

SURINAME

BY SOCIAL SOLUTIONS

Country/regional report series on the political ecology of mercury within the artisanal and small-scale gold sector

COORDINATED BY IUCN NL UNDER THE SHARED RESOURCES, JOINT SOLUTIONS (SRJS) PROGRAMME

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The political ecology of mercury within the small-scale gold sector.

Shared Resources Joined Solutions (SRJS)

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ABBREVIATIONS

ABS	<i>Algemeen Bureau voor de Statistiek</i> (General Bureau of Statistics)
Au	Gold (Symbol of chemical element)
ASM	Artisanal and Small-scale gold Mining
Br.	Brazil
DC	District Commissioner
FG	French Guiana
Hg	Mercury (symbol of chemical element)
EPA	Environmental Protection Agency
HBM	Human Bio Monitoring
IADB	Inter-American Development Bank
IUD	<i>Dienst Invoer, Uitvoer en Doorvoer</i> (Department for Import, Export and Transit Licenses)
IUCN	International Union for Conservation of Nature
KAP	Knowledge Attitude Practices
Kg	Kilogram
KPS	<i>Korps Politie Suriname</i> (Suriname Police Corps)
NIMOS	<i>Nationaal Instituut voor Milieu en Ontwikkeling Suriname</i> (National Institute for Environment and Development Suriname)
OEC	Observatory of Economic Complexity
PME	Small and middle size enterprises (<i>Petites et Moyennes Enterprises</i>)
SGA	Small for Gestational Age
SRJS	Shared Resources Joined Solutions
T	Ton (1000 Kg)
USA	United States of America
USD	US Dollar
WHO	World Health Organisation

GLOSSARY OF TERMS

Term	Definition
Batea	Gold pan
District	Administrative Unit, comparable with a province. Each district has its own district government with limited powers of decision-making, headed by a District Commissioner (DC).
Flask	British unit of weight, used to measure mercury. It is defined as 76 lb (34.47 Kg). Near room temperature, a flask of mercury occupies a volume of approximately 2.5471 litres.
Garimpeiro	Brazilian small-scale gold miner
Maroons	Tribal people of African descent; the descendants of persons who escaped slavery, and established independent tribal communities in the forested interior of Suriname.
Minamata Convention on Mercury	The Minamata Convention on Mercury is a multilateral environmental agreement that addresses specific human activities which are contributing to widespread mercury pollution, such as mercury mining, the use of mercury in production processing, and mercury trade. The Minamata Convention entered into force in August 2017.

Figure 1. Suriname country map with districts



Table 1. Suriname Facts and Figures

Indicator	Value ¹
Land area	163,820 km ² (ABS, 2018)
Total population, 2016 estimate	575,700 (ABS, 2018)
Economy	
GDP (current SRD), 2016 figure	SRD 20,420 Mln (ABS, 2018) (USD 3,299 Mln)
GDP growth, annual, 2016 figure	-5.1 % (World Bank, 2018)
Per capita National Income, 2016 figure in SRD and USD	SRD 34,245 (ABS, 2018) (USD 5,532)
% of population living in poverty, 2016 data	26.2%, (IADB, 2018)
Hourly minimum wage	SRD 8.40 (USD 1.12), since July 1, 2018
Unemployment rate, relaxed definition. 2016	15% (ABS, 2018)
Annual remittances flow to Suriname	114 million (Multilateral Investment Fund, 2012)
Extractive industries	
Minerals mined	Gold and construction materials; diamonds on a very small scale
Large-scale gold mining firms	2 (Newmont, Iam Gold)
Est. # of Artisanal and Small-scale gold Miners (ASM).	12-15 thousand, including service providers (Heemskerk et al., 2016)
National gold production, 2014	30 tons (Central Bank of Suriname, 2016)
Government mining revenue in % of GDP	6,2%
ASM gold production as a percentage of total gold production, 2014	65.4% (Central Bank of Suriname, 2016)
Mercury	
Amount of mercury officially imported per year, 2006-2019	0 kg
Status Minamata Convention	Ratified August 2018

¹ For SRD to USD conversions, an average rate of 6.19 was used for 2016; 7.5 SRD to 1 USD was used for 2018.

