Portuguese) introduced the Conama Resolution No. 420 on December 28, 2009 in order to publish information on the characteristics of contaminated areas using data provided by government environmental bodies and authorities. To achieve this, the Databank consolidated available information and published the Inventory of Contaminated Areas in 2017 for the Minas Gerais state. The INEA also published a report on the administration of Contaminated Areas in the Rio de Janeiro state. This databank is an important step forward to achieve the commitments undertaken under article 12 of the Minamata Convention regarding the identification and management of sites contaminated by mercury.

30. <https://www.survival.es/noticias/11193>

31. <http://assets.survivalinternational.org/documents/1542/urgent-appeal-mercury-poisoning-in-south-america.pdf>

3. COLOMBIA



A report by the UNIDO (2010) classified Colombia as the third-most contaminated country in the world in terms of mercury, only exceeded by China and Indonesia, in spite of the fact that it is the fourteenth country in terms of gold production. Colombia is also the country with the second highest atmospheric emissions: the first is China with 444 metric tons, followed by Colombia with 180 metric tons, and then by Indonesia with 175 metric tons (UNIDO, 2010). WWF Colombia and the Colombian National Forum in a report in 2017 on mercury in the country indicated that Colombia is the country with the highest mercury per capita releases in the world: between 50 and 100 metric tons, equivalent to 1.6 kilograms per inhabitant. The site with the highest rates of mercury contamination in the country is Segovia, Antioquia (Veiga, 2010).³² Even though Colombia has been frequently mentioned in these unfavorable rankings because in effect its emissions and releases have increased in the last decade, these figures are not completely accurate given variations in time and the specific contribution of emissions and releases from the IIGM sector is not always distinguished.

In 2005, Colombia emitted 26 metric tons of mercury into the atmosphere, 26.5 of which came from IIGM (AMAP & UNEP, 2013, cited in Congress of the Republic, 2018). In 2010, the Ministry of Environment and Sustainable Development and the University of Antioquia conducted a new inventory of mercury using data from 2009. They reported that a total of 352 metric tons was emitted and released by all sectors. The highest contributor was the IIGM sector with 195 metric tons per year. This inventory reported that 151 metric tons were released into soils, 31.2 into water systems, and 74.4 into the air (MAVDT & University of Antioquia, 2010). According to the Ministry of Environment and Sustainable Development (MADS) and UNEP (2012: 57), an estimated 298.2 metric tons of mercury were released into the environment from gold extraction processes related to IIGM.³³

32. Average mercury concentrations in urban air samples in residential areas of mining municipalities in northeastern Antioquia were 10 µg/m³. This is the highest mercury contamination per capita rate in the world. The highest rate ever measured in the world was 1,000 µg/m³ in gold shops in Antioquia. The World Health Organization (WHO) standard for public mercury exposure is 1 µg/m³ (WHO, 2007). The long-term tolerable intake by respiration is 0,2 µg/m³ (OCDE/CEPAL 2014; OCDE 2014: 39).

33. According to MADS and UNEP (2012), in 2011 the average atmospheric emission and releases on land and in water of mercury was 7,05 g Hg per recovered gram of gold (equal to 7,05 kg Hg/kg of produced gold), this widely surpasses the recommended 3,0 kg Hg/kg factor for produced gold by the UNEP Toolkit for identifying and measuring mercury releases.

The same study conducted by the MADS and UNEP provided mercury release and emission data by department for 2011. What is noticeable is that 503.2 kilograms of mercury were emitted in Putumayo, a department in the Amazon region of the country. Official data from this year are not available for mercury use in rest of the Amazonian departments, but this activity also takes place in the Amazonas, Vaupés, and Guainía departments.

Table 5. Gold production and mercury releases by department in 2011

Department	Gold production by department (kg)	Gold vein production (kg)	Alluvial gold production (kg)	Mercury releases into the atmosphere, soil, and water (kg)	Mercury releases into the atmosphere, soil, and water (ghg/g produced gold)
Antioquia	12.935,20	3.492,50	9.442,70	76.102,10	5,9
Bolívar	5.423,00	2.820,00	2.603,00	114.490,40	21,1
Caldas	1.273,10	1.247,60	25,5	Not measured	Not measured
Cauca	1.127,60	530	597,6	8.171,00	7,2
Chocó	27.915,10	0.0	27.915,10	93.050,30	3,3
Córdoba	69,2	0	69,2	203	2,9
Huila	30,1	27,5	2,7	239,4	8
Nariño	235,8	49,5	186,3	1.609,90	6,8
Putumayo	73,7	15,5	58,2	503,2	6,8
Risaralda	36	36	0	226,8	6,3
Santander	60,4	60,4	0	70,5	1,2
Tolima	268,9	193,6	75,3	2.056,80	7,6
Valle	200,6	126,4	74,2	1.505,30	7,5
TOTALS	49.648,70	8.598,85	41.049.85	298.228,75	7,05

Source: MADS & UNEP (2012: 57).

In 2016, the National Planning Department (DNP in Spanish) estimated that since 2009, annual emissions have increased to 75 metric tons. This coincides with the figure of 74.4 metric tons of emissions reported by the Ministry of Environment and Sustainable Development (MAVDT in Spanish) and the University of Antioquia in 2010. Starting that year, Colombia became known as the country with the third highest rate of mercury releases (180 metric tons per year), after China and Indonesia (DNP, 2016). Four other countries from the Amazon Biome are also on this list:

Table 6. Net mercury consumption by country in 2014.

Country	Consumption/mt Hg/year
China	444,5
Colombia	180
Indonesia	175
Bolivia	120
Peru	70
Ghana	70
Sudan	60
Brazil	60
Venezuela	20

Source: Mercury Watch (2014) cited in Congress of the Republic (2018).

According to the Ministry of Environment and Sustainable Development, close to 55% of the mercury used in Colombia “is allocated to gold mining, for the illicit extraction of minerals, and in some industrial components. Each year between 50 and 100 metric tons are dumped in the country.”³⁴ The same source reports that “approximately 180 metric tons are emitted each year within the country’s borders”. The source does not specify if these 180 metric tons are atmospheric emissions or if they include releases into water and soils. It is also uncertain whether these emissions are a result of only the IIGM sector or totals for the country. The UNEP (2013) data on emissions from IIGM presented in Table 5 in section A of this chapter are lower (60 mt Hg/year for IIGM), which suggests that the list in Table 6 corresponds to emissions from all sources in general and not only from IIGM.

UNEP (2013) data indicates that Colombia emits 60 metric tons of mercury per year as a result of IIGM activities. Nevertheless, a more updated report was released within the scope of the Minamata Initial Assessment in Colombia. The National Center for Cleaner Production (*CNMPL* in Spanish), the Ministry of Environment and Sustainable Development, and UNIDO (2017) calculated emissions and releases from IIGM with several input and distribution factors. Different calculations were determined based on the input factor for gold amalgamation, which represents 80% of IIGM. Using a factor of 2 kg/kg of gold, IIGM activities would have emitted 56.8 metric tons of mercury into the atmosphere, 18.9 into the soil, and 18.9 into the air. Using a factor of 3.5 kg, IIGM activities would have emitted 41.4 metric tons of mercury into the atmosphere, 58 into

34. <https://www.elespectador.com/noticias/medio-ambiente/entra-en-vigor-el-convenio-de-minamata-sobre-mercurio-articulo-694400>

the soil, and 66.3 into the air. Using a factor of 7 kg, IIGM activities would have emitted 199 metric tons of mercury into the atmosphere, 66.3 into the soil, and 66.3 into the air. (CNMPL, MADS, & UNIDO, 2017: 34). With regards to gold extraction without amalgamation, the results also vary according to the input factor: a factor of 0.005 kg Hg/mt gold results in 6.3 metric tons of emissions into the air, 3 released into the water, and 143 released into the soil; a factor of 0.015 kg Hg/mt gold resulted in 1.7 metric tons emitted into the air, 0.86 released into the water, and 39 released into the soil.

A literature review by FES (2012) on mercury effects on the environment and health in Colombia found 182 results in databases: close to half of the documents dealt with public health and occupational health topics, and the rest was related to environmental health. Nevertheless, data on the Amazon region was scarce. In November 2018, the Ministry of Health and Social Protection conducted an exhaustive bibliographic compilation of national level research done on mercury contamination, within the framework of the Sectorial Plan on Mercury in the Public Sector to be carried out to comply with the National Mercury Law (Act 1658 of 2013). The report indicated that a large number of studies exist in certain Northern regions of the country like Bolivar and Antioquia, but only two exist on the Amazon region. Human rights violations have been presented by plaintiff associations in this latter region. The first investigation was conducted by the scientist Jesus Olivero Verbel and his team (2015) in the lower Caquetá River in the PANI Association's territory. The second was a working paper from 2016 done in collaboration with the Ministry of Health, the National Health Institute (INS), and the University of Cordoba, in order to measure mercury concentrations in 222 people in communities within the ACITAVA (now ACIYAVA) indigenous association in the Apaporis River in Vaupés.

A more in-depth look reveals that some studies on mercury in the Colombian Amazon do exist. The Sinchi Amazonian Institute of Scientific Research has carried out physical-chemical analysis of water in Amazonian departments. In their 2013 annual report they indicate that heavy metals in water like mercury, chromium, lead, cadmium, aluminum, and arsenic "were present in levels under the recommended water quality limits for human consumption; this indicates that their presence in the environment is low. A comparison with the Guidelines for the Protection and Management of Aquatic Sediment Quality of Canada of the levels of metals in sediments indicates that the levels do not surpass the recommended limits. However, these values are preliminary, given the tendency for bioaccumulation and biomagnification in aquatic biota. Further investigation should be conducted on muscular tissue and atmospheric emissions, as well as monitoring of water and sediments" (Núñez, Agudelo y Gil,

2014: 66).³⁵ The values calculated were between 0.0012 and 0.0087 mg/L, which are below the Colombian standards for permitted limits for human consumption (0.001 mg/L according to Resolution 2115 from 2007) and for untreated water (0.002 mg/L according to Decree 1594 from 1984). The Sinchi Institute also found that mercury levels in sediments were 0.39-0.89 mg/kg, which are lower than the United States Environmental Protection Agency (EPA) standards (0.15mg/kg) and guidelines provided by Environment Canada and the Quebec Ministry of Sustainable Development, Environment and Parks (ECMDEPQ) (0.094 mg/kg; Ehrlich & Núñez-Avellaneda, 2016). Organizations such as the WWF and Omacha Foundation have also done biomonitoring projects in the Amazon Basin, documenting mercury levels in vulture catfish (*Calophysus macropterus*) and in pink dolphins (Salinas *et al.*, 2014).

In the last fifteen years, studies have been published, partly due to warnings from local communities, activists, scientists, and control agencies, that have investigated some parts of the Colombian Amazon which had previously been excluded from the country's analyses of mercury use. One study from 2015 done by Olivero-Verbel and his team (2015) to identify the health impacts of mining activities in the Amazonas department found that close to 150 inhabitants of various communities along the Caquetá River had average mercury concentrations in hair samples between 15.4 and 19.7 µg/g (ppm). According to the researchers, the presence of mercury in their hair samples is a direct result of their daily consumption of fish, since it is a principle food staple in their villages.

The results of this study in the mid-Caquetá River are extremely high in comparison with the international standards for human health (1.0 ppm) set by the WHO and the United States EPA. It is important to mention that these were the highest values of mercury in hair samples in the country up until 2016. In general, these figures demonstrate that mercury contamination in the Amazonas department is a significant public health problem, especially considering that the levels found are, on average, fifteen times greater than the recommended limits for human health. High concentrations of mercury can cause neurological, sensorial, and reproductive problems.

In spite of this study's results and other health consequences documented in the Colombian Amazon as part of a wider research and action strategy (Guio, 2016), some have questioned the causal relationship, or the attributable risk, between illegal gold mining activities and the high levels of mercury in indigenous peoples in the Amazon. Some government officials have dismissed the studies reviewed above claiming that

35. <https://www.sinchi.org.co/files/DOCUMENTOS%20INSTITUCIONALES/INFORME%20DE%20GESTION/Informe%202013.pdf>

mercury does not come from IIGM but it rather is a naturally occurring element in Amazonian soils, as was discussed previously in a comparison of literature on the topic of mercury in the Amazon (Hacon *et al.*, 2008: 1485). Others have proposed that the levels of mercury found in riverside communities along the Caquetá could be the result of different processes, like evapotranspiration from other regions in the country or the world (Strode *et al.*, 2008), even though no concrete evidence supports this theory. Other actors, especially the fishing industry in the Amazon, have simply discredited research, including the pilot project designed by Olivero (2015), by questioning the methods and protocols used and requesting new studies. Some researchers in Leticia were even threatened when they were studying the mercury concentrations in fish and pink dolphins (Salinas, Cubillos, Gómez, Trujillo, & Caballero, 2014).

Another aspect that has hindered these investigative efforts is the limited and unequally distributed capacity in the country to carry out mercury measurements using various matrices. Monitoring activities have been implemented in twenty-four departments in the country, and only five of those, none of which are in the Amazon, have the correct equipment and infrastructure to analyze mercury in water, food, or biological matrices (INS, 2014). Another fundamental problem in Colombia is that the government tends to not recognize the validity of studies that were not carried out by their own institutions or research institutes. Colombian researches have reported that in several cases, studies done by universities or NGOs were dismissed as invalid or untrustworthy by government authorities, even though they had followed established protocols. Other reports suggest that some studies that did not use certified laboratories were discarded, and have not been considered by the state even as a sign of warning to implement preventative actions.

It is also important to mention that information on mercury contaminated fish in the Amazon is still emerging. Apart from the study by Olivero *et al.* (2016), another recent study was published by Salinas *et al.* (2014). The authors collected 86 samples of fish in markets in eight Colombian cities: Leticia, Puerto Nariño, Bogotá, Puerto Inirida, Puerto Lopez, Puerto Asis, Girardot, and Melgar. Sixty-eight samples were molecularly identified as vulture catfish (*C. macropterus*), and mercury concentrations were measured in twenty-nine instances. The specimen presented total mercury concentrations higher than the limit for human consumption established by the WHO (0.5 µg/g). These results showed that not only is the vulture catfish widely consumed in Colombia (sometimes even being covertly sold as other species of fish), but that it also contains high levels of mercury, leading therefore to the suggestion that its consumption presents a risk for public health. It is also important to point out that five of the eight cities surveyed are located in the Amazon.

