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WHERE DOES SO MUCH MERCURY COME FROM?

INSTITUTO
ESCOLHAS

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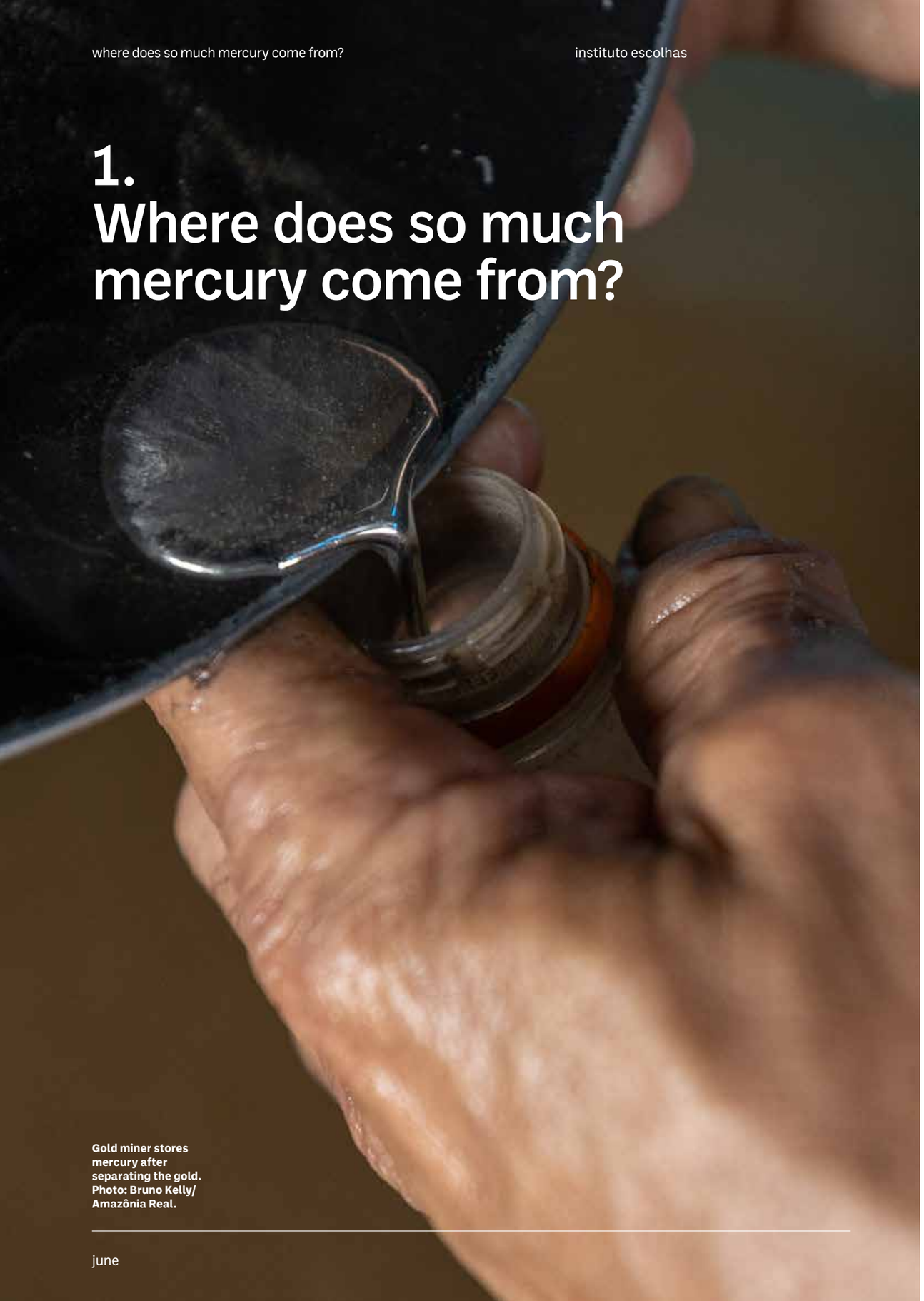


1. Where does so much mercury come from?

Gold miner stores mercury after separating the gold. Photo: Bruno Kelly/ Amazônia Real.

185 tons of mercury, of unknown origin, may have been used in gold production across Brazil between 2018 and 2022.