SUMMARY

This report analyses the gold mining-related mercury marketing chain in Suriname, describing the legal context, institutional roles and responsibilities, trading routes, the use of mercury in the artisanal and small-scale gold mining (ASM) sector, and related health and environmental impacts.

Current national legislation regarding import, use, export and handling of mercury is inadequate. There is a restriction on mercury import, which is subject to authorization. Given that in the period 2004-present (mid 2019) no authorization for import has been extended, it can be concluded that all mercury used in ASM is being smuggled to Suriname. By extension, mercury trade within Suriname occurs outside of legal chains of custody. The labour law states that employees may not be exposed to “harmful gasses and fumes”. To date, employee compensation for illness caused by working with mercury has never occurred, and no firms have ever been penalized for exposing employees to mercury vapour.

Responsibility for control on compliance with laws on mercury import and transportation lies with the Suriname Police Corps (KPS), the Coast Guard Authority Suriname, and the Suriname Customs department. None of these authorities specifically focusses on mercury smuggle, but they seize mercury if it is encountered during control on contraband. Since its establishment in 2013, the Coast Guard never encountered mercury during control of vessels at sea. Neither has the customs department intercepted any mercury in freight containers or luggage at main entry points (harbours, border posts, international airport) in past years. The most recent report of a mercury find by the police dates from 2014, when two flasks were found in Nickerie district. Key informant interviews and national media suggest that corruption affects the level of control on contraband, as well as actions taken when encountering it smuggled goods. Suriname’s ratification of the Minamata Convention in 2018 has had no immediate consequences for the Suriname mercury market and mercury use. Validation of the Minamata Initial Assessment (MIA) and completion of the National Action Plan (NAP) will inform future Suriname policy on mercury.

Virtually all ASM miners use mercury to extract gold from the ore. In 2016, it was estimated ASM operations in Suriname applied mercury to gold in a ratio of 3.3:1. Using this figure, 2018 mercury emissions in Suriname are estimated at 56 T Hg/yr, with a minimum of 17 T Hg/Yr. In ASM operations, the equipment owner decides how much mercury is used, when it is applied, and how the amalgam will be burned. Gold mining induced mercury contamination has been found to affect fresh water ecosystems, including fish. Elevated levels of mercury have been found in hair, urine, and blood of interior populations, especially among Indigenous peoples who consume much fish. Possible neurological and developmental effects have not yet been systematically researched.

Mercury enters Suriname (in part or all) from neighbouring Guyana; mostly over land and water. Mercury is mostly smuggled from Guyana by individual small informal traders, who buy flasks or plastic bottles with mercury either just across the border Guyana or in the border district of Nickerie. These persons resell the mercury in smaller amounts in the Paramaribo neighbourhoods where gold miners buy their supplies. Most gold miners buy mercury in Paramaribo, though some gold miners go to Guyana

themselves. A second probable source of elementary mercury used in ASM is China. In this case, mercury enters Suriname in containers that bring other merchandise, for example mining equipment. Several respondents mentioned the involvement of influential Chinese businessmen in smuggle of mercury from China, but none has ever been intercepted in the Suriname harbour. Both in Paramaribo and in the gold fields in the interior, Chinese shops that cater to ASM miners sell mercury.

In the past ten years, Suriname formally exported mercury to the Netherlands (2010) and to the US (2016). It is likely that these shipments represented (in part) mercury that was mined as a by-product during bauxite mining. Gold shops resell minor amounts of mercury that are recaptured when they clean the gold that is offered for sale. The gold mint house Kaloti, where ASM gold is calibrated prior to export, does not encounter visual mercury in its filters. This firm harbours the only location in Suriname where mercury can be safely stored. Gold mining multinationals in Suriname reported not recovering any elemental mercury during their operations. Elementary mercury does leave Suriname informally though, when it is smuggled to French Guiana by migrant (mostly Brazilian) gold miners who work in French Guiana.