Another study promoted by the Sinchi Institute in Amazonian rivers (the Amazon, Putumayo, Guaviare, and Vaupés Rivers) found that individuals of several species of fish presented greater mercury concentration levels than the permitted limits (Núñez, Agudelo, & Gil-Manrique, 2014). The results of this study indicate that mercury is concentrated in fish in higher trophic levels, while fish like yaraquí, *palometa*, or *bocachico* from the lower levels present concentrations that are below the standard. Since local consumption is usually based off of fish from the lower trophic levels, it can be inferred that these fish have low levels of mercury concentrations, whereas more highly valued fish from higher trophic levels (sometimes sold in the interior of the country) likely have higher levels of mercury concentrations, above the recommended WHO and EPA standards.

Furthermore, some Regional Environmental Agencies (CARs in Spanish), like the Regional Autonomous Corporation for the Defense of the Bucaramanga Plateau (CDMB in Spanish), and the Corporation for the Sustainable Development of the Northern and Eastern Amazon (CDA in Spanish), among others, have also conducted studies on mercury contamination and its impact in mining areas in their jurisdictions. However, these have not been made public nor are they easily accessible, as is frequently the case with studies that are commissioned by the regional environmental agencies to their personal or contractors. It is important to mention that this report did not include studies conducted by these agencies in their jurisdictions.

4. ECUADOR

In Ecuador, the process of using amalgamation for ore concentrates in IIGM operations is widespread. Approximately 40% of gold production is estimated to come from amalgamation processes, whereas 60% uses cyanidation. Of the miners that still use amalgamation, 50% employ retorts and 50% remove mercury using a blowtorch in the open air, many times in their own homes (Loayza, 2007; Loor, 2008 in UNDP, 2008: 60, cited in SPDA 2014: 158).

In 2008, a national inventory of emissions was published in Ecuador. The report's conclusions stated that mercury emissions in the country in 2005 ranged between 56.75 and 108.70 metric tons of mercury. One of the sources was "gold extraction and initial processing other than mercury amalgamation (19.282 kg/Hg annually, subcategory 2.6). The elevated levels of releases in this subcategory are due to the high input factors, which cast doubt about the situation of Ecuador, because the cyanidation method does not directly use mercury". There is a high level of uncertainty regarding emissions by IIGM in Ecuador; the inventory

report recommended “that a mining census take place to consider the perspective of mercury use in gold production”, and “the characteristics of mercury release in soils and cyanidation waste should be studied and evaluated using mercury monitoring in environmental matrices”. The UNEP (2013) figures on IIGM emissions reported 17.5 metric tons annually from this sector.

The report also recommended focused efforts for reductions using action plans to combat mercury releases, primarily in the Nambija, Zaruma-Portovelo, and Ponce Enriquez regions (Ministry of the Environment of Ecuador, 2008: 146).³⁶ One of the problems in Ecuador, according to health experts, is that “there are no laboratories that can measure levels of metals that residents have in blood or hair samples, that are available in other countries”.³⁷

Indeed, the Portovelo canton is one Ecuadorian mining region where the use of mercury is widespread but inefficiently applied in the more than 200 production plants that exist there (Velásquez-López, Veiga, & Hall, 2010). With regards to the Amazon region, few studies have been conducted on this situation; more studies are available for regions like the Puyango River in the Condor Mountain Range. Some information on mining in the Nambija area of the Zamora Chinchipe province (known for an unfortunate mining accident in 1993) is available that suggest around 1200 people have exploited gold in the area for more than three decades. The use of mercury for IIGM in the Namirez River is also rampant. A report from IIGM in Ecuador estimates that at least 500 families pan for gold using traditional methods in rivers in the Amazon (Sandoval, 2001). The Napo River valley in the Amazon has also been studied by Webb *et al.* (2004).

5. Peru

In Peru, the IIGM sector has grown dramatically in the last few years in the Madre de Dios and Amazonas regions (IIAP, 2011). It is estimated that more than 80,000 miners work in the country (SPDA 2014: 186). The impacts of this activity in the country are substantial. According to SPDA (2014: 190), “in Madre de Dios an estimated 16,000 to 18,000 kilograms of gold are produced each year, and each kilogram of extracted gold uses about 2.8 kilograms of mercury”.

36. https://wedocs.unep.org/bitstream/handle/20.500.11822/11685/ECUADOR_Hg_InVENTORY_FINAL_report_SPANISH_Aug_2008.pdf?sequence=1&isAllowed=y

37. <http://www.elcomercio.com/tendencias/mercurio-se-zamora.html>.

The majority of information available on mercury use in IIGM in Peru focuses on the Madre de Dios region. Among its other goals, this project also aims to connect local people and former miners as collaborators and co-investigators in research projects. The section on Peru in the SPDA report on gold mining in Amazonian countries contains an excellent summary of this information, which is why it is transcribed here *in extenso*:

“A study conducted by CENSOPAS (2010) on the presence of mercury in fish in the Huepetuhe area that evaluated twelve varieties of fish (Yuliya, Sapamama, Corvina, Carachama, Bocachico, Bacalao, Dorado, Zorro, Chiuchiu, Yahuarachi, Chambira, and Paco), found that three surpassed the maximum permitted concentration limits (0.5 ppm, WHO 2008): Chambira 0.7 ppm, Corvina 0.59 ppm, and Zorro 0.52 ppm. Studies carried out in mining communities of Madre de Dios show several worrying findings of mercury contamination. In Huepetuhe, the local Ministry of Health center took and analyzed random urine samples from the local population. Even though the results were varied, some people were found to have levels as high as 508 µg Hg/L (the recommended limit is 5 µg Hg/L for people who are not occupationally exposed).

73.6% of the 231 people without occupational exposure that were analyzed had mercury concentrations that were under the reference level (<5 µg Hg/L in urine), while 26.4% had levels higher than the standard. Two of these people had levels that were extremely high, above 300 µg Hg/L, and one person had a concentration of 467.2 µg Hg/L. The relatively low levels of mercury contamination found in Huepetuhe, a zone that has historically been intensely exposed to mercury, is probably related to low fish consumption from the Andean region (fish and other aquatic resources are the main source of methylmercury in the human organism).

More worrying are the results related to clinical symptoms associated with mercury exposure. 31.2% of the population evaluated in Huepetuhe presented memory loss, 29.5% mood swings, 24.3% irritability, 31.2% muscular weakness, 12.7% muscle tremors, 37.7% headaches, 22.3% allergies, and 15.1% skin peeling. Psychological and emotional health indicators are also alarming: decreased attention spans in school-aged children and reduced IQ (32% showed lower levels), increased domestic violence, growing rates of anxiety and depression, accompanied by migraines, decreased motivation and energy, more feelings of hopelessness, crying, irritability, sleeping disorders, and loss of appetite (CENOSOPAS, 2010).

Another study by the Carnegie Institute confirmed alarming levels of mercury exposure in humans and animals. They found by analyzing samples from fifteen of the most consumed fish species by the Madre de Dios community, that nine of them (60%) had average mercury levels that exceeded mercury reference levels. 78% of the evaluated population in Madre de Dios had mercury concentration levels above the recommended levels including the population of women of reproductive age with levels above the average. This situation also affects indigenous communities because an important part of their diet comes from the consumption of hydrobiological species” (SPDA 2014: 192-193).

The study carried out by the Carnegie Amazon Mercury Ecosystem Project (CAMEP) indicates that between 2002 and 2012, mercury contamination in fish in Puerto Maldonado increased by 90% in ten of the eleven sampled species, revealing the magnitude of the crisis in the Peruvian Amazon (CAMEP, 2013). Lastly, in Peru the contribution of the Camisea gas project on mercury concentrations in neighboring villages is unknown. The Nahua communities within the Nahua-Nanti Reserve are the most affected by this uncertainty.

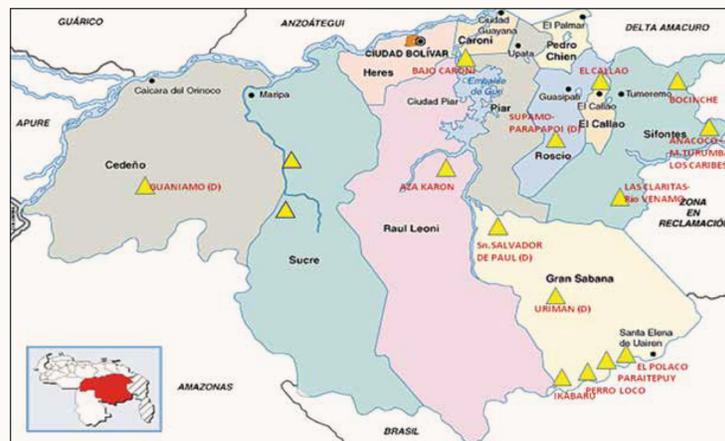
A project conducted by the Amazon Scientific Innovation Center (CINCIA in Spanish), a consortium of universities and local and regional organizations, has also notably contributed to the increase in knowledge on the problem of mercury use in mining and in general on the environmental impacts of this activity in the Peruvian Amazon.

6. Venezuela



An estimated 15,000 people work in the IIGM sector in Venezuela and the livelihoods of some 68,000 depend on this activity. The distribution of people involved in this line of mining work suggests that at least 2,000 miners use artisanal practices, 5,000 use hydraulic monitors, 3,000 mine vein deposits, and 5,000 use floating dredges to mine aquatic sediments in lakes and rivers. The mining areas are found in states in the Guayana region (Amazonas, Delta Amacuro, and Bolivar), and particularly in Bolivar state. Mining in the Amazonas state is less prevalent and it is completely prohibited (SPDA, 2014: 222). According to SPDA (2014), mining areas in the Amazonas and Bolivar states are distributed in the following manner:

Map 7. IIGM Zones in the Bolivar and Amazonas states in Venezuela



Source: SPDA (2014: 223).

The Amazon Biome in the face of mercury contamination



The role of IIGM in the local and regional economy of these two states is significant, yet its role on the national GDP is negligible (SPDA 2014: 226). Historically, IIGM has been concentrated along the Cuyuni River basin in the state of Bolívar, but this situation changed at the end of the last century due to the migration of Brazilian *garimpeiros* and the country's development policies. At the present time, IIGM is prevalent along the Cuyuní, Caroní, and Caura Rivers in the Bolívar state, and in different areas of the Amazonas state. However, IIGM in the state of Amazonas was formally prohibited by Decree 269 in 1989. Furthermore, IIGM activities exist in protected areas in Bolívar and Amazonas in the Duida Marawaka, Yapacana, Parima Tapirapeco, La Neblina National Parks and the Alto Orinoco-Casiquiare Biosphere Reserve (Red ARA, 2013: 10).

Similar to other Amazonian countries, Venezuela has recognized the significant risk mercury exposure poses to human and environmental health. Local organizations contend that IIGM is the leading cause of mercury contamination (Red ARA, 2013), yet in spite of this the quantity and quality of information about the health and environmental effects of mercury from IIGM is lower than in other countries (Rojas, 2010). Regardless of the few studies that exist, a literature review in Venezuela conducted between 2004 and 2008 concluded that the majority of research focused on the Bolívar state. Furthermore, the review by Rojas noted that there are substantially fewer health studies on communities than research on environmental matrices (Rojas, 2010: 37). Nevertheless, some cases of mercury poisoning and contamination have been docu-

mented in mining communities like Claritas, Santo Domingo, El Manteco, El Callao, and el Bajo Canoni, with impacts on human health, soil, water, and fish. Likewise, mercury contamination has been seen in different areas of Guayana in Venezuela.

For example, an investigation conducted by request of the Yekuana indigenous organization by Venezuelan scientists from the Lasalle Foundation of Natural Sciences (Guayana Campus), the Wildlife Conservation Society (WCS-Caura Program), and the Oriente University (Bolívar City Campus), found that mercury contamination levels in Ye'kuana and Sanema communities in the Caura River basin were abnormal: 92% of the evaluated women had levels above the WHO limit of 2 milligrams per kilogram. This study also found that indigenous communities more than 200 kilometers from mining sites were contaminated.³⁸ Researchers concluded that 36.8% of the sampled female inhabitants had mercury levels that presented significant risks for causing neurological disorders in unborn children.³⁹ Sampled fish also presented high levels of mercury; given that fish is a vital part of the diet of indigenous peoples along the Caura, they have begun to question whether it would be better to eat fish once a week or every ten days (EJOLT, 2017).

In 2002, the Venezuelan National Institute of Geology and Mining (INGEOMIN in Spanish), the Ministry of Popular Control of the Environment (MINAMB in Spanish), and the Venezuelan Cooperation for Guayana (CVG in Spanish), promoted the implementation of several analyses of the current situation in the Callao area (El Callao Municipality, Bolívar State), as part of the country's inclusion in the United Nations Global Mercury Project. The ARA Network reported that "this process intends to promote the development of a national policy related to mercury use and distribution, to evaluate health, risks, and program design for environmental monitoring, and to implement educational programs on the environment, health, and the economy. These objectives have not yet been achieved because of many reasons." (Red ARA, 2013: 21)

7. Guyana

The Guianas (Guyana, Suriname, and French Guiana) share a large cross-border gold deposit that has been intensely exploited by IIGM operations. The IIGM sector in the Guianas is composed of approximately

38. Report, "Evaluation of the risk of exposure to metal-mercury in riverside communities along the Caura River" (Bolívar State, Venezuela)", published in 2013.