This staggering figure not only underscores the country's alarming lack of control over this highly toxic metal trade but also the immediate and severe threat it poses to human health[1]. Urgent action is needed to eradicate the use of mercury, and until then, its trade should be strictly controlled.

The figure above highlights the magnitude of the already well known and severe problem of illegal mercury trade and its associated environmental contamination. This estimate is based on an analysis of 1) official records on gold production in areas with wildcat mining permits, 2) estimates of mercury usage in these operations, and 3) official mercury import records.

Data reveals that between 2018 and 2022, Brazil produced 127 tons of gold in areas with wildcat mining permits. These operations use mercury to form a gold-mercury amalgam, separating it from the remaining extracted material. It is estimated that between 165 and 254 tons of mercury were used during this period. However, official data shows that Brazil imported a much smaller amount: 68.7 tons. This stark difference suggests that about 96 to 185 tons of mercury may be of illegal origin (Table 1).

Furthermore, while Brazilian gold exports and the areas dedicated to wildcat gold mining tripled over the past decades, official mercury imports decreased by 78%. From 2002 to 2022, gold exports escalated from 35 to 96 tons per year[2], and the areas dedicated to wildcat gold mining expanded from 68 thousand hectares to 224 thousand hectares. Meanwhile, official mercury imports in the country dropped from 67 tons to 15 tons annually. This alarming trend points to potential illegality in the mercury trade, as mining operations have not stopped using the product to extract gold (Graph 1).

1
Cases of mercury contamination have already been proven and reported. Many organizations in Brazil, such as Fundação Oswaldo Cruz, have done competent work to combat the serious effects of mercury on human health. Refer to, "BASTA, P. C. et al. Mercury Exposure in Munduruku Indigenous Communities from the Brazilian Amazon: Methodological Background and an Overview of the Principal Results. Int. J. Environ. Res. Public Health, 2021 Sep, 18(17):9222", available at: <link>. See also "MENESES, H.d.N.d.M. et al. Mercury Contamination: A Growing Threat to Riverine and Urban Communities in the Brazilian Amazon. Int. J. Environ. Res. Public Health, 2022, 19, 2816", available at: <link>. See also "VEGA, C. M. et al. Human Mercury Exposure in Yanomami Indigenous Villages from the Brazilian Amazon. Int. J. Environ. Res. Public Health, 2018, 15, n.6, pp.1-13", available at: <link>. Accessed on: May 20, 2024.

2
Exports include 1) gold produced in areas with wildcat mining permits that inherently use mercury and 2) gold from big mining operations under the concession regime. Analyses by Instituto Escolhas confirm that the share of wildcat mining gold has increased.

Table 01.
Estimates of Unregistered Mercury Imports (kilograms)

Year	Gold from Wildcat Mining[3]	Mercury Use Estimates[4]		Mercury Imports[5]	Estimates of Mercury Shortfalls for Gold Production		
		Scenario 1 *(1,3Hg:1Au)*	Scenario 2 *(2Hg:1Au)*		Shortfall 1	Shortfall 2	Shortfall Average
2018	15.589	20.266	31.178	21.218	952	-9.960	-4.504
2019	19.958	25.945	39.915	20.115	-5.830	-19.800	-12.815
2020	29.342	38.145	58.684	12.386	-25.759	-46.298	-36.029
2021	31.356	40.763	62.712	0	-40.763	-62.712	-51.737
2022	30.761	39.989	61.522	15.016	-24.973	-46.506	-35.740
Total	**127.006**	**165.107**	**254.011**	**68.735**	**-96.372**	**-185.276**	**-140.824**

Source: a self-made analysis based on data from the Brazilian National Mining Agency, Comex Stat[6], and parameters obtained from UNEP (2015)[7] and Castilhos, Z.C. & Domingos, L. M. (2018)[8].

3
Calculating the volume of gold production in wildcat mines is essential for estimating the amount of mercury used in the country, as Hg consumption prevails in these operations. Instituto Escolhas calculated gold production between 2018 and 2022 based on the records of the Financial Compensation for Mineral Exploration provided by the National Mining Agency. Only gold production registered in areas with wildcat mining permits was considered.