It is concluded that despite legal restrictions, smuggling mercury into Suriname, and trading and using it in the country's ASM sector, is rather easy and not actively tracked down and persecuted by law enforcement. In the context of Suriname's economic recession, a tough stance on mercury trade and use would affect the livelihoods of many families who depend on ASM for their incomes, including both some of the most marginalized and some of the wealthiest population segments. Given Suriname's accession to the Minamata Convention and increasing global restrictions on mercury trade, a suitable alternative for ASM miners is direly needed.

Recommended actions for IUCN NL include support for more systematic measurement of mercury vapours in Paramaribo, in order to mobilize urban populations in efforts to ban mercury. In addition, the organization may contribute by supporting existing initiatives aimed at promoting the use of Hg-free techniques in ASM operations.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND AND OBJECTIVE

This report describes the results of a study on the gold related mercury value chain in Suriname. In 2018, Suriname's Level II mercury inventory established that 97 percent of mercury releases in water, in the air, and on land in Suriname can be attributed to primary metal production (Quik and Sabajo, 2018). The individual mercury release sub-categories contributing with the highest mercury releases to the atmosphere were, using the UN mercury inventory categories:

1. Gold and silver extraction with mercury-amalgamation processing (89%). In the Suriname context, this category refers to Artisanal and Small-scale Gold Mining (ASM).
2. Informal waste burning and Informal dumping of general waste (6%)
3. Gold extraction and initial processing by other processes than mercury amalgamation (3%)

The individual mercury release sub-categories contributing with the highest inputs of new mercury were

1. Gold and silver extraction with mercury-amalgamation processing (70%). In the Suriname context this category refers to Artisanal and Small-scale Gold Mining (ASM).
2. Gold extraction and initial processing by other processes than mercury amalgamation (27%).

As the above data indicate, the number one category of mercury input and mercury releases in Suriname is ASM. Since the early 1990s, Suriname is experiencing a gold mining boom which exceeds earlier gold mining activities in this country not only in the number of people involved and amount of gold produced, but also in its impacts on the natural environment, communities, and public health. In Suriname, a large share of the gold is extracted by informal small-scale gold miners. An estimated 10-15 thousand persons directly earn a living in the small-scale gold mining sector, and many more indirectly depend on small-scale gold mining for their livelihoods (Heemskerk et al, 2016). While sustaining many, often poor families, small-scale gold mining also has harmful impacts on the natural environment and peoples health, among others due to miners' use of mercury. Mercury amalgamates with gold, and its use to extract gold is easy, cheap, and effective. In 2016, it was estimated that Suriname small-scale gold mining operations released annual mercury emissions of 63.0 T Hg/yr. (Heemskerk et al., 2016).

This study was commissioned by the IUCN National Committee of the Netherlands (IUCN NL) as part of its Shared Resources Joined Solutions (SRJS) program, and in line with commitments under the Dutch International Responsible Business Conduct agreement for the gold sector. IUCN NL poses that for mercury elimination from our ecosystems, it is crucial to know who drives the trade and how. Hence, the main objective of this study is to realize a detailed description of the mercury value chain in Suriname. The specific objectives are to identify:

- Local drivers of the mercury trade in Suriname
- Local social and environmental impacts resulting from mercury trade and use
- Entrance points of mercury

- Policy pitfalls that facilitate mercury trade and use

This research will fit tightly with the SRJS mission of strengthening the lobby and advocacy capacities for mainstreaming an ecosystems approach to development scenarios. A comparable study is being executed in neighbouring Guyana.

This study also closely links with current activities of the National Institute for Environment and Development in Suriname (NIMOS) in relation to Suriname's recent accession to the Minamata Convention. Among others, NIMOS is currently developing Suriname's Minamata Initial Assessment (MIA) and the National Action Plan (NAP). By providing a better understanding of the trade in mercury, the data presented in this report can contribute these planning documents that will lay down Suriname's national policy vis-à-vis mercury in coming years.

1.2 METHODOLOGY

Given that the import of mercury into Suriname takes place in the illegal sphere, specific and reliable data on mercury trade in Suriname is scarce, and exact numeric figures on quantities are impossible to obtain. Information was collected through a combination of literature review and qualitative stakeholder interviews, as described below.