39. <http://assets.survivalinternational.org/documents/1542/urgent-appeal-mercury-poisoning-in-south-america.pdf>

40,000 miners, many of whom immigrated from the north of Brazil (De Theije & Bal, 2010). One of the world's largest unfragmented forest areas is found in the area shared by the three countries, but at the same time it is an area responsible for 41% of all of the deforestation in the Amazon (Alvarez-Berrios & Mitchell Aide, 2015 cited in Bare *et al.*, 2017). Some of the area's characteristics like gold deposits and forest cover are shared by the neighboring Brazilian state of Amapa. IIGM in Guyana and Suriname is considered one of the largest drivers of deforestation in both countries. It is responsible for 90% of deforestation in Guyana. According to WWF (2013), illegal miners are estimated to use up to one kilogram of mercury to produce the same amount of gold. Years before Picot *et al.* (1993) had calculated a ratio of 1.37 Hg/Au.⁴⁰ WWF has suggested that annually in the three Guianas, thirty metric tons of mercury are released into the environment, with a large part of this contamination occurring in protected areas and indigenous lands (Bourscheit, 2013).⁴¹

Specific conditions in tropical forests of the Guiana Shield magnifies mercury contamination to cause ecological devastation. This includes the convergence of high temperatures, large quantities of organic matter, and the high biological activity of tropical forests, which increases the conversion rate of elemental mercury to methylmercury. High levels of mercury associated with IIGM use have been found in Guyana in the soil, sediments, fauna, and people (Veening *et al.*, 2015: 12). Reports also have shown how mercury contaminated water (approximately forty metric tons of mercury are released annually in Brazil) is transported by river currents to the coast of the Guianas and the Caribbean Sea. Research has also demonstrated that mercury that is released into the Caribbean Sea by the Amazonas River is then spread by the Guyana Ocean Current to places as far away as Cumana city in Venezuela (Veening *et al.*, 2015: 14). 90% of deforestation in Guyana is a result of gold mining (Guyana Forestry Commission & Indufor, 2013), which represents 20% of the country's GDP and 25% of its exports (Miller *et al.*, 2003). In Suriname, small-scale gold mining is the main cause of deforestation and an important income source for 12% of the population (Cremers *et al.*, 2013).

Mercury is directly released into aquatic systems through effluent discharges from mining, and the increase of its impact on riverside habitats in forests in the Guiana Shield has been considerable. High concentrations of mercury have been documented in alluvial sediments in the Essequibo and Mazaruni Rivers in Guyana (Miller *et al.*, 2003), some parts of the Sinnamary River in French Guiana (Richard *et al.*, 2000), in wastewater discharges and sediments in Suriname (Gray *et al.*, 2002), concentrated as methylmercury in the Tapajós River (Guimarães *et al.*,

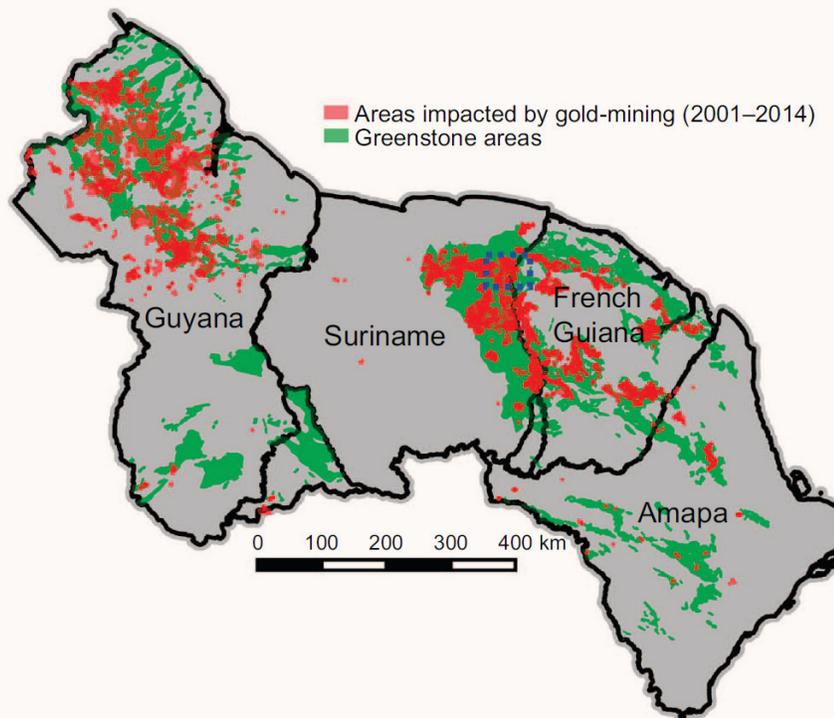
40. Refer to <https://hal-brgm.archives-ouvertes.fr/hal-01024630/document>

41. Refer to <https://www.wwf.org.br/?35422/tensions-run-high-on-french-guiana-border>

2000), and in high concentrations (6–32.6 $\mu\text{g/g}$) in hair samples and fish eaten by approximately one fourth of women surveyed along the upper Negro River. Concentration in carnivorous fish were high than in non-carnivorous fish in French Guiana (Richard *et al.*, 2000), but only a small percent was in the range of being so high as to present health risks.

The following map shows the location of IIGM zones in Guyana, Suriname, and French Guiana, as well as the Brazilian state of Amapá (from left to right). Gold mineral deposits are concentrated in the so-called Greenstone Belt which is shown in green. The Greenstone Belt region where most of the impacts of gold mining were found in 2014 are shown in red (Bare *et al.*, 2017: 3).

Map 8. IIGM Areas in Guyana, Suriname, French Guiana, and the Amapá State of Brazil

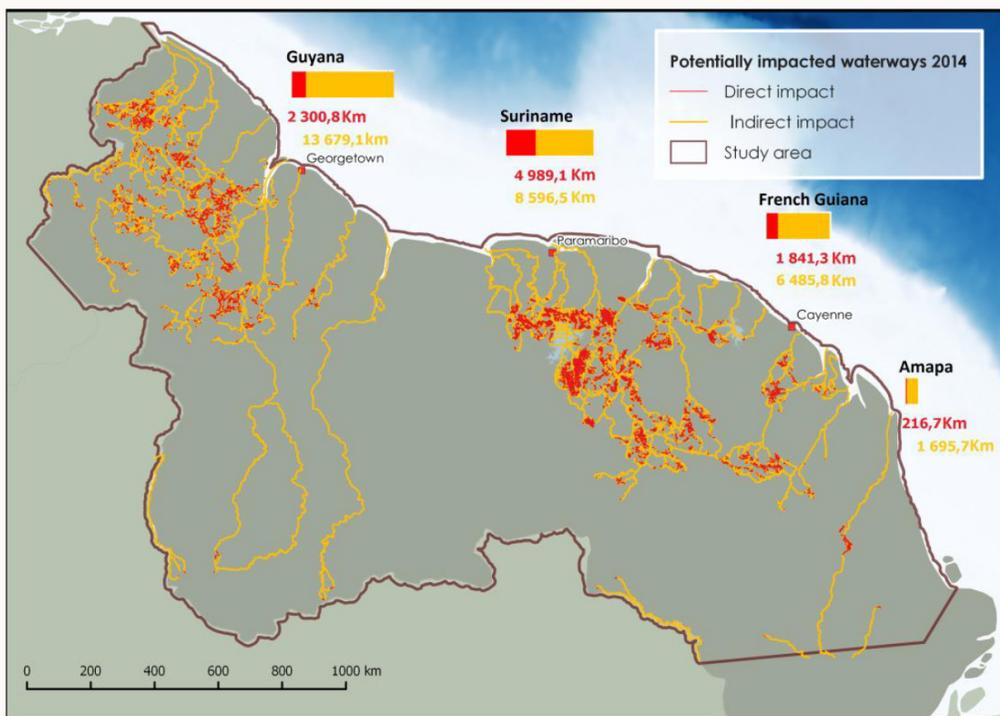


Source: Bare *et al.*, 2017: 3

The IIGM sector in the three Guianas are closely connected, especially along the rivers on the borders where miners, mercury, and gold can easily crossover. Maps show that the transnational character of IIGM in the Amazonian Biome is especially notorious in the Guianas and northern Brazil. In several of the main mining areas in the Guianas, mining communities are made up of not only local workers but many migrants from northern Brazil. These *garimpeiros* are part of a larger population of hundreds of thousands of migrant miners in all of the Amazon.

A WWF report indicated that the increase in mercury levels in sediments in parts of the Potaro River basin appear to have come from placer gold mining activities. Measurements from this river were taken in 2001 indicating that 57% of carnivorous fish had mercury levels above WHO standards (Legg, Ouboter, & Wright, 2015). The document also showed that in Georgetown and inhabited areas along the coast, the surface water was contaminated as a result of improper disposal of waste and chemicals from rice and sugarcane production (cited in EPA, MNRE, & GEF, 2015).⁴² The WWF study also noted that information on mercury contamination in Guyana is insufficient. Certain investigations have shown that in some areas fish populations have demonstrated high levels of mercury, yet it is unclear why corresponding studies on contamination in sediments and water bodies have not been conducted. The report concludes that regardless of the reason, the presence of contaminated fish populations in “pristine areas”, together with the imbalances of inorganic mercury levels, indicates that “recommendations to avoid fish consumption in mining areas and to calculate environmental contamination are insufficient measures to protect communities and wildlife against mercury toxicity” (Legg, Ouboter, & Wright, 2015; 37).

Map 9. Water bodies affected by IIGM in Guyana, Suriname, French Guiana, and the Amapá state in Brazil.



Source: Van Ravenswaay, Batchasingh, & Berrenstein, 2016: 60

42. Refer to <https://www.cbd.int/doc/world/gy/gy-nbsap-v3-en.pdf>

8. French Guiana



In the nineties, the miner population in French Guiana increased, as a result of *garimpeiros* migrations from Brazil. Many of them had worked under strict governmental controls in mines like Serra Pelada (Bare *et al.*, 2017: 6). Official reports and literature confirm that a similar migration flow occurred in neighboring Suriname because of the repressive politics against IIGM starting in 2002 in French Guiana. Even though migrations of miners from French Guiana can affect Guyana, the ease of access to mining areas in Suriname from French Guiana by crossing the Maroni River suggests that the majority of miners travel into Suriname and not Guyana. Illegal mining presents many risks, perhaps the greatest being the dumping of residual waste which not only affects the environment and local populations, but causes mercury and other metals to enter the food chain (Observatorio de Política Internacional de Argentina, 2015).

More than 90% of the French Guianese territory is covered by rainforest. Information about environmental contamination by mercury and its health effects is limited. A study conducted by Frery *et al.* (1999) in French Guiana confirmed that the Wayana population in the upper Maroni River presented high levels of mercury exposure from eating contaminated fish as a result of mercury use in gold activities. The main source of food for the Wayana is freshwater fish from rivers. The study analyzed 242 samples of fish, and found that 14.5% had mercury levels that exceeded 0.5 mg/kg (the highest being 1.62 mg/kg). The authors also calculated mercury consumption rates by age groups: adults (between 40 and 60 μg Hg daily), infants (3 $\mu\text{g}/\text{day}$), children between 1 and 3 years (7 $\mu\text{g}/\text{day}$), children between 3 and 6 years (15 $\mu\text{g}/\text{day}$), and youths between 10 and 15 (28-40 $\mu\text{g}/\text{day}$). The study also concluded that more than half of the Wayana population had higher mercury exposure levels in hair samples (11.4 $\mu\text{g}/\text{g}$) than the rest of the country's population (3 $\mu\text{g}/\text{g}$ and 1.7 $\mu\text{g}/\text{g}$ in people from urban areas), and above WHO recommended limits (10 $\mu\text{g}/\text{g}$) (Fréry, Maillot, & Boudou, 1999 cited in Duque Nivia *et al.*, 2015).

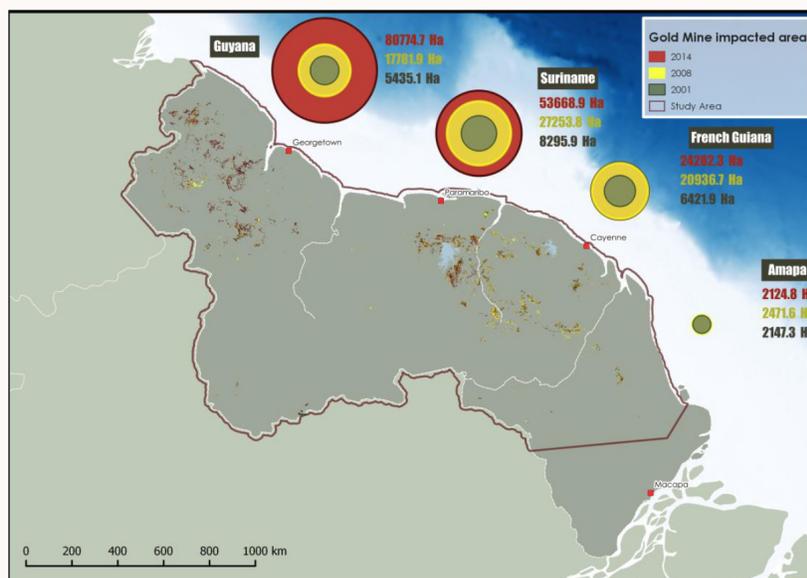
In 2005, 25% of gold production in French Guiana came from primary gold ore (from four extraction sites), and 75% from placer alluvial deposits (Laperche *et al.*, 2014). In spite of the fact that mercury was prohibited in France and its overseas territories starting in 2006, at that time the majority of mining operations used mercury to extract gold. Nevertheless, sufficient information about local level mercury consumption is not available (Laperche *et al.*, 2014). The same study measured mercury concentration levels in river sediments from the country's five main rivers (the Approuague, Comté, Mana, Maroni, and Oyapock Rivers) and their tributaries, including more than 5,450 kilometers of waterways. All regions presented a consistent pattern of significantly higher mercury concentrations in areas of IIGM in comparison to zones where IIGM was not carried out.

In some cases, the connection between mercury contamination (in the soil, sediments, fish, and humans) and gold mining is not always clear. For example, Quenel *et al.* (2007) found high levels of mercury in hair samples in Amerindia communities in Trois Sauts in the upper Oyapock River (French Guiana), however no gold mining occurs in this area. Prior to the study by Quenel *et al.*, mercury contamination had been reported in riverside communities in remote areas along the Upper Negro River (Silva-Forsberg *et al.*, 1999), the Tapajós River (Castilhos *et al.*, 1998), the Apicacas Reserve (Barbosa *et al.*, 1997), and the Amapas (Bidone *et al.*, 1997).⁴³

9. Suriname

The mining industry in Suriname is of vital importance to the country. It supports 30% of the country's GDP and 90% of the country's imports. Since the mid-eighties, the IIGM sector has grown in Suriname, due in part to the massive migration by Brazilian *garimpeiros*. The Guiana rainforest has been untouched by the main drivers of deforestation in large part, and it is therefore an important area to prioritize conservation in the Amazon region. Nevertheless, in the last few years, the region has become an important focal point for environmental destruction caused by gold mining, concentrating 40% of deforestation caused by mining in the Amazon (Legg, Ouboter, & Wright, 2015; Gomes *et al.*, 2016). The following map shows the areas deforested in the Guianas as a result of IIGM activities.