4
The use of mercury in the country was estimated by multiplying the volume of gold production in wildcat mines by 1 (Scenario 1) and by 2 (Scenario 2), considering the proportions of mercury units used for each unit of gold produced, according to UNEP, 2015 and CASTILHOS & DOMINGOS, 2018. The estimates used the proportions corresponding to the addition of mercury in concentrated gold materials, which is common practice in Brazilian wildcat mines. The estimated mercury use obtained is conservative and may be higher, as it was only calculated based on the registered gold production in areas with a wildcat mining permit. However, what determines mercury use is the type of operation, not the legal regime and permits it falls under. Therefore, mercury use may occur in other gold mining operations in addition to illegally mined gold that has not even been counted in any authorized area. Another premise of this study was to consider the mercury demand only for gold mining, the main consuming sector.

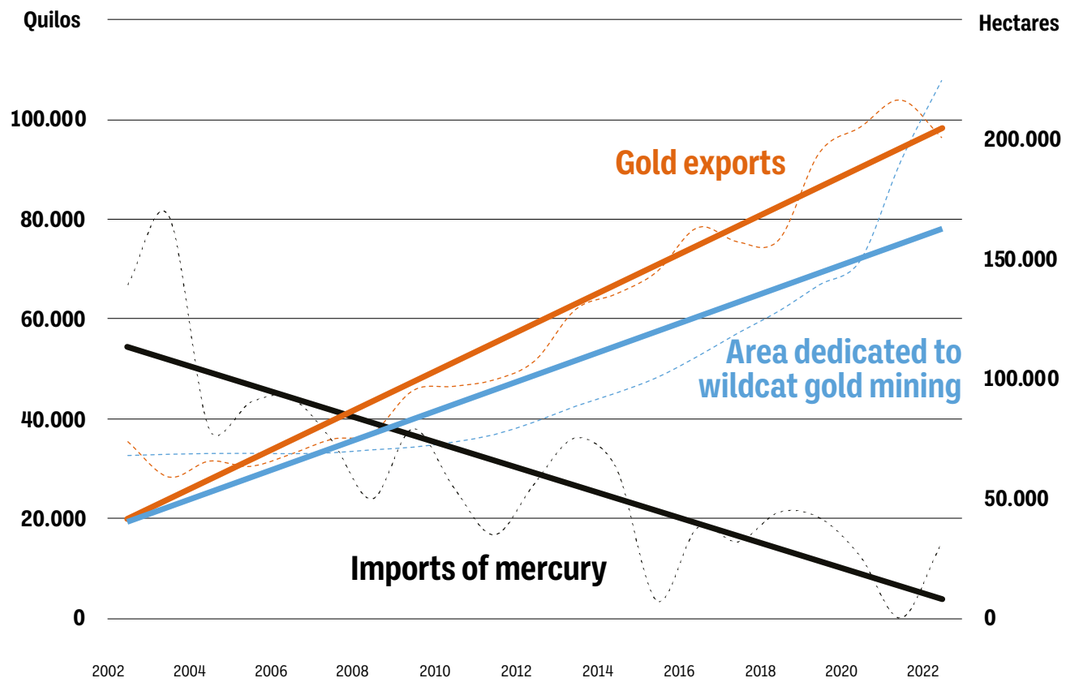
5
Brazil did not record mercury any exports during this period, only imports. The study assumed that all mercury imported by Brazil was directed towards gold amalgamation in wildcat mines, the predominant use sector.

6
COMEX STAT. Data Base. Brasília: Ministry of Economy. 2002-2022. Available at: <link>. Data was retrieved on April 8, 2024, using the code NCM 2805.40.00 (Mercury).

7
UNEP (United Nations Environment Programme). Toolkit para a Identificação e Quantificação de Liberações de Mercúrio. Diretriz para Inventário Nível 2. 2015. Available at: <link>. Accessed on: May 20, 2024.

8
CASTILHOS, Z.C. & DOMINGOS, L. M. Relatório Final: Inventário Nacional de Emissões e Liberações de Mercúrio no Âmbito da Mineração Artesanal e de Pequena Escala no Brasil. 2018. Available at: <link>. Accessed on: May 20, 2024.