1.2.1 Review of existing data

A desktop review was carried out including academic studies, government and research reports and website articles. The documents helped to get a better understanding of the trade of mercury worldwide and the regulatory framework. The researchers conducted several previous studies in small-scale gold mining areas, and already were familiar with details about use and impact of mercury use in Suriname. Results from these previous studies² were used to describe mercury use in the mining areas, and the health and environmental impacts of mercury use in Suriname. All sources are presented in the reference list.

1.2.2 Stakeholder interviews

Because of the sensitive character of the topic, little details on the trade of mercury were described in literature. To complete and update findings, interviews with open-ended questions were conducted with stakeholders. The content and length of the interview depended on the type and background of the respondent. Interviews focused on the route of mercury into the country, the route within the country, the quantities and types of mercury imported, transported and sold, characteristics of players in the chain.

Two different sets of stakeholders were interviewed. In the first place, the researchers approached government officials who could have knowledge of the mercury marketing chain because of their function. These persons were primarily government officials, and included the representative of the Police Corps Suriname (KPS), the coast guard, and customs. A list of consulted government stakeholders is presented in Annex 1.

² These studies are available from the Social Solutions website: www.social-solutions.net

Secondly, we interviewed persons who were personally involved in the use or marketing of mercury. These people included traders in Suriname and Guyana, middlemen, and gold miners. These persons were interviewed on the basis of anonymity, and we do not reveal their names in this report.

1.3 REPORT OUTLINE

The remainder of this report is structured as follows.

- Chapter 2: Relevant Suriname legal and regulatory framework
- Chapter 3: Description of mercury use in the Suriname gold sector and related circulation of mercury within Suriname
- Chapter 4: Environmental and health effects of mercury use in Suriname
- Chapter 5: Bringing mercury to Suriname
- Chapter 6: Mercury leaving Suriname to elsewhere
- Chapter 7: Conclusions: the mercury marketing chain

2 LEGAL AND INSTITUTIONAL FRAMEWORK

A recent Government of Suriname (GoS) inventory report of mercury releases reports that: “In Suriname, ... current legislation regarding use, import, export and handling of mercury is non-existent and a comprehensive law needs to be developed to address this” (Office of the President of the Republic of Suriname, Coordination Environment, 2016). A draft State Decree (*Staatsbesluit*) to regulate mercury was formulated some years ago, but has been put on hold for unknown reasons³. The NIMOS Minamata Advisory Document (2014) provides a full overview of Suriname legal instruments related to mercury import, export, and use, as well as production processes where mercury may be released (e.g. gold buying houses). These laws and regulations are summarized in this chapter.

2.1 LAWS AND REGULATIONS ON MERCURY IMPORT, TRADE AND TRANSPORT⁴

2.1.1 Legal instruments

Internationally, much has changed in recent years with regard to import, export, trade and use of mercury and mercury components. The European Mercury regulation, which entered into application on January 1st, 2018⁵, poses strong restrictions on mercury import, export, trade and use. In its footsteps, EU member states brought their own legislation in line with the European regulations. Historically, a significant share of both commercial and private mercury shipments to Suriname arrived from the Netherlands. Yet by January 1, 1999, in the Netherlands, the production of, import of, trade in, and use of products containing mercury was forbidden, with some exceptions for primarily measurement instruments for which there was no feasible alternative. This law was amended in January 2019⁶, with further restrictions.

In Suriname, few legal instruments explicitly apply to the export, trade and use of mercury, but there is a restriction on its import. In January 2003, the Ministry of Trade and Industry (the current Ministry of Trade, Industry and Tourism) placed mercury on the list of items for which a special license is required in case of import (Decree Negative List 2003), as part of the law on the transportation of goods (*Wet Goederenverkeer; S.B. 2003 no. 58*)⁷. The reason for placing mercury on this list was the protection of

³ G. Griffith, legal advisor, Office of Environmental Legal Services, NIMOS. Pers. com. 25/03/2019 (per e-mail)

⁴ Adopted from Heemskerk et al., 2016

⁵ The new EU Regulation (EU) No. 2017/852 on mercury and mercury compounds complements the export ban on mercury (preexisting in the repealed Regulation (EC) No. 1102/2008), by strict conditions on import, by phasing out various products and industrial process, by (quasi) banning the use the dental amalgam for the children (and pregnant women) and by imposing strict management rules on the storage and on the mercury waste (including their traceability). Art. 3 and 4 of the new EU regulation concern restrictions of mercury exports and imports.