Map 10. Deforestation resulting from IIGM in Guyana, Suriname, French Guiana and the Amapá state in Brazil.



Source: Rahm *et al.* (2014) cited in Van Ravenswaay *et al.* (2016: 60).

43. Refer to <https://hal-brgm.archives-ouvertes.fr/hal-01024630/document>

This map illustrates the evolution of the impact of IIGM on forest cover. A significant increase in the area affected by IIGM activities in Suriname can be seen in the last thirteen years: the total amount of deforested hectares grew from 8,295.9 in 2001 to 53,668.9 in 2014 (Van Ravenswaay *et al.*, 2016). Similar to the situation in Guyana and French Guiana, very few studies on mercury have been done in Suriname. Nevertheless, mercury assessments have been conducted in all of the country's population groups, and the results show that mercury concentrations exceed the World Health Organization's standards of 10 µg/g (Ouboter *et al.*, 2007). This is especially true in the Wayana indigenous group in Apetina and the Lawa River, where mercury levels are worryingly high, even in small children (Heemskerk, 2009: 36).

According to NIMOS (2013), one anthropogenic source of mercury emissions is from high temperature mineral processing, like burning fossil fuels, pyrometallurgical process, metal melting, cement production, forest fires, and mercury production and its components. According to Roulet *et al.* (1998), "the natural capacity of the soil is more significant than possible new anthropic mercury inputs from gold mining or biomass combustion, representing 97% of accumulated mercury in soils. As a result, sedimentation or incorporation of anthropic mercury is insignificant and soils should be considered an important natural mercury sink" (Ouboter, n.d.). According to estimates from 2000, between 25,000 and 35,000 local miners, Maroons, and Brazilians work in gold mining in the country (Veiga, 1997). Mining is principally focused in the so called Greenstone Belt. In Suriname, undeclared production by small operators was estimated to be greater than 15,000 kilograms in 1997 and 30,000 kilograms (100 times greater than the declared amount) in 2001 (Szczesniak, 2001).

Map 11. Greenstone Belt in Suriname



Source: Ouboter (n.d.).

Mining is a significant economic activity in Suriname because of the existence of Precambrian rocks that are strategically important to industrial mining operations for modern technology (gold, bauxite, iron, manganese, zinc, and copper). Even though the majority of gold is produced in industrial mines, small-scale gold mining is a common activity in the Amazon where miners extract the mineral from alluvial sediments using mercury for the amalgamation process. Ouboter (n.d.) asserts that in the last few years IIGM in Suriname has changed to more medium scale mining, and that mercury used for amalgamation is generally combined with weir boxes or dredges that do not usually employ tailings ponds. Ouboter (n.d.) also points out that documented impacts include: deforestation, hydrological destruction, an increase in turbidity, metals, and nutrients in rivers, a change in aquatic vegetation, a change in fish populations, mercury contamination, and mercury accumulation in the food chain.

D. SUMMARY OF KEY POINTS

- According to data from 2010, on average 199 of the 727 metric tons of mercury emitted annually into the atmosphere by the illegal and informal gold mining sector occurs in the nine countries of the Amazon Biome. Emissions from IIGM represent almost 75% of total emissions in all of Latin America.

- Emissions from IIGM in 2015 increased to 838 metric tons. More updated emission data per country is not available. The contribution of Amazon countries ranges from 24% to 27.5% of global mercury emissions. Data on emissions does not discriminate by subnational areas, making it hard to define the amount of emissions caused directly by activities in the Biome.

- According to data from 2010 reported in 2013 by the UNEP, the amounts of mercury emitted in IIGM activities in each country are: Colombia (60 mt/year), Bolivia (between 45 and 60 mt/year), Peru (26 mt/year), Brazil (23 mt/year), Ecuador (between 18 and 20 mt/year), and Guyana (11 mt/year) followed by Suriname, Venezuela, and French Guiana with 6 mt/year. A report from 2016 indicated that emissions in Bolivia during that year were 133 metric tons, and more updated data from Colombia register annual emissions of 180 metric tons.

- Emissions from gold production account for 5% of the global total. Since this report focuses on IIGM, it has not investigated what part of that percent proceeds from large gold mining projects in the Amazon, but this is an important topic for future research.

- In total, in all of South America, 313 metric tons of mercury are released by the IIGM sector, which represents 35% of total mercury releases from IIGM in the world. Unlike the information on emissions, it is not certain how much of this amount occurs in countries in the Amazon Biome.

- The Amazon soil naturally contains mercury. Land use change from expanding grazing and agriculture frontiers, deforestation, and mining have caused an increase in soil erosion which releases the naturally-occurring mercury found there.

- Some studies have shown that biomass burning is also a significant source of emissions, but this was not included in the UNEP's Global Mercury Assessment in 2013. The 2018 UNEP inventory calculated emissions from this source for the first time: 52 metric tons or 2.33% of the global total.

- Mercury emission and releases in the Amazon Biome come from both natural and anthropogenic sources, but evidence shows that mercury concentrations in IIGM zones are higher than standards established for water, fish, and other matrices. This suggests that IIGM activities have increased natural mercury concentrations as a result of deforestation, alluvial sediments removal, as well as from waste dumped from mining and amalgam burning processes.

D. SUMMARY OF KEY POINTS

- When conducting mercury biomonitoring, it is more beneficial to carry out chemical water studies together with biological matrices, but this is not done in the majority of studies: barely 10% of the more than 300 articles studied included a comprehensive focus.
- It is easier to detect contamination in water before mercury bioaccumulates and produces an impact on the trophic chain, but programs to monitor water systems in the Biome and installed capacity for this kind of monitoring are insufficient.
- The majority of data on mercury in fish in South America were collected in areas affected by IIGM. Mercury levels were higher than the recommended WHO standard in at least one site in each of the countries of the Amazon Biome. This pattern is common in other regions of Brazil, Peru, and the Guianas.
- The amount of studies on remote IIGM areas is limited.
- Even though bioaccumulation is less dangerous on land than in aquatic environments, it is important to consider the dynamics of flooding in several Amazonian ecosystems that can affect these conditions. There is a significant lack of information on the atmospheric transport of mercury from the Amazon and release trends from Amazonian soils.
- Since biomass combustion had not been measured until recently, the topic of mercury has not been incorporated in research agendas or advocacy related to deforestation and land use change to the same extent that it has with the subject of mining. Similarly, the inclusion of mercury in discussions on dams, energy, and climate change in the Amazon is an inevitable and urgent necessity, because evidence suggests that the construction and operation of large dams in the Amazon may accelerate mercury exposure levels in local communities.
- Bolivia has become the second highest emitter of mercury for gold mining in Latin America after Colombia, with an average 133.1 metric tons of mercury emitted each year. Close to 47% of these emissions comes from IIGM. A national inventory of emissions is in place in Bolivia and the country has a good background in academic research on the effects of mercury in the environment and on health. The Beni and Madre de Dios River basins are critical points for mercury contamination in the Biome.
- Brazil is the country with the greatest amount of studies on mercury in the Amazon region. The indigenous peoples of the northern arch appear to have the highest risk of exposure to mercury.

D. SUMMARY OF KEY POINTS

- Colombia emits 60 metric tons of mercury each year into the atmosphere as result of IIGM, yet this figure has varied in the last few years because of disaggregated figures. Other recent data suggests this figure to be 180 metric tons. Information on the environmental and health effects of mercury in the Colombian Amazon is limited, but the few studies that exist show alarming levels of contamination in fish and people, particularly in indigenous communities. The technical and logistical capacity of taking and processing samples in the Colombian Amazon needs to be improved.
- A national emissions inventory is in place in Ecuador which registers mercury emissions to be between 56.75 and 108.70 metric tons per year. At least 18 of these are caused by IIGM.
- After Brazil, Peru is the second country with the most studies carried out or in process. The Madre de Dios area is the country's most contaminated and is perhaps the region where mercury contamination is most critical in the whole Amazon Biome.
- The Yanomami territory on the border between Brazil and Venezuela is another critical point for mercury contamination in the Amazon Biome.
- The information for the Guianas is not as complete as other countries like Brazil, Peru, or Bolivia, but existing studies confirm that this sub-region of the Biome is not isolated from the effects of mercury use in IIGM.





CHAPTER IV.

GLOBAL RESPONSES: MERCURY AND INTERNATIONAL LAW ON CHEMICAL PRODUCTS AND THE MINAMATA CONVENTION⁴⁴

44. Sections A and B of this chapter are reproduced here, with slight modifications, from Rubiano-Galvis (2019)



In 2013, the Minamata Convention on mercury was adopted. The agreement is a legal instrument that is fundamental to understanding the situation and response to mercury use in the Amazon Biome. The Convention begins a new chapter in the international environmental governance of chemical products because of its inclusion of heavy metals, which had previously only been regulated within the scope of waste products. In spite of this, prior to 2013, mercury had been included in the international management of chemical products. The early appearances of mercury in global environmental governance instruments can be seen in explicit references to the metal in large UN conferences and legal instruments since the 1970s and its prominence as one of the pressing issues raised by environmental activists in North America and Europe in the 1960s (Selin 2010). The 1972 Stockholm Declaration on the Human Environment, as well as the Rio Declaration on Environment and Development and Agenda 21, reaffirmed the need to eliminate chemical substance discharges into the environment and established the creation of specific programs aimed at solving problems associated with contamination caused by these types of materials.

Since the Rio Summit in 1992, several international multilateral instruments have addressed the management of chemical products. The implementation plan for the 2002 Johannesburg Declaration on Sustainable Development established that by 2020 chemicals should be used and produced in such a way as to minimize significant adverse effects on human and environmental health. In February 2006, the International Conference on Chemicals Management in Dubai resulted in the creation of three important instruments to manage chemical products: The Dubai Declaration on International Chemicals Management, the Strategic Approach to International Chemicals Management (SAICM), and a Global Plan of Action. The SAICM has five objectives: risk reduction; knowledge and information; governance; capacity-building and technical cooperation; and illegal international traffic. It functions under a regional model of multilateral discussion bodies from the United Nations and since its adoption each region within the system has held at least one meeting. It is important to mention that even though the strategy attempts to regulate a wide variety of chemical substances, mercury is just one of many other priority elements.

A. THE MINAMATA CONVENTION

In 2013, after four years of negotiations, the Minamata Convention on Mercury was adopted in Kumamoto, Japan. It was named to honor the victims of the disaster in the bay of the same name decades ago. The Convention adopted a comprehensive regulatory approach towards the problem of mercury contamination. It encompasses almost all of

the sectors and important routes through which mercury is traded and released into the environment, in spite of the fact that some industries and activities were not included in its scope. In addition to the mandates and admonishments to provide prior informed consent and disclose information, the Convention's main mechanisms include measures to control emissions at source, progressive elimination, gradual elimination, and other requirements for specific sources of contamination. The Convention does not adopt a scope of national quotas to quantify total permissible consumption or discharge of mercury or elemental mercury in a country, nor does it quantify the total required reduction per country (You, 2014). These were some of the suggestions provided by European countries during negotiations, but in the end a system of voluntary reductions took precedence. Furthermore, the Convention does not establish time limits for mercury eliminations in IIGM⁴⁵, but it does do so for the other industries where short-term technological shifts are more feasible, especially in oligopolistic sectors like chlor-alkali production (Ovodenko, 2017).

The Convention particularly stresses the close association between IIGM and mercury consumption, emissions, and releases. Article 2 of the Convention defines IIGM as "gold mining conducted by individual miners or small enterprises with limited capital investment and production" (UNEP, 2013). While the Convention does not impose a complete prohibition on the use of mercury in artisanal gold mining, it requires parties "to reduce and where feasible to eliminate the use of mercury" and the emissions from IIGM activities. Each signatory country where IIGM activities that are "more than insignificant" occur must present a National Action Plan (NAP) to the Convention's Secretariat no later than three years after entering into the agreement and revise its progress every three years. The National Action Plan requires parties to establish national emissions and mercury use reductions objectives for IIGM. Additionally, it requires parties to develop "(1) Strategies for promoting the reduction of emissions and releases of mercury; (2) Strategies for managing trade and preventing the diversion of mercury from both foreign and domestic sources to use in ASGM; (3) Strategies for involving stakeholders in the implementation and continuing development of the national action plan; (4) A public health strategy on the exposure to mercury including gathering of health data and training for health-care workers; (5) Strategies to prevent the exposure of vulnerable populations, particularly children and women of child-bearing age; and (6) (j) Strategies for providing information to miners and affected communities" (Buccella, 2014).

45. The Convention refers to artisanal and small-scale mining (ASGM), which may be illegal or informal. See *supra* note 1.

The Minamata Convention reflects a new type of environmental multilateralism in which states have a wide margin to define implementation objectives, unlike previous agreements in which the objectives are clearly fixed by all of the parties. Consequently, the Convention's challenge is how can national regulation systems implement and integrate the treaty's commitments (Yang, 2015). An effort to this effect is the Minamata Initial Assessment (MIA), which with the financial support of GEF and the technical support of several UN agencies like UNEP, UNIDO, UNITAR, and UNDP, has allowed several countries to begin to evaluate their current capacities to comply with the Convention's provisions. MIA projects are being implemented in all of the countries in the Biome. The main objective of MIA is to evaluate countries' abilities to comply with the Convention's regulations and to identify aspects that need to be strengthened in the interest of comply with these.

Currently (October 2019), 128 states have signed the Convention and 114 have ratified it. The following table provides an updated list of signatures and ratifications of the Minamata Convention by countries in the Amazon Biome:

Table 5. Dates in which countries from the Amazon Biome signed and ratified the Minamata Convention

COUNTRY	SIGNED	RATIFIED
Bolivia	October 10, 2013	January 26, 2016
Brazil	October 10, 2013	August 22, 2018
Colombia	October 10, 2013	August 27, 2019 ⁴⁶
Ecuador	October 10, 2013	July 29, 2016
Peru	October 10, 2013	January 21, 2016
Venezuela	October 10, 2013	Pending
Guyana	October 10, 2013	September 24, 2014
France (F. Guiana)	October 10, 2013	June 15, 2017
Suriname	August 2, 2018	August 2, 2018

Sources: NIMOS (2017) and UNEP (2018): <http://www.mercuryconvention.org/Pa%C3%AD-ses/Partes/tabid/5694/language/es-CO/Default.aspx>

45. In June 2019, the Colombian Constitutional Court endorsed the law which approved the treaty. The inclusion of the ratification instrument by the Ministry of Foreign Relations in the Convention's Secretariat is still pending. This process is expected to end in late August.