Graph 01.
Brazilian Imports of Mercury (kg), Brazilian Gold Exports (kg), and Area Dedicated to Wildcat Gold Mining in Brazil (hectares) between 2002 and 2022



Source: analysis by the authors based on data from the Comex Stat and MapBiomas Project[9].

9
MAPBIOMAS PROJECT. Statistics. Mining (Collection 8). Available at: <link>. Accessed on: May 20, 2024.

Considering all this, **where does so much mercury come from?**

I. Mercury Routes

But where does so much mercury come from? China, the world's leading mercury producer is responsible for over 80% of the global production. Tajikistan, which has not signed the Minamata Convention on mercury use, is the next major producer. Mexico, which extracts mercury from old gold mines, is also a significant contributor[10,11]. Global trade data also reveal the involvement of other countries in supplying the metal (Table 2). This involvement is generally explained by the sale of mercury recovered from products, processes, and own stockpiles.

Brazil is not a mercury-producing country. Therefore, all mercury used within its territory is imported. Given its highly toxic nature, both importation and usage are regulated. Companies importing mercury must register with Ibama — the national environmental authority — and obtain authorization for each import process[12].

Between 2018 and 2022, Brazil officially imported 68.7 tons of mercury, primarily from Japan (91%), Mexico, and the United States (Table 3). Japan had not produced mercury since 1974 when the Itomuka mine was closed, yet remains a significant exporter, selling its stockpiles and recovered mercury[13]. Mexico, as mentioned, is a considerable mercury exporter due to its extraction from inactive gold mines. The United States is neither a producer nor a major exporter, but some mercury exports are recorded from the US to various countries.

It is noteworthy that during the same period, while Brazil officially recorded the importation of 68.7 tons of mercury, Ibama authorized the importation of 99.1 tons (Table 4). The discrepancy between these figures may indicate instances where records and authorizations are potentially used for fraudulent trade schemes, as the agency has been investigating[14].

It is also essential to consider that Brazil shares borders with countries that also engage in gold mining activities, many of which located in remote areas with weak government controls. Therefore, it is crucial to analyze mercury trade closely on a regional scale (Graph 2).

The situation in Bolivia is particularly alarming in South America, as the country is the main mercury importer in the region and one of the largest globally. Between 2018 and 2022, Bolivia imported 723 tons of mercury, mainly from Mexico, Russia, India, and Tajikistan, while exporting 196 tons of gold[15]. This stark contrast, importing about ten times more mercury than Brazil despite producing only 1.5 times more gold, raises serious concerns[16]. This information highlights the discrepancies in the region and signals an illegal mercury trade route into Brazil, which investigations and seizures have already confirmed[17].

Guyana and Peru are other countries drawing attention. Guyana, the second largest importer of mercury in the region and one of the largest in the world, has also been confirmed as an illegal mercury route into Brazil. Between 2018 and 2022, gold production in Guyana, from small and medium operations using mercury, was approximately 60 tons—about half the amount produced in similar operations in Brazil[18]. On the other hand, Peru is one of the major mercury exporters in the region and the world, and therefore warrants attention. During the same period, Peru exported 176 tons of mercury to India, the Netherlands, and Switzerland.

All these countries, whether importing or exporting large quantities of mercury either have significant gold mining activities, or weak border controls, being potential suppliers and receivers of illegal mercury. Therefore, they require constant monitoring and border controls.

10 U.S. GEOLOGICAL SURVEY. Mineral Commodity Summaries – Mercury. January 2024. Available at: <link>. Accessed on: May 20, 2024.

11 Read more about Mexico's case in the article by UNEP "Com o tempo se esgotando, os mineradores de mercúrio do México buscam um novo começo", from October 2023. Available at: <link>. Accessed on: May 20, 2024.

12 According to Decree nº 97,634 from 1989 and Ibama's Regulation (Instrução Normativa) nº 8 of 2015.

13 MINAMATA CONVENTION ON MERCURY. First full national report - 2021 - Japan. Available at: <link>. Accessed on: May 20, 2024.

14 Recently, in 2022 and 2023, the Federal Police and Ibama launched operations Hermes (Hg) I and Hermes (Hg) II to combat illegal mercury in the country. Read more in the Federal Police Agency article at <link>. See also the article by G1 available at <link>. Accessed on: May 20, 2024.