⁶ Besluit van 31 januari 2019, tot wijziging van het Besluit kwik en kwikhoudende producten milieubeheer, het Besluit stortplaatsen en stortverboden afvalstoffen, en het Activiteitenbesluit milieubeheer ter uitvoering van Verordening (EU) nr. 2017/852 van het Europees Parlement en de Raad van 17 mei 2017 betreffende kwik, en tot intrekking van Verordening (EG) nr. 1102/2008 (PbEU 2017, L 137)

⁷ Besluit Negatieve Lijst (S.B. 1999 no. 34, z.l.g. bij S.B.2006 no. 20); see also Wet Goederenverkeer (S.B. 2003 no. 58 z.l.g. bij S.B. 2004 no. 121).

public health. The Department for Import, Export and Transit Licenses (*Dienst Invoer, Uitvoer en Doorvoer* - IUD) of the Ministry of Trade, Industry and Tourism (HI&T) is responsible for providing the certificate. Since that date, no licenses for mercury import have been issued (Heemskerk and Duijves, 2014). A representative from the Ministry of HI&T indicated that according to their customs system no mercury has been imported in the period 2004-2018 and that they had not received reports on the import of mercury⁸.

This implies that all mercury entering Suriname from abroad enters the country illegally⁹.

Other than the *Besluit Negatieve Lijst*, there are no legal instruments that specifically mention mercury. For example, the Suriname legal framework contains no regulations about the sale of mercury. The criminal code dictates that it is punishable to “sell, offer for sale, deliver or hand out goods, knowing that these goods are harmful to life or health, while omitting to mention their harmful character...” (*Wetboek van Strafrecht, Art. 226*). The criminal code also stipulates that it is unlawful to be responsible for “the sale, delivery or handing out of goods that are harmful for life or health, without the buyer or recipient being aware of the harmful character ...” (*Wetboek van Strafrecht, Art. 227*). From the above it appears that someone who transports or carries with him behaves within the boundaries of the law¹⁰. However, trading mercury within Suriname is only allowed if this mercury entered the country legally (i.e. the chain of custody is clear). Given that no mercury entered the country legally in the past decade, trading mercury within Suriname is illegal¹¹.

2.1.2 Institutional responsibilities

Responsibility for control on compliance with the laws lies with the Suriname Police Corps (*Korps Politie Suriname* – KPS), Coast Guard Authority Suriname (*Kustwachtautoriteit Suriname*) and the Suriname Customs department (*Douane Suriname*).

Suriname Police Corps

The KPS operates at control posts/check points on main roads to control documents (insurance, drivers' license, nationality and residency status) and prevent smuggle and transport of illegal goods at the following locations (Figure 2):

- Burnside, West from Paramaribo, along the road from Nickerie (border with Guyana) to Paramaribo.
- Stolkertsijver, East from Paramaribo, along the road from Paramaribo to Albina (border with French Guiana).
- Klaaskreek, South from Paramaribo, along the road to most interior mining locations that are accessible by road.

⁸ G. Griffith, legal officer, NIMOS. Pers. com., 13 March 2019.

⁹ J. Renfurm, Project Manager Ministry of Trade, Industry and Tourism. Pers. com., 17 March 2019

¹⁰ G. Griffith, legal advisor, Office of Environmental Legal Services, NIMOS. Pers. com. 25 March 2019 (per e-mail).

¹¹ Ibid.

The Burnside checkpoint that controls the main road from Nickerie to Paramaribo and vice versa has not seized any mercury in the past five years, according to the Chief Inspector of Police¹². As of December 2018 the task of the policemen at Burnside is to check all vehicles and trucks and to search all hand baggage. In practice, witness accounts suggest that vehicle inspection is not applied to all passing cars, and not all luggage is checked.