Map 7. Signatures and ratifications of the Minamata Convention in countries of the Amazon Biome as of 2019



As can be seen, except for Venezuela, all of the countries with territory in the Amazon Biome including France have signed and ratified the Minamata Convention. Furthermore, all of the countries in the Biome have begun to implement MIA projects. In spite of not having ratified the Convention yet (Venezuela) or having ratified it recently (Colombia), both countries are carrying out MIA projects to determine their institutional, regulatory, technical, and commercial capacities in order to comply with the Convention's obligations. The evaluation of these abilities includes each country's previous experience with UNIDO's Global Mercury Project (which had pilot projects and visits to several countries of the Amazon Biome) and with international cooperation projects prior to the Minamata Convention. The next section will discuss the initiatives that were in place before the Convention, and the following section will provide a general overview of the institutional responses of each country.

B. CAN WE PREVENT THE AMAZON TO BECOME A NEW MINAMATA BAY?

The Minamata Convention is a fundamental tool in the fight against the use of mercury in IIGM and its environmental and health consequences. However, its success depends on how each of the countries in the Biome implement the treaty on a domestic level. The development of National Action Plans (NAP) on IIGM is an obligation described in the Article 7 of the Convention that applies for all of the treaty's parties who voluntarily decide if IIGM activities in their country are "more than insignificant". The Convention does not only not set a time limit for eliminating mercury use in IIGM (contrary to almost all of the other industry uses and processes covered by the treaty where time limits are established), but it also allows for flexible solutions for countries developing IIGM-NAP. This is because the countries were aware of the role of this sector in the economic development and poverty in southern countries. Nevertheless, Annex C of the Convention provides a list of elements that the NAP should include. According to Annex C, each country that has identified that IIGM activities in their country are "more than insignificant" must elaborate an NAP that contains the following twelve minimum standards (Annex C, item 1) and additional voluntary strategies (item 2). Each NAP should include:

- (a)** National objectives and reduction targets;
- (b)** Actions to eliminate:
 - (i)** Whole ore amalgamation;
 - (ii)** Open burning of amalgam or processed amalgam;
 - (iii)** Burning of amalgam in residential areas; and
 - (iv)** Cyanide leaching in sediment, ore or tailings to which mercury has been added without first removing the mercury;
- (c)** Steps to facilitate the formalization or regulation of the artisanal and small-scale gold mining sector;
- (d)** Baseline estimates of the quantities of mercury used and the practices employed in artisanal and small-scale gold mining and processing within its territory;
- (e)** Strategies for promoting the reduction of emissions and releases of, and exposure to, mercury in artisanal and small-scale gold mining and processing, including mercury-free methods;

- (f) Strategies for managing trade and preventing the diversion of mercury and mercury compounds from both foreign and domestic sources to use in artisanal and small scale gold mining and processing;
 - (g) Strategies for involving stakeholders in the implementation and continuing development of the national action plan;
 - (h) A public health strategy on the exposure of artisanal and small-scale gold miners and their communities to mercury. Such a strategy should include, inter alia, the gathering of health data, training for health-care workers and awareness-raising through health facilities;
 - (i) Strategies to prevent the exposure of vulnerable populations, particularly children and women of child-bearing age, especially pregnant women, to mercury used in artisanal and small-scale gold mining;
 - (j) Strategies for providing information to artisanal and small-scale gold miners and affected communities; and
 - (k) A schedule for the implementation of the national action plan
2. Each Party may include in its national action plan additional strategies to achieve its objectives, including the use or introduction of standards for mercury-free artisanal and small-scale gold mining and market-based mechanisms or marketing tools.”

Paragraph 2 of Annex C establishes a series of additional mechanisms in order to reach the NAP's objectives. These are a series of market mechanisms that respond to the growth of an emerging global market to buy and sell gold with no or reduced mercury. Mainly, the jewelry sector, the high technology industry, and central banks of European governments have shown interest in driving this tendency. According to the NAP Guide approved by the Convention's first COP in September 2017 in Geneva, “Standards and other market-based mechanisms can provide incentives to miners to transition away from mercury use and/or specific bad practices, and to transition toward more environmentally and socially sustainable practices. Standards and other market-based mechanisms generally have two elements: some kind of verification or certification process to ensure the supplier uses mercury-free (or in some cases, mercury-reduced) methods; and supply chain traceability and transparency” (UNEP, 2015: 72).⁴⁷

47. https://wedocs.unep.org/bitstream/handle/20.500.11822/11371/National_Action_Plan_draft_guidance_v12.pdf?sequence=1&isAllowed=y

Some of the measures suggested by the UNEP Guide include:

- “Certification standards for mercury-free gold
- Due Diligence Requirements in the mineral supply chain. The Organization for Economic Cooperation and Development (OECD) has developed a due diligence guidance for responsible supply chains for minerals from “conflict-affected or high-risk areas.” The OECD guidance includes an Appendix on ASGM, which suggests that stakeholders support formalization and legalization, and help miners create verifiable supply chains.
- Supply chain policies of retailers. Some prominent retailers of gold have adopted their own sourcing policies that require good environmental practices in gold production. While these policies are generally directed at large scale mining, they can also be tailored to create markets for small scale gold producers.
- Development of local businesses to design and make distinctive jewelry is another way to increase wealth distribution in rural areas.
- Socially responsible investment funds. Recent decades have seen the development and growth of investment instruments that focus investments in socially responsible companies. The socially responsible investment (SRI) market currently represents trillions of dollars of investment. It is possible that the private sector could develop instruments that include producers of mercury-free artisanal gold in the SRI market.” (UNEP, 2015: 72-73).

According to the Guide, governments can encourage the development of market-based mechanisms by:

- “Demonstrating rigorous implementation, monitoring and enforcement of the NAP and ability to ensure traceability and certification of practices;
- Offering encouragement to industrial scale mining companies to work with the ASGM sector on certification and supply chain traceability through tax incentives and other inducements;
- Convening stakeholders to discuss development of a market-based mechanism, such as at regional mining conferences;
- Offering tax incentives for the ASGM sector to participate in a certification process;
- In countries where gold is purchased by a national government entity, countries may consider special programs for purchase from artisanal and small scale miners who meet certain criteria for mercury-free gold production.” (UNEP, 2015: 73).

The guide also recognizes that “to be successful, these mechanisms often require strong and sustained intervention; independent verification and certification; and ongoing monitoring. This kind of intervention can be challenging and time consuming to implement at a large scale. In the NAP process, countries may choose to focus first on the highest priorities of basic compliance assistance and formalization, while evaluating where market-based mechanisms can provide needed supplementary incentive for encouraging change.” (UNEP, 2015: 73). It is dependent upon each country to decide what kind of focus it will prioritize to confront IIGM activities.

During the Minamata Convention COP 1, many parallel events took place with invited speakers, publicity, high level meetings, and the presence of stakeholders from high levels of the gold supply chain like representatives from refineries, jewelry stores, and other gold buyers. COP 1 served as a platform to promote the Global Opportunities for Long-term Development (GOLD) in the ASGM Sector project, launched by GEF in 2016. The project seeks to attract private sector actors (large jewelry stores, electronic product manufacturers, gold refiners, and potential commercial banks) to “help connect miners with private actors in the global supply chain that can help ensure production” (GEF GOLD, 2016). The project is working with the governments and local authorities of eight countries (Colombia, Guyana, Peru, Kenya, Burkina Faso, Philippines, Indonesia, and Mongolia) to “strengthen land ownership, miners’ rights, and other regulatory matters in order to reduce informality in the sector”. At the same time, the project promises to “help improve access to financing for miners and mining communities to make investments in necessary mercury-free technologies” (Ishii, 2016). The project’s budget is US\$ 45 million.

It is important to note that three countries in the Amazon Biome (Colombia, Guyana, and Peru) form part of the GEF GOLD project which shows that they have agreed to prioritize market based strategies, transparencies, and supply chain traceability. In fact, the Guyanese president explicitly stated in his intervention in COP 1 that this was going to be the emphasis of the country’s NAP. Even though these mechanisms can benefit the upper levels of the supply chain, it is important to consider that given the IIGM sector’s current conditions in Latin America and the Amazon Biome, only a few official miners or miners in the process of becoming legal, have the capacity to comply with the different requirements that are mandated by the abovementioned market strategies (which call for miners to stop using mercury as well as comply with other social and labor standards). Therefore, favoring a market approach will overlook the vast majority of the informal or illegal mining sector who is already on the political and economic margins of society, especially in the Amazon region where legalizing mining activities is difficult because of the area’s territorial organization, among other reasons. With that in

mind, this report recommends promoting that countries in the Amazon Biome do not overlook the aforementioned other twelve fundamental elements of the NAP for ASGM. In the NAP process, the participation of civil society members and non-governmental organizations, like the ones that commissioned this report, will be central. In the case of Colombia, Guyana, and Peru, the challenge will consist in making sure that their inclusion in the GEF GOLD project which prioritizes market mechanisms does not distract from the importance and other objectives of the NAP in these countries.

In the countries of the Amazon Biome, Peru and Ecuador are making progress in the construction of their NAP with the help of UNIDO. Suriname is working on developing its NAP with support from the UNDP. Although not in the Biome, Paraguay is also advancing with help from the UNEP (UNEP, 2018).⁴⁸ The Natural Resource Defense Council has also published a guide for countries that wish to present projects to the GEF in order to receive financial and technical support to elaborate the NAP and implement preparation and facilitation activities (NRDS, 2015).⁴⁹

It is critical that countries in the Amazon Biome consider to all of the components of the IIGM NAP, but special attention should be given to sections C (formalization measures), D and E (quantifications and emissions reductions strategies), F (strategies for preventing the diversion of mercury in IIGM), G (participation of relevant stakeholders), H (a public health strategy on mercury exposure of miners and their communities), and I (strategies to prevent mercury exposure from IIGM in vulnerable communities, particularly in children and women of child-bearing age, especially pregnant women). The emphasis of these components is important so that market-based strategies (that directly benefit the upper levels of the gold supply chain) do not receive all the attention by party states and other stakeholders and displace the main aspects that should make up the NAP, primarily those mentioned in this paragraph. The potential for success of the Minamata Convention in the Amazon depends on a balance between the interest of several stakeholders to promote mercury-free gold markets on the one hand, and the urgent need to reduce emissions, formalize miners, protect communities from exposure, and prevent the trafficking of illegal mercury on the other. Without this, the possibilities to stop, fix, and prevent mercury contamination in the Amazon Biome are limited.

Several projects within the scope of the Alliance for Responsible Mining (ARM) already are in place in countries in the Amazon Biome.

48. <http://web.unep.org/chemicalsandwaste/global-mercury-partnership/asgm/national-action-plans>

49. https://assets.nrdc.org/sites/default/files/int_15101401a.pdf?_ga=2.94809948.1168022282.1521684372-1883027488.1521165682

This organization has promoted the FairMined Certification since 2004 in various mining operations in Latin American and Africa. It works with miners from some cooperatives in Bolivia, Colombia, Ecuador, Peru, and Venezuela to minimize the use of mercury and cyanide by applying responsible practices and technologies that mitigate environmental and health impacts. The ARM has several projects in place in Latin America, but so far no pilot FairMined gold production project has been implemented in the Amazon region. One of these projects is an alliance between the Swiss jeweler Chopard, ARM, and local support organizations that are supporting miners in the La Llanada municipality in Nariño, Colombia and the 15 de Agosto Cooperative in Bolivia, to introduce more responsible practices in order to directly export gold with the FairMined Certification. Similar projects exist in Peru (area still to be defined) and in Colombia (in the Suarez municipality in Cauca, and in Tarazá in Antioquia), and another in the same areas in Colombia but focused on gold mining in conflict zones.⁵⁰ It is important to evaluate up to what point these kinds of schemes should be promoted in an eco-region like the Amazon, where mining activities are the center of a heated debate and are not always consolidated and socially or institutionally legitimized in each country.

50. Information retrieved from the ARM website: <http://www.responsiblemines.org/en/>

CHAPTER V.

LOCAL AND REGIONAL RESPONSES





The questions that this chapter will try to answer are: What have the responses to the problem of mercury use been in the countries of the Amazon Biome? To what measure have the countries of the Amazon Biome incorporated international standards on managing the lifecycle of mercury, especially the Minamata Convention? This section will provide a brief summary of the Biome-level and country-level regulatory and institutional framework in place, focusing especially on IIGM, its role in mercury emissions and releases, and its impacts on human health and the environment.

A. REGIONAL RESPONSES

Some preliminary actions relating to the topic of environmental and human health effects of mercury in particular and of IIGM in general have been implemented by the Amazon Cooperation Treaty Organization (ACTO). The main goal of the ACTO is to foster the sustainable development of the Amazon River, and it has promoted the chemical security, especially relating to mercury contamination, of the Amazon River basin within its working areas. In January 2006, the ACTO, together with the Brazilian Ministry of Environment and with the support of the US State Department, issued a Regional Action Plan to Prevent and Control Mercury Contamination in Amazon Ecosystems.⁵¹ Additionally, the party countries proposed a new Strategic Cooperation Agenda for the Amazon as part of an ACTO Heads of State Declaration in November 2009, which includes a proposal to identify relevant actions for managing IIGM (UNDP, GEF & UBC 2011).

The topic of chemical risk (mercury, pesticides, and air quality) was prioritized during the development of the 2011 Health Monitoring Plan, as noted in the final report from the “Environmental Health Monitoring System for the Amazon Region” project (Sánchez Otero, 2015). The report describes activities related to mercury carried out by the ACTO between 2011 and 2015. It also details how the organization proposed in 2013 a project on health monitoring related to mercury, yet by 2015 no resources had been secured to this end. Even though the ACTO has reiterated its interest in this issue, the lack of resources to implement the project remains a problem until now.

The signing of the Minamata Convention in 2013 changed the international environmental political context in which the ACTO operated.