15 INSTITUTO NACIONAL DE ESTADÍSTICA. Bolivia – Exportaciones de Oro según Año y Mes 1990 – 2024. Available at: <link>. Accessed on: May 20, 2024.

16 For comparison, only Brazilian gold registered in areas with wildcat mining permits was considered, as these are generally the operations using mercury. When comparing the volumes of mercury imports by Bolivia and Brazil, it must be considered, as pointed out at the beginning of this study, that Brazilian imports are low, lower than the estimated demand in the country, and therefore indicate a deficit. The comparison is still interesting, as it corroborates the regional discrepancies.

17 See the article from the Federal Prosecution Service in São Paulo "Após denúncia do MPF, 10 pessoas tornam-se rés por comércio ilegal de mercúrio", from January 27, 2023, available at: <link>. See also the article by G1 "PF e Ibama veem indícios de que 'quase toda' mineração de ouro do Brasil utiliza mercúrio ilegal", from November 8, 2023, available at: <link>. See also the article by G1 RR "Mais de 100 kg de mercúrio são apreendidos pela Polícia Federal na fronteira do Brasil com a Guiana", from April 6, 2024, available at: <link>. See also the article by RD News "Mercúrio foi contrabandeado de pelo menos três continentes, aponta PF", from November 13, 2023, available at: <link>. All links accessed on: May 20, 2024.

18 Own analysis based on gold production data in Guyana between 2018 and 2022 and the participation of small and medium-sized operations published in the 2020 and 2023 annual reports of the Bank of Guyana. Available at: <link>. Accessed on: May 20, 2024.

The Minamata Convention

The Minamata Convention, signed in 2013 and effective in Brazil since 2017, is a global treaty aimed at protecting human health and the environment from deleterious mercury effects. According to the Convention, opening new mercury mines is prohibited, and existing ones must be closed by 2032. There are also deadlines for reducing and eliminating mercury in various products and processes. Regarding gold mining, Article 7 and Annex C establish that countries must present plans with objectives, strategies, and goals to reduce mercury use in the sector, and, if possible, eliminate its use. The Convention should review this goal, setting a clear deadline for a complete mercury phaseout in the sector, as was established for mercury mines, use of Hg in batteries, lamps, thermometers, etc. In Colombia, for example, mercury is proscribed since 2018[19].

19 Projeto Ouro Sem Mercúrio. O Plano de Ação Nacional. Available at: <link>. Accessed on: May 20, 2024.

Table 02.
Worldwide mercury exports and imports between 2018 and 2022 (in kilograms)

#	Top exporting countries	Total exports
1	Nigeria	1.913.653
2	Tajikistan	988.427
3	United Arab Emirates	889.824
4	Indonesia	888.359
5	Russia	501.254
6	China	176.678
7	Peru	176.121
8	India	175.883
9	Czech Republic	173.879
10	Japan	160.001
11	Turkey	136.680
12	Mexico	128.911
13	Brunei	120.860
14	Canada	106.369
15	Thailand	59.013
-	Others	294.064
-	Total	6.889.975

#	Top importing countries	Total imports
1	Switzerland	752.903
2	Bolivia	722.559
3	India	597.200
4	United Arab Emirates	401.552
5	Togo	378.927
6	China	330.382
7	South Africa	216.304
8	Israel	109.759
9	Turkey	104.645
10	Guyana	78.513
11	France	71.464
12	**Brazil**	68.750
13	Canada	68.467
14	Italy	65.975
15	Argentina	63.136
-	Others	679.589
-	Total	4.710.125

Source: analysis by the authors based on data from UN Comtrade[20]. Note: data reflects mercury exports and imports reported by each country in UN Comtrade. China did not report any operations during the analyzed period. Therefore, in this case, volumes reported by other countries for exports to China and imports from China were used.

20 UN COMTRADE. Available at: <link>. Data was retrieved on April 25, 2024, using the code HS 280540 - Mercury.

Table 03.
Mercury Imports by Brazil, by Country of Origin (in kilograms)

	2018	2019	2020	2021	2022	Total
Japan	15.008	20.114	12.386	0	15.008	62.516
Mexico	6.210	0	0	0	0	6.210
United States	0	1	0	0	8	9
Total	21.218	20.115	12.386	0	15.016	68.735

Source: analysis by the authors, based on Comex Stat data. Note: There are differences between the Comex Stat figures and UN Comtrade. This study always considers Comex Stat data for Brazil.

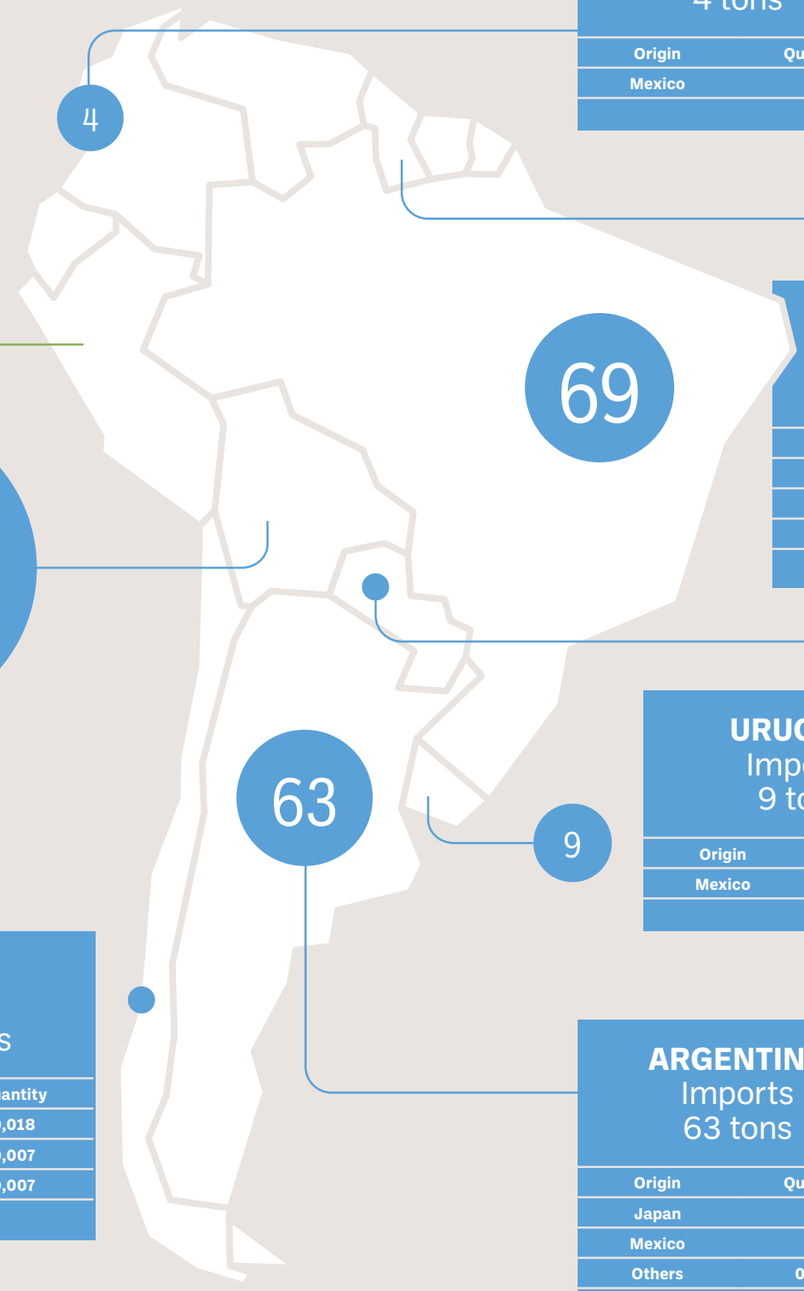
Table 04.
Mercury Imports by Brazil According to Database (in kilograms)

Imports	2018	2019	2020	2021	2022	Total
Registered on official foreign trade statistics	21.218	20.115	12.386	0	15.016	68.735
Authorized by Ibama	44.367	37.569	5.072	0	12.066	99.074

Source: analysis by the authors, based on data from Comex Stat and Ibama[21].