51. The Regional Action Plan seeks to collaboratively promote a development model for the region that incorporates the sound management of chemicals, a greater use of clean technologies, sustainable economic development in the gold production chain, social inclusion, the sustainable use of natural resources, and the wellbeing of communities in the Amazon river basin.

For example, the 2016-2018 ACTO Cooperation Agenda planned dialogue and conciliation actions among the member countries, including topics like regional health management in the new international environmental policy context. According to the ACTO, "The health agenda of ACTO's Permanent Secretariat is proposed from the actions drawing from the new global context, based on the agendas of the Ministries of Health from the Amazonian countries; the Millennium Development Goals' 2030 Agenda; the PAHO/WHO Health Agenda for the Americas; the Five-Year Health Plan of the UNASUR South American Health Council; international conventions like the Paris Climate Change Agreement, the WHO International Health Regulations, and the Minamata Convention, among others, in which member states have urged the ACTO to create forums for dialogue and work."⁵² The agenda's goal in terms of health is to "promote the necessary actions that will inclusively support the improvement of health systems in the region, emphasizing vulnerable or at risk populations. Its objective is to improve the quality of life, access to quality health services, the development of environmental health and health in border regions, and disease control and monitoring" (Ibid). The ACTO is currently elaborating the "Regional Proposal for Health Protection in Amazon Populations Exposed to Mercury in ACTO Member Countries" project, as part of the Regional Health Coordination's 2016-2018 Work Plan. It has suggested to hold the "Second Amazonian Regional Meeting on Mercury and Its Effects" during the next three years.⁵³

Additionally, during the past three years the subject of mercury has surfaced in other spaces within the ACTO. For example, within the framework of the Indigenous Peoples in Border Regions Project, financed by the Inter-American Development Bank (IADB), the ACTO held a meeting in September 2016 in which an information exchange took place between Health Ministers from the region and epidemiology experts on indigenous peoples from member state organizations. Among the topics discussed was the issue of mercury contamination.⁵⁴ Similarly, in the May 2017 Regional Workshop for Information and Experiences Exchange on Health Protection in Brasilia, participants also concluded that mercury contamination is one of the priorities for a working agenda on the health of uncontacted peoples and peoples in initial contact, as well as for the rest of indigenous peoples.⁵⁵ Furthermore, in November 2017, a tri-national meeting between Brazil, Guyana, and Suriname took place to exchange information about indigenous peoples in the border areas. The meeting

52. <http://www.otca-oficial.info/themes/details/14>

53. <http://www.otca-oficial.info/assets/documents/20161007/da6ffa6fa8833dba65313b-5cfbeaad19.pdf>

54. <http://www.otca-oficial.info/news/details/75>

55. <http://www.otca-oficial.info/news/details/227>

took place within the framework of the ACTO/IADB Indigenous Peoples in Border Regions Project that seeks to promote information exchange between Amazonian countries in order to identify their epidemiological profiles. Government delegates from indigenous affair and indigenous health institutions in the three countries agreed to begin “a dialogue process for cooperation in attending to indigenous peoples, principally focusing on the main diseases identified as malaria, leishmaniasis, and the effects of mercury.”⁵⁶

Mercury contamination in the Amazon has activated processes within the Inter-American Human Rights System and special procedures in the United Nations Human Rights Council. In a letter addressed to the UN Special Rapporteur on the Right to Health, the NGO Survival International denounced the failure of South American governments to combat this type of contamination. The uncontrolled use of mercury, notably in Peru, Brazil, and Venezuela, frequently affects indigenous territories. The statement declares that “the discriminatory attitudes that States hold towards tribal peoples means little or no action is being taken.”⁵⁷ Complaints of mercury contamination have been presented to the UN Special Rapporteur on the Rights of Indigenous Peoples and the UN Special Rapporteur on the Right to Health. It is foreseeable if this problem worsens that some organizations will seek to bring the case before the Inter-American Commission on Human Rights (IACHR) regarding the lack of an effective domestic-level response by countries like Brazil, Colombia, Peru, and Venezuela. Precautionary measures have already been employed by the IACHR for the Tres Islas community in Madre de Dios, Peru, facing the serious threat that indigenous peoples are dealing with from illegal mining and the uncontrolled use of mercury. Declarations by these regional human rights protection bodies are limited, yet if governments continue their inaction, it is likely that not only more complaints or injunctions like in the case of Tres Islas will occur, but also possible actions by international organizations to address the situation of mercury use in IIGM in the Amazon and in Latin America in general.

It is important to mention that in June 2019, the Andean Community of Nations (CAN in Spanish) resolved to create an Andean Observatory in charge of the Management of Official Information relating to Mercury

56. [Http://Assets.survivalinternational.org/Documents/1542/Urgent-Appeal-Mercury-Poisoning-In-South-America.pdf](http://Assets.survivalinternational.org/Documents/1542/Urgent-Appeal-Mercury-Poisoning-In-South-America.pdf)

57. https://www.plataformaintegraldemineria.org/Es/Noticias/Peru-Paises-De-La-Can-Crean-El-Observatorio-Andino-Encargado-De-La-Gestion-De-La?Fbclid=Iwar31dfhqkvtwwrkm6etd_e4fsr0yfr1ya8bz8j3kt3orqarxnclu1emwda

(PIM, June 7, 2019).⁵⁸ In 2012, the CAN issued the Andean Decision 774 on several aspects of illegal mining in the border regions of Andean countries, emphasizing regional cooperation for control, monitoring, and demolition of illegal mining equipment. Decision 774, called “Andean policy against illegal mining”, recognizes that illegal mining “is a multidimensional problem that threatens peace, security, governability, the economy, and stability in all aspects”, and that “it provokes serious harm, many times irreversibly, to the population’s health, the environment, and natural resources, causing, among other things, the loss of vegetation cover and fertile soils, the contamination of water resources, the alteration of natural ecosystems, and serious effects on biodiversity”. Furthermore, the Decision acknowledges that border areas within the CAN “are being effected environmentally and socially by illegal mining activities, in particular in shared river basins”. Since the 2012 Decision, which focused on both policing and control measures, the most recent action by the CAN related to this issue was the creation of the abovementioned Observatory.

Civil society has also begun organizing to keep track of the problem of mercury use in the Amazon and in Latin America. In the beginning of 2018, the IIED, together with the Amazon Sustainable Foundation (FAS in Portuguese), and the Latin American office of the UNDP, announced the launch of a regional discussion on illegal and informal gold mining, focusing first on Peru, Brazil, and Colombia⁵⁹, even though to date this process has not yet begun. Perhaps the first tangible and coordinated civil society development occurred in October 2018 in Bogota when a group of organizations from countries in the Amazon Biome met for the “**Regional workshop on the use of mercury in mining in the Amazon**”, organized by WWF, the Gaia Amazonas Foundation, FCDS, the Colombian National Park Unit, and the Frankfurt Zoological Society. The first version of the present report was presented there. Participants from Colombia, Guyana, Peru, Ecuador, and Bolivia deliberated and issued the Bogota Declaration, which is included below. This declaration was also presented by WWF in the Minamata Convention’s COP 2 in Geneva in November 2018.

58. https://www.iied.org/Using-Dialogue-Extract-Sustainable-Solutions-For-Artisanal-Small-Scale-Mining?utm_content=Bufferb2ec9&utm_medium=Social&utm_source=Twitter.com&utm_campaign=Buffer

59. https://www.iied.org/using-dialogue-extract-sustainable-solutions-for-artisanal-small-scale-mining?utm_content=bufferb2ec9&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

“BOGOTA DECLARATION OF CIVIL SOCIETY REPRESENTATIVES ON MERCURY CONTAMINATION IN THE AMAZON BIOME

We, civil society representatives from Bolivia, Colombia, Ecuador, Guyana, and Peru, within the framework of the Working Group on the Implications of Mining Activities in the Colombian Amazon conducted in the city of Bogota on October 24 and 25, 2018, express our concern about the serious effects on public health and ecosystems caused by the indiscriminate use of mercury by informal and illegal gold mining in the Amazon region of our countries in particular and in the Amazon Biome in general.

Therefore, following the meeting for the Latin American and Caribbean region in preparation for the Second Meeting of the Conference of the Parties (COP2) from the Minamata Convention on Mercury to be held on October 30 and 31, 2018, we declare that in order to promote the reduction of mercury in air, water, soil, flora, and fauna we urge:

- 1.** That both exporting and importing countries create information regarding the origins of mercury, its purchasers, and its destination, and that this information be made transparent.
- 2.** That countries implement measures to comprehensively care for cultural, ecological, social, and public health as well as ecosystem affectations derived from illegal and informal gold mining, especially as a result of mercury use.
- 3.** That gold certification processes be promoted in a way that ensures the traceability of the mineral in international and national commerce.
- 4.** That a regional strategy be developed to combat mercury smuggling including the allocation by governments of human and financial resources.
- 5.** That the countries develop a strategy to care for people affected by chronic and acute mercury contamination.

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Conservation and Sustainable Development Foundation (FCDS)

Frankfurt Zoological Society (SZF) of Colombia

Frankfurt Zoological Society (SZF) of Peru

Peruvian Society of Environmental Law (SPDA)

World Wildlife Fund (WWF) Peru”.

A preliminary summary of the report was also presented at a parallel event in COP 2 of the Minamata Convention called “*Uniting to stop the mercury crisis in the Amazon*”, organized by WWF on November 19, 2018. In this way, these and other organizations have been progressing in the creation of regional dialogue, coordination, and advocacy spaces regarding mercury use in the Amazon.

B. COUNTRY-LEVEL RESPONSES

This subsection provides a brief summary of the institutional responses to mercury in each country. These sections do not intend to serve as comprehensive overviews but to provide an introductory look at each country’s policy and regulatory situation with regards to mercury. Some transversal and common points are shared at the end of the chapter.

1. Bolivia

Bolivia is a party of the Minamata Convention, which the country signed in October 2013 and ratified in January 2016 through Law No. 759. This permitted the country to begin work on a Minamata Initial Assessment (MIA) project in order to construct a national inventory of mercury releases and emissions in the country. Furthermore, a national program of persistent organic contaminants was created with the aim of undertaking technical commitments within the framework of the Stockholm, Rotterdam, Basel and Minamata Conventions, in addition to guidelines established by the Intergovernmental Forum on Chemical Safety (IFCS) and the Strategic Approach to International Chemicals Management (SAICM).

In 2015, the national government indicated that it was undertaking measures to reduce and/or eliminate mercury contamination. As mentioned in the Lima Declaration of 2017, during the presidential encounter and third binational cabinet meeting between Bolivia and Peru, the Bolivian government also emphasized that the two states have reached a joint commitment for a roadmap to confront the cross-border movement of mercury compounds and waste.

Some important initiatives that stand out are the treatment and management of fluorescent tubes and energy-saving bulbs by the Mekatronika company, rewarded the bronze seal of the Well Being Excellence Award by the national government in 2017; the training of 150,000 artisanal gold miners in the sound management of mercury (MMAYA, 2016); the Lake Titicaca sanitation program (2016); and the implementation of the FairMined Certification in two mining zones in the country by the Responsible Mining Alliance.

2. BRAZIL

The problem of mercury contamination in Brazil is related mainly to its use in gold mining. The Brazilian Ministry of Environment has promoted actions to minimize the risks derived from using mercury, within the framework of the guidelines provided by the Minamata Convention on Mercury, principally through the implementation of activities that mitigate possible damage caused by mercury. The country has national policies that allow for the control of imports, production, trade, and use of mercury. The National Environmental Policy (Law 6938/81, approved by Congress in 1981) determined that the Brazilian Institute of Environment and Renewable Resources (IBAMA in Portuguese) is responsible for controlling mercury imports, production, trade, and use in the country (SPDA 2014: 93):

“The authorization to import mercury is subject to a company’s or individual’s registration in the Federal Technical Registry, in addition to an annual fee, as determined by the law. Each metallic mercury recycler, distributor, or user must declare information about the activities where they use mercury. If it is considered that contamination may result from the activities, all of the trade and/or transportation of the dangerous products must be declared, as well as atmospheric emissions, solid waste, and any other information related to an environmental impact. Moreover, the recycler, merchant, or user of metallic mercury are jointly responsible for the sound management and elimination of the mercury.” (SPDA, 2014: 95).

Brazil began a process to ratify the Minamata Convention in August 2017 (Legislative Decree Project No. 144, 2017) and this was concluded in August 2018. Currently, the country is developing a Minamata Initial Assessment (MIA) project in order to support its obligations for ratification and implementation under the Minamata Convention, providing the main national actors with technical and scientific expertise and the necessary tools for its application⁶⁰ The FICEM, within the framework of advancing towards implementation of the Convention, has proposed that it is necessary “to refine data and information in order to create more precise inventories; to improve the national infrastructure to control and monitor mercury; to analyze and adapt legislation to implement the convention; to educate civil society, universities, private associations, and the government about the Convention; and, to improve the inter-governmental articulation and communication with other organizations” (Reis, 2016).

60. This aims to create the National Mercury Emissions Inventory, using the UNEP Toolkit, as a mechanism to estimate the quantity of emissions and releases to promote control and reduction measures in benefit of human and environmental health.

3. COLOMBIA



Law 1658 passed in 2013 regulates the use, import, production, trade, handling, transportation, storage, final disposal, and environmental releases of mercury in all types of industrial activities.⁶¹ This law orders the eradication of mercury use in all industrial processes in a maximum period established by the Ministries of Environment and Sustainable Development, Mines and Energy, Health and Social Protection, and Labor. Its aim is to implement measures that allow for the “safe and sustainable reduction and elimination of mercury use in different industrial activities in the country”. Furthermore, it orders the eradication of “mercury use in the entire national territory, in all industrial and production processes in a period no greater than ten (10) years, and in mining activities in a period no greater than five (5) years” (MinMinas, 2016).

In December 2014, the National Unified Mercury Plan was launched, in pursuance with the authority of this law, and under the leadership of the Ministry of Environment and Sustainable Development. This is a public policy instrument that seeks to gradually and conclusively eliminate mercury use in the mining and industrial sectors of Colombia through coordinated actions with eight ministries (Environment and Sustainable Development; Mines and Energy; Health and Social Protection; Labor; Commerce, Industry and Tourism; Exterior Relations; Agriculture and Rural Development; and Transportation), as well as two mining institutions (National Mining Agency; and the Mining and Energy Planning Unit). In January 2018, the Comptroller General of the Republic warned that compliance with the Plan’s goals was precarious and disjointed, which led authorities to update and adjust it. In 2019, the Ministry of Environment issued the Environmental Sectorial Plan for Mercury.

Subsequent to Law 1658, other regulations have been issued regarding this issue. In 2015, Resolution 631 was released in relation to the permitted levels for dumping waste in water and soils. Similarly, keeping with Law 1658 in 2013, Decree 2133 was published in 2016 that establishes that mercury importers should subscribe themselves in a single registry of authorized importers. This registry also applies to mercury suppliers. The decree defines that mercury importers and exporters can only sell to registered users who in turn must certify the direct use of the metal.⁶² The extent to which it is possible to easily buy mercury in different cities and

61. Prior to Law 1658, Colombia already regulated specific aspects of mercury use like standards for permitted levels in human drinking water (Resolution 2115 from 2007) and raw water (Decree 1594 from 1984).

62. The decree also establishes the gradual reduction of import quotas in the tariff headings and subheadings related to mercury. Since 2017, the import quota was reduced to 2 metric tons annually of mercury to be used in different IIGM activities.

rural or border areas of Colombia will be the measure of Decree 2133's effectivity in eliminating the mercury supply to IIGM. Nevertheless, it is similarly fundamental that measures are taken to control the illegal sale of mercury from China and Mexico and the trade of mercury that operates through regional distribution networks from other countries in the Amazon Biome previously mentioned. In a meeting of the CAN in June 2019, Colombia and Peru decided to strengthen binational cooperation to tackle illegal mining in the Amazon.

Another reason Colombia is interested in reducing and eliminating mercury use in IIGM and other industrial sectors is because this was recommended by the Organization for Economic Co-operation and Development (OECD) as one of the elements required to achieve admission into the institution, which the country began to seek in 2014 (OECD, 2015). In fact, the national government designed the National Unified Mercury Plan considering the OECD's Chemical Committee's recommendations and decisions, as well as guidelines from the Strategic Approach to International Chemicals Management's (SAICM) Global Action Plan. In 2018, Colombia entered the OECD and therefore going forward it should uphold this organization's standards for the mining sector and with regards to the management of chemicals.

Colombia has received support from the UNIDO to implement a MIA project using the National Cleaner Production Network as the executing body, in conjunction with the Ministry of Environment and Sustainable Development. This project evaluates the country's capacity of early implementation of the Colombia Convention. The project is composed of three pillars: i) institutional capacity; ii) policy and strategy investigations; iii) the national mercury inventory; in addition to its distribution and promotion. This evaluation will be fundamental in complementing existing knowledge about the institutional capacity of mercury production and expertise in the country. In particular, the third point will be central in updating the existing inventory created in 2010 by the Ministry of Environment and the Antioquia University. In May 2017, the results of the MIA project were presented in an event by the Ministry of Foreign Affairs but by the beginning of 2019 the final project evaluation document for the MIA had still not been publically presented or made available. In June 2019, the Constitutional Court endorsed the law that approved the Minamata Convention, and the country ratified the instrument in August 2019. The Colombian government has presented before the Secretariat a formal proposal to hold COP 4 in 2021 in Colombia.

Lastly, it should be emphasized that in Colombia multiple international cooperation projects are taking place to deal with the issue of mercury. The Ministry of Environment (2016)⁶³ reported the following projects:

- “Comprehensive Management of Mercury in the IIGM sector in Colombia”, within the “Global Opportunities for the Long-term Development of the Artisanal and Small-Scale Gold Mining Sector” (GEF GOLD)
- “Strategies for recovering mining lands contaminated by mercury for their reuse in renewable energy or other self-sustainable reuses”.
- GEF Project “Biodiversity conservation in landscapes impacted by mining in the Chocó biogeographical region,” implemented by WWF Colombia.
- “Inter-institutional strengthening to create and evaluate a baseline for mercury in marine environments in order to protect human and environmental health in South America”, project in development.
- “Cooperation mechanisms to regulate mercury trade and control measures to reduce illegal sale to other countries in the region and the world”, project in development.
- “Oro Legal”, a USAID international cooperation project.
- “Better Gold Initiative – BGI” Project from the Swiss cooperation.
- “Comunica” Project by the Canadian government’s cooperation.
- “Project to foster sustainable development in the Mid-Atrato region of the Chocó”, with the support of UNIDO and the Office of the UN High Commissioner for Human Rights.
- Similarly, in Colombia projects by the Responsible Mining Alliance are in place to achieve the FairMined Certification that this organization promotes in two mining zones (Íquira in Huila and La Llanada in Nariño).

Sufficient work has not been undertaken in Colombia to evaluate the impacts of these projects. A deliberated analysis is needed of the new set of international interventions aimed at reducing mercury use in IIGM and its impacts in different regions in the country, in order to avoid errors made in similar projects in the past (Rubiano, forthcoming). It is important to also mention that it seems that the implementation of market mechanisms like the FairMined certification or the Swiss Cooperation’s Responsible Gold Initiative will be complicated in the Colombian

63. http://www.minambiente.gov.co/images/5_ExperienciaGestionMercurio_MADS.pdf

Amazon because no legal title with an environmental license exists in the region to mine gold, and in general the dynamics of mining is politically contested. In the majority of the Amazon, gold mining is perceived as a criminal threat to the environment and indigenous peoples. Because of this, it seems improbable that market mechanisms could gain ground in Colombia, at least in the Amazon. In general, there is a crisis of authority in Colombia to regulate mining, which has a direct impact on the problem of mercury use (Siegel, 2013).

4. ECUADOR



The 2008 Constitution declared that minerals are a strategic natural resource, and the subsequent Mining Law of 2009 which declared a Special Regime for Artisanal and Small-Scale Mining and Regulation on Artisanal Mining, together with an Artisanal Mining Plan. Other regulations in the country include a Basic Environmental Policy from 1994 and the Environmental Management Law from 2004, which was updated in 2018 with the Environmental Organic Code. These are complemented by secondary environmental legislation emitted by the Ministry of Environment; ordinances on pesticides and other agricultural products; the National Vegetal Sanitation Program; the Ecuadorian Institute of Standardization (INEN in Spanish) regulations including lists of goods and services subject to control (INEC) and a list of chemical products subject to control, including mercury; the Ecuadorian Technical Regulation on Transportation, Storage, and Use of Dangerous Chemical Products; and finally, the codification of the Water Law. Law 03 from 2013 added articles to the aforementioned Mining Law and explicitly included dispositions for a transition to mining without mercury.

Another important regulation is the Ministerial Agreement No. 003 from January 11, 2013 that restricted the manufacturing, trade, use, and possession of mercury, sodium cyanide, and potassium. The Ministry of Environment also created a registry system of dangerous chemical substances like mercury and cyanide in order to register and control traders and end consumers. Likewise, import quotas have been established to control illegal trade and in 2014 the Public Import Company took on the responsibility as the exclusive mercury importer in the country, which ended free mercury imports. The Ministry has also undertaken projects to change technology, train, and provide courses in mining zones in the provinces of Azuay, Cotopaxi, Zamora Chinchipe, and El Oro to substitute the use of mercury in IIGM. The Zero Mercury Project, developed as a result of the 2013 legal reforms, is an initiative that has progressed in identifying environmental liabilities. The government has also committed to reduce the use of mercury in mining activities through the National Program for the Sound Management of Chemical Substances.

Ecuador signed the Minamata Convention on October 10, 2013 and ratified it in July 2016. Moreover, Ecuador is a party to the Basel, Rotterdam and Stockholm Conventions. During COP1 of the Minamata Convention in September 2017 in Geneva, Ecuador announced as one of the country's achievements the definitive prohibition of mercury in mining activities, as well as the Zero Mercury Project. Additionally, the Ministry of Health is currently developing a management model to reduce, substitute, and eliminate equipment, devices, and materials that contain mercury in all public and private health establishments in the country, and the definition of an action plan for its implementation. Presently, Ecuador together with Peru, Argentina, Nicaragua, and Uruguay are participating in the Latin American and Caribbean MIA 1 Project, one of three regional MIA projects that is being developed with the support of the UNEP (PAHO, 2015).

The Ecuadorian Ministry of Environment, within the framework of the Latin American Network of Environmental Inspection and Compliance (RED LAFICA in Spanish), held two meetings in 2017 and 2018 to discuss topics of regional interest to the network, like control mechanisms to reduce the negative effects of mercury.⁶⁴

5. Peru

The Peruvian legal framework has a wide range of regulations that seek to formalize IIGM.⁶⁵ Among the commitments regarding mercury that the country has undertaken is Legislative Decree No. 1103 from 2012 which classifies mercury as a chemical product and mandates associated measures to regulate its control in the country, including for example the national registry of consumers of materials used in mining activities. Furthermore, one of the goals of the Artisanal and Small-Scale Mining Sanitation Strategy, approved by the Supreme Decree No. 29-2014-PCM, is the reduction of mercury use in mining operations. Other regulatory developments in Peru include the prohibition of mercury use in agriculture, its consideration in the management plans of energy and metallurgy projects, its inclusion as a parameter in regulations on dumping waste into water, and about workplace security. It is important to mention that Peru is the only country in the region that possesses a mining environmental liability law. Initiatives like the CINCIA Project have also worked on restoring environmental liabilities caused by mining in Madre de Dios.

64. <http://www.ambiente.gob.ec/ecuador-continua-trabajando-para-la-reduccion-de-efectos-negativos-del-mercurio/>

65. For example, Decree 1103 that dictates control and oversight measures for the distribution, transportation, and trade of chemical substances that can be used in illegal mining, in which mercury is emphasized.

The institutional framework of Peru is led by the Ministry of Mines and Energy, together with the Permanent Commission of the Formalization Process that is proposing an interdiction strategy for illegal mining. Other actors include the Ministries of Environment, Health, Agriculture and Irrigation, Defense, and regional governments. Peru also has several responsible gold initiatives related to the Comprehensive Platform for Small-Scale Mining.⁶⁶

The Peruvian government ratified the Minamata Convention in January 2016. Since 2015, the Peruvian legislation has “facilitated the Minamata Convention’s adoption by combating illegal mining through legal channels, as well as through interdiction actions. Moreover, joint efforts for binational focus has occurred with Colombia, Bolivia, and Brazil, as well as work with the CAN and ACTO” (Carrillo, 2015).⁶⁷ Currently, the country is participating in the Latin America and Caribbean MIA 1 project, one of the three regional projects supported by the UNEP (PAHO, 2015), together with Ecuador, Argentina, Nicaragua, and Uruguay. In this way, the Ministry of Environment has been coordinating multisector actions with several state agencies to implement the Minamata Convention, and to this end it established a multisector action plan, approved by Legislative Decree No. 010-2016-MINAM.

6. Venezuela



Venezuela has implemented several actions to control IIGM and mercury use since the 1980s. For example, in 1989 the country prohibited illegal gold mining in the Amazonas state, and later it emitted several Use Regulations and Management Plans, like one for the Imataca Forest Reserve in 2004 and one in the El Caura Forest Reserve in 2007. Likewise, between 2006 and 2007, the national government developed a program aimed at eliminating mining in the Caroni River basin and at promoting the labor reconversion of miners to other activities. Subsequently in 2010, the government launched the Caura Plan to achieve, among other things, the eradication of illegal mining in the Caura River basin, through military interventions and the participation of several ministries.⁶⁸ Nev-

66. Yanaquihua Mining (MYSAC in Spanish) in the Arequipa Department was the first mining association to receive certification by the Responsible Jewelry Council (RJC) in all of South America. Likewise, Macdesa, a small-scale mining company, has been certified by Fairtrade since June 2015.

67. Refer to <http://lasrutasdoloro.com/latinoamerica-relacion-entre-mineria-ilegal-y-mercurio-en-debate/>

68. According to reports by several indigenous organizations, soldiers and the National Guard conspired with miners to receive a share of the profits in exchange for turning a blind eye on their activities. Refer to <http://assets.survivalinternational.org/documents/1542/urgent-appeal-mercury-poisoning-in-south-america.pdf>

ertheless, these efforts to order and control mining activities “does not seem to have achieved their objectives, in addition to being questioned by local communities and environmental groups, as well as generating serious social conflicts with miners and indigenous communities” (Red ARA, 2013: 20).

The legal framework for mercury can be found in the Mining Law, technical guidelines for controlling environmental effects, the General Regulation of the Law, and the declaration of state control of gold mining and exploration activities in 2011. Furthermore, several programs to reduce mercury contamination, to provide medical attention to affected people, and a permanent education program on the health risks from mercury contamination have been developed; in addition to prevention measures and precautionary measures in the case of suspected poisoning.

Venezuela is currently working on establishing a National Action Plan that will be implemented once the Minamata Convention is ratified. A project to evaluate the exposure of people to mercury from IIGM and formal large-scale mining is also underway in the Upper Cauri (PAHO, 2015). In spite of this, it is important to point out that the Venezuelan Government, stating among other justifications the “fight against illegal mining,” is promoting a mega mining project called the Orinoco Mining Arc that will have a significant impact on the Caura lands and its peoples.⁶⁹

7. Guyana

Guyana is trying to minimize in the short-term, and eliminate in the long-term, mercury releases into the air, water, and land through environmentally appropriate management practices. Given the recent discovery of oil and gas in the country, capacity building in these concepts should become a required condition for employment, especially given the increase in the workforce. Guyana has posed the need to create alternatives to mining with mercury and modernizing technology in order to reduce dependency on this metal, by fostering more sustainable, efficient, and ecological gold mining practices.

Guyana was one of the first to sign the Minamata Convention in October 2013, which the country then ratified a year later. Implementation began with the preparation of a draft for the National Action Plan to make progress in efforts to gradually reduce and eventually eliminate mercury use and mercury products. The Plan intends to provide technical training to the mining industry with the support of the Guyanese

69. The ye'kwana-sanema and pemón indigenous groups in the Caura River basin released a press statement against this project (Radio Noticias Venezuela, 2016).

Geological and Mining Commission, the Mining School of Guyana, and the Training Center. Similarly, plans have been developed to eliminate the use of mercury in the IIGM sector and the gold supply chain.