21 Data obtained from Ibama through a freedom of information request.

Graph 02.
South American mercury imports (blue) and exports (green) between 2018 and 2022 (in tons)



PERU
Exports
176 tons

Destination	Quantity
India	44
Netherlands	88
Switzerland	44

COLOMBIA
Imports
4 tons

Origin	Quantity
Mexico	4

GUYANA
Imports
79 tons

Origin	Quantity
India	42
China	11
Turkey	8
Russia	8
United Kingdom	6
USA	3
Vietnan	2

BRAZIL
Imports
69 tons

Origin	Quantity
Mexico	63
Japan	6
USA	0,009

BOLIVIA
Imports
723 tons

Origin	Quantity
Mexico	331
Russia	146
India	71
Tajikistan	50
Vietnam	36
Turkey	34
UAE	23
United Kingdom	10
China	9
Others	14

PARAGUAY
Imports
0.345 tons

Origin	Quantity
China	0,345

URUGUAY
Imports
9 tons

Origin	Quantity
Mexico	9

CHILE
Imports
0.032 tons

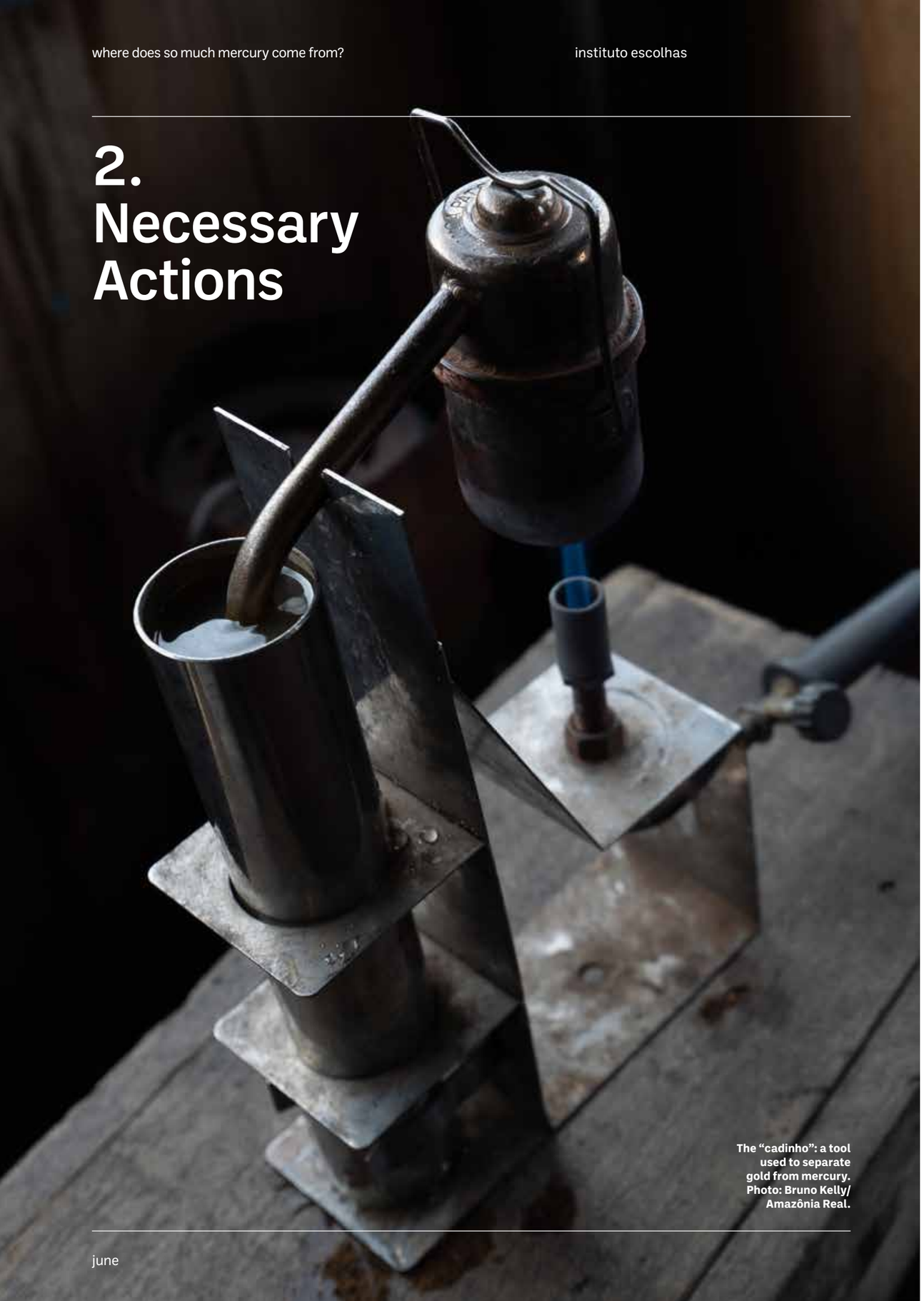
Origin	Quantity
Germany	0,018
USA	0,007
Others	0,007