The country has organized the Convention's implementation during the next decade with financing from the GEF in a project entitled "Global Opportunities for Long-term Development in Artisanal and Small Scale Mining Programme" (GOLD). This initiative in Guyana is one of the eight GEF GOLD projects that is already underway with help from the NGO Conservation International. This demonstrates that Guyana, like it has done in the past (for example in the forest sector), is clearly the country that has given the highest priority to market mechanisms to reduce mercury in the IIGM supply chain in the Amazon Biome. Currently, Guyana is participating in another regional MIA called the Caribbean MIA together with Antigua and Barbuda, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, and Suriname. It is also working on its own MIA on a national level.⁷⁰

At present, Guyana is working to develop its National Action Plan under article 7 of the Minamata Convention with help from WWF-Guyana, Conservation International-Guyana, and the UNDP. It has also established other initiatives to limit mercury emissions, like the Mercury-Free Mining Development Fund, in order to increase gold recovery rates and small- and medium-scale miners' access to adequate financing to adopt mercury-free technology.

8. French Guiana



French Guiana is an overseas territory of France, defined by the French Constitution of 1958, and therefore it is part of the European Union. In this sense, French law governs the territory, which while being an express faculty is subject to change that could grant the possibility to determine applicable laws for the respective State powers (like nationality, civil rights, public liberty guarantees, among others). The country's mining legislation is based on French law and chemical products, fuel, machinery, and transportation equipment are principally imported from France.⁷¹ This territory is composed of approximately 90% forest which has been well conserved thanks to the low deforestation rate. Nevertheless,

70. According to the 2015 Annual Report from the Department of Environment and Natural Resources, the MIA will be supported by the UNDP and will provide a basis for any additional work towards ratifying and implementing the Convention, in order to support its rapid entry into the agreement.

71. Refer to <https://minerals.usgs.gov/minerals/pubs/country/2002/gfgynsmyb02.pdf>

as the BBC has reported, this area is appealing to the *garimpeiros* who have employed very rudimentary gold mining methods using cyanide and mercury and contaminating water sources (BBC, 2008).

France signed the Minamata Convention in October 2013 and ratified it in June 2017. The national environmental legislation has established rules regarding mercury, including a national policy to reduce air contamination by restricting establishments that contribute to emissions of controlled substances (local industries, local chambers of commerce and industry, chambers of agriculture, etc.). It also regulates electrical and electronic device waste that contain mercury. Similarly, it is important to mention that the European Council's guidelines apply in French Guiana. In this manner, French Guiana should have begun to take steps to counter the effects of mercury, like preventing the use of mercury amalgams in dental treatments in adolescents under the age of 15 and pregnant women, in accordance with European rules (El Mundo, 2017).

In spite of France declaring a rigorous ecological protection of the territory, the high level of profit from mining and the attractive pay in Euros has caused migratory flows that have included in some cases human trafficking, illegal arms trade, the creation of transnational criminal organizations, corruption, and the undermining of authorities on both sides of the border, among other consequences, as reported by the Argentinean Environmental Policy Observatory (Observatorio de Política Ambiental, 2015).

According to Veening *et al.*, (2015), "smuggling mercury from the EU is a violation of Regulation 1102/2008, to which, if detected, 'effective, proportionate and dissuasive penalties' should be applied by the Member States. An example where a Member State has criminalized contravention of the Regulation is the UK. The UK Mercury Export and Data (Enforcement) Regulation 2010 No. 265) states that it is an 'offence to contravene or fail to comply with any requirement of (amongst others) Art 1 (1) of the EU Regulation concerning the "prohibition on export of mercury from the EU (...)'". If guilty and "on conviction on indictment, a person is liable to a fine or to imprisonment for a term not exceeding two years, or both." Better compliance with Regulation 1102/2008, as adjusted in the near future to bring it in line with the EU ratification of the Minamata Convention, will require more focus of the responsible authorities, more international cooperation both between EU Member States and with des-

69. De acuerdo con el Informe Anual de 2015 del Departamento de Ambiente y Recursos Naturales, para facilitar la pronta entrada en vigor de la Convención, la evaluación (MIA) apoyada por el PNUD proporcionará una base para cualquier trabajo adicional hacia la ratificación y la implementación.

70. Ver en <https://minerals.usgs.gov/minerals/pubs/country/2002/gfgynsmyb02.pdf>

tinuation countries. Due to vested interests in the gold sector, the latter will be a challenge. Also, as shipments are small, enforcement is difficult, like it is in the field of drugs smuggling.” (Veening *et al.*, 2015)

9. Suriname

Mercury in Suriname is a priority issue for the country’s environmental public policy (Gomiam-Suriname, 2015). IIGM is one of the activities that uses the most mercury. In this sense, the Ministry of Natural Resources has expressed that even though mercury use has not been prohibited, gold recovery processes should respect the environment and businesses that use this substance must pay certain taxes.⁷² The Geology and Mining Department (GMD) and the Planning Commission for the Gold Sector (OGS in Dutch) are in charge of creating effective policies to combat mercury use. The OGS is directly connected to the Surinamese Presidential Cabinet and is responsible for regulating small-scale gold mining activities and for keeping peace and safety in the sector. Both bodies conduct important supervisory roles given their legal mandate and direct connection to Suriname’s highest office (NIMOS, 2014: 17).

Currently, it is evident that within the legal framework and the country’s policies there is no central administration for development, implementation, and political control to regulate the use of mercury in small-scale gold mining. In practice, laws are not implemented and coordination between the different government agencies has not been sufficient to combat the problem, in spite of the existing institutional framework (Heemskerk 2010). This scheme is supported by the Labor, Technology, and Environment Ministry’s Environmental Department⁷³; the National Institute for Environmental Development (NIMOS in Dutch), that advises public policy decision makers; the Natural Resources Ministry’s Geology Department⁷⁴; and the Gold Sector Regulation Commission.⁷⁵ The Surinamese government ministries receive support from the UNDP to develop programs to manage mercury, such as inventories or control and management measures for products or waste that contain mercury.

In 2006, mercury exports were banned and the Ministry of Commerce and Industry was charged with issuing mercury import licenses.

72. The ideas that amalgamation alternatives are not as effective as mercury in gold mining is a widespread belief among miners (GOMIAM-SURINAME, 2015).

73. This ministry controls, implements, and formulates environmental policy, in addition to conducting labor inspections of the conditions of exposure to dangerous substances.

74. In charge of controlling the application of best practices in small-scale gold mining.

75. Responsible for implementing and controlling national policy for this sector.

Nevertheless, data from the Inspector of Import Rights and Special Taxes has not registered official records of mercury imports in recent years (NIMOS, 2014: 16). In this sense, it is important to mention that regulations on mercury in Suriname are still limited to only legislation on international goods trafficking. On a legal level, certain limited rules on mercury management are in place but “legal regulations show how the current legislation is managed by sectors and a comprehensive law to regulate the use, import, export, and treatment of mercury does not exist” (NIMOS, 2014: 16).

At the beginning of 2018, Suriname had not yet signed the Minamata Convention, because the government did not consider the country to be ready until it had created a route map that allowed it comply with the treaty’s commitments. NIMOS warned in 2017 and 2018 that if it was not ratified soon, the country would run the risk of losing the momentum it had gained from the Convention as well as the collaborative opportunities for cross-border solutions to the problem. Nevertheless, the government has also implemented a “Step by Step Plan for the Progressive Elimination of Mercury in Suriname” (NIMOS, 2014). The main objective of the plan is to design national measures to protect human and environmental health from mercury exposure with the aim of having a mercury-free environment in Suriname.⁷⁶ This plan provides a general description of the steps that Suriname should follow to eliminate mercury, including short-, mid-, and long-term activities. After a period of progress in the development of this plan, Suriname signed and ratified the Minamata Convention on August 2, 2018.

Finally, Suriname is participating in the Caribbean MIA, one of the three regional projects supported by the UNEP (PAHO, 2015), together with Antigua and Barbuda, Belize, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, and Guyana. The Surinamese National Assembly is also working on two legislative projects that plan to include provisions related to mercury.

76. Seven policy areas have been defined for intervention, including: adjust the legal and institutional framework; establish an agenda for the gradual elimination of mercury and mercury components and for meeting emissions targets; and establish a financial mechanism to implement the previous objectives (NIMOS, 2014: 25).

C. SUMMARY OF KEY POINTS

- The topic of mercury has been on the ACTO's agenda at least since 2006 and the organization has made progress to position the subject in its work plan and agendas for health, environment, and indigenous peoples for the party countries. However, a lack of resources has hindered the implementation of the programs foreseen in the work agenda. The CAN has focused on promoting cooperation between Andean countries for police control since 2012 and for knowledge management since 2019. Since 2018, several civil society organizations in Colombia, Peru, Bolivia, Ecuador, and Guyana have organized themselves to work collaboratively on the issue.

- Gaps in information and a lack of technical and scientific capacities of several countries in the Amazon Biome that were discussed in Chapter III are related to the fragmented and unequal development of regulations on mercury. Legislation has been designed mainly on specific points like imports, trade, and use licenses for mercury. The topic of mercury tends to be included as a specific issue in general standards on chemical substances, mining, dumping, releases, and in general in environmental guidelines against contamination. Other measures have included progressive prohibitions or import restrictions, the creation of unique registries for importers and retailers, and the registry of contaminated sites. All of the issued regulations are currently being reevaluated or adapted to the requirements of the Minamata Convention in all of the countries.

- A lack of articulation between the various agencies and ministries responsible for combating the mercury problem in IIGM can be observed across levels and in all countries. Nevertheless, since the signing of the Minamata Convention in 2013, the law making processes, inter-institutional articulation, and pursuit of common goals established by the Convention's obligations have been revitalized.

- Except for Colombia and Venezuela, all of the countries with territory in the Amazon Biome, including France, have signed and ratified the Minamata Convention and are in the process of elaborating the National Action Plans detailed in the Convention's Article 7.

- All of the countries in the Biome are currently developing MIA projects. Even though Venezuela has not yet ratified the Convention and Colombia did it very recently, they are also progressing in the elaboration of MIA projects in order to determine the institutional, regulatory, technical, and commercial capacity of the country in order to comply with the treaty's commitments.

- Countries like Colombia, Guyana, Peru, and Bolivia have begun to develop Fair Trade gold certification programs. However, up until now none of these programs have been implemented in the Amazon regions of these countries, because they have not been able to meet the minimum conditions to do so. It is important that a comprehensive, participatory, and informed discussion occur about the convenience and implications of these types of measures in IIGM in the countries of the Biome.

- Complaints of mercury contamination in the Yanomami lands in Brazil and Venezuela have been presented to the UN Special Rapporteur on the Rights of Indigenous Peoples and the UN Special Rapporteur on the Right to Health. It is foreseeable if this problem worsens that some

C. SUMMARY OF KEY POINTS

organizations will seek to bring the case before the Inter-American Commission on Human Rights regarding the lack of an effective domestic-level response by countries like Brazil, Colombia, Peru, and Venezuela. Precautionary measures have already been employed by the IACHR for the Tres Islas community in Madre de Dios in Peru.

- In spite of the progress of each country with regards to institutional responses to the problem of mercury use in IIGM, the conclusion of this chapter is that resolving the situation in the Amazon Biome will not be possible without a collaborative, articulated, cooperative effort between all of the countries in the Biome, the ACTO, and other regional cooperation bodies like the CAN. Except for certain limited exceptions (like cooperation between Brazil and the Guianas, Bolivia and Brazil, and between Colombia, Peru, and Ecuador), joint programs between countries of the Amazon Biome to combat the problem are still limited or inexistent. Domestic legislature has not been effective in countering the growing illegal market of mercury in Latin America and particularly in countries in the Amazon Biome.

CHAPTER VI.

CONCLUSION





This report presented a general overview and a preliminary attempt at systematizing available figures, literature, policies, and, in general, information about the problem of mercury use in IIGM in countries in the Amazon Biome. Given its nature and scope, this report did not offer solutions to the problem for all of the countries in the Biome. Nor did it provide specific solutions for each country. On the contrary, the report should serve as a resource for this process and the answers should be designed according to the context and state of progress of the solutions in each country. This document is intended to serve as a guideline to create and consolidate a regional platform for discussions, analysis, knowledge generation, and advocacy that can serve to provide a joint prevention strategy and response to the issue of mercury use in IIGM in the Amazon Biome.

Since each chapter provided a summary of key points, this section will not replicate that information here. However, two points can be emphasized. What is clear after a general assessment, and according to several authors, is that a regional policy is the only viable and realistic option to achieve a long-term solution that prevents devastating consequences of mercury use in IIGM in human and environmental health (Rohan *et al.*, 2011, referenced in Bare *et al.*, 2017). Even though control and regulatory policies are important and needed in order to counteract powerful illegal mercury markets in the region, more comprehensive actions are required for prevention, information generation, and improvement of sources of livelihood in local populations (Hirons, 2011). The problem of IIGM in Latin America, and in general in the global south, is not only related to health and environmental effects, but also wider structural phenomena like inequality, poverty, and the advancement of economic development policies that have excluded important sectors of urban and rural populations.

On the other hand, the way in which countries in the Amazon Biome design and implement their National Action Plans according to Article 7 of the Minamata Convention will determine the type of solutions that will be enacted in the short and medium terms, as well as their eventual effectiveness. As was discussed in chapter IV, even though market mechanisms were included only as a suggestion in the guide for elaborating National Action Plans, it appears that the first projects that have been derived from the Convention, like GEF GOLD, have placed significant importance on these types of options. Market mechanisms are not incompatible with other elements that the National Action Plans should include, like formalization mechanisms, knowledge production, emissions reduction strategies, curbing the deviation of mercury to IIGM, the inclusion of stakeholders, or public health strategies. Nevertheless, the emphasis of implementing market mechanisms threatens to relegate these other aspects to the background.

For this reason, the possibilities for the Minamata Convention to be successful in the Amazon are finely balanced between the interest of several actors to promote mercury-free gold markets on the one hand, and the urgency to reduce emissions, formalize miners, protect communities from exposure, and stop the black market trade of mercury, as was discussed in greater detail in the end of chapter IV. If this is not achieved, then the possibilities to stop, remedy, and prevent mercury contamination in the Amazon Biome will be increasingly limited. On its own, the market will not be able to prevent the Amazon from becoming another Minamata. Committed and active collaboration from governments and regional bodies like the ACTO and the CAN, together with support from the Minamata Convention's Secretariat will be needed.



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