ARGENTINA
Imports
63 tons

Origin	Quantity
Japan	51
Mexico	12
Others	0,146

Source: analysis by the authors based on UN Comtrade data. Note: Bolivia, Guyana, Brazil, Argentina, Uruguay, Colombia, Paraguay, and Chile only imported mercury during the period; without registering any exports. Peru, which exported 176 tons, also imported 15 tons. Venezuela, Ecuador, Suriname, and French Guiana did not report any exports or imports of mercury during the period.

2. Necessary Actions



The “cadinho”: a tool used to separate gold from mercury. Photo: Bruno Kelly/ Amazônia Real.

Given Brazil’s lack of control over mercury trade and use and the severe human contamination cases, it is urgent to adopt the following measures to eradicate mercury use and transform gold mining practices.

1. Establish the **eradication** of mercury use in Brazil. This will give the country a clear strategy, with a concrete goal and a deadline, to address the problem.

2. Engage other countries in the region for mercury eradication. This will prevent cross-border contamination and illegal trade. In Colombia, mercury has been banned since 2018[22].

3. Encourage, through training and regulations, the use of existing technologies and processes to replace mercury in gold mining. Using gravity, it is possible to obtain high-grade gold concentrates. To achieve this, improving crushers, mills, and sluice boxes and using centrifuges, shaking tables, pans, and magnets to clean gold concentrates is essential. These tools and techniques are often used without proper adjustments, harming gold recovery[23].

4. Promote research and development of new elements and processes to replace mercury in gold mining. An example is Embrapa’s research performed on balsa tree leaves, a native Amazonian tree that can serve this purpose[24]. Planting balsa trees can also be a good option for reforesting degraded mining areas.

5. Dedicate resources to law enforcement operations to combat illegal gold mining and ensure mining activities adopt measures to prevent mercury environmental releases and emissions.

22 Mercury use in Colombia was banned by Law 1658 in 2013, with a phaseout period that ended in 2018.

23 The United Nations Environment Programme (UNEP) developed the guide “Reducing Mercury Use In Artisanal And Small-Scale Gold Mining: A Practical Guide”, available at <link>. The guide explains the operation and importance of these devices for obtaining high-grade gold concentrates. These devices and practices are suited to the Brazilian context and are already widely used.

24 Read more on the article published by Embrapa “Pesquisa estuda folha da Amazônia para substituição do mercúrio na extração de ouro”, from May 23, 2023, available at: <link>. Accessed on: May 20, 2024.

Controls on Mercury Trade in Brazil

In Brazil, Ibama is the oversight agency for mercury trade and use. However, controls still need to be enhanced to combat the persisting illegality. Establishing a traceability system capable of monitoring all mercury sold and used in the country is crucial. In March 2024, Ibama released a proposal for public consultation regarding a new regulation for tis aim[25], which received contributions from Instituto Escolhas. Adopting this proposal as a definitive regulation is urgent, as it would strengthen controls on mercury trade including importation, exportation, recycling, recovery, use, and transportation. It also includes detailed registration and document requirements, such as the Metallic Mercury Operations Document (DOMM).
Learn more about the proposal and the contributions sent by Instituto Escolhas here (available only in Portuguese).

Mixture of gold and mercury obtained after extraction in the riverbed. Photo: Bruno Kelly/Amazônia Real.

25
IBAMA. Proposed Normative Instruction on controlling metallic mercury import, export, recycling, recovery, trade, use, and transportation. Public Consultation Process 02001.004821/2013-63. Available at: <link>. Accessed on: May 20, 2024.

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