Large containers that are officially sealed will not be checked by the police at Burnside, as they are not allowed to break the seal. Controlling these containers is the responsibility of customs agents at the port where the containers enter, or from where they leave. A source at the customs department reported that in the past 1 ½ years, customs agents have not found any mercury during checks of containers¹³. However, it was also acknowledged that the agents do not actively search for mercury (ibid.). An anonymous KPS official reported that corruption in the customs department also plays, or used to play, a role in allowing containers to enter or leave the country unchecked. A recent newspaper article confirms that corruption in the customs department is deeply rooted (Cairo, 2018¹⁴).

All consulted gold miners reported that the police at the other two check points, Stolkertsijver and Klaaskreek hardly control on illegal goods, but are more focused on migrants who do not have a residence permit. According to their accounts, if the police see foreigners (e.g. Brazilians), they will check whether they are legal in the country. Those who are not legal typically pay a “fee” (bribe), ranging from SRD 100 (USD 13) up to SRD 500 (USD 67) per person, as one Brazilian explained: “There is no fixed price”. After payment they are sent through. Other individuals working in the gold sector, as well as a consulted police official (anonymous), confirmed that some policemen at the check points accept payment to let people pass. Recent media reporting cites cases wherein police officers at the check points of Stolkertsijver¹⁵ and Burnside¹⁶ have been found to ask for or accept bribes.

Just like at Burnside, it is very uncommon that police agents at the Klaaskreek control post check the luggage for mercury or other illegal substances. A retired official from the Geology and Mining

¹² R. Forster, chief inspector KPS region West. Pers. Com., 12 April 2019.

¹³ Mr. Profijt, Chief Recherche, Customs Department Suriname

¹⁴ Newspaper article De Ware Tijd, 25/12/2018. Available at: <http://www.dwtonline.com/paramaribo-post/2018/12/25/corruptie-bij-douane-diepgeworteld/>

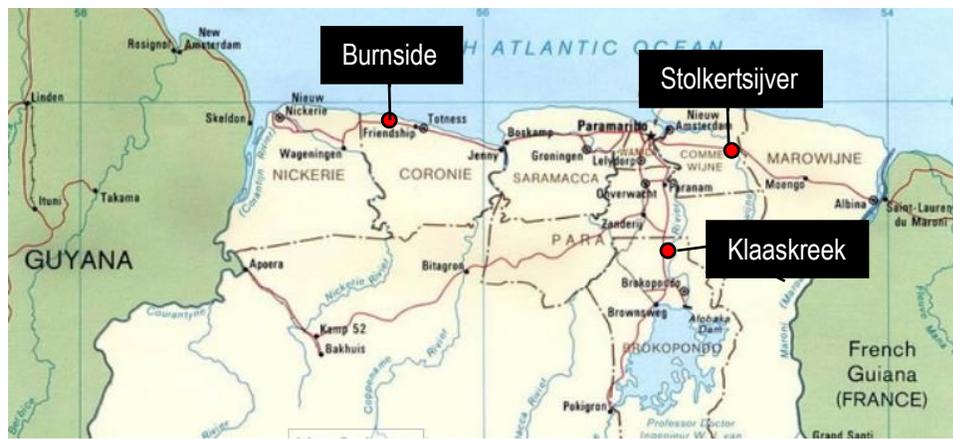
¹⁵ For example: Dagblad Suriname, Friday October 5th, “Politie Suriname neemt 5 kilo cocaïne en Euro 3.000 als zwijggeld”; available at: <https://suriname-mirror.blogspot.com/2018/10/politie-stolkertsijver-accepteert-5.html>

Starnieuws 10 October 2018, “Tweede politieman aangehouden in drugszaak Fransman” available at: <http://www.starnieuws.com/index.php/welcome/index/nieuwsitem/49316>

¹⁶ Radio 10, 19 February 2019: “<http://www.radio10.sr/nieuws/doorlichting-politiecontrole-post-burnside-nog-op-schema/83776>”.

Department (GMD) noted: ““We [Suriname] do not worry about mercury There is not targeted control for mercury, and on who carry it with them.”

Figure 2. Map of North Suriname with police road check points



In general there is no specific focus on the combat of mercury smuggle and transportation. The chief inspector of Region West stated that the police “searches for everything”. Besides the checkpoint at Burnside they use incidental road blocks and planned traffic controls as detection methods. According to the administration of KPS region West, one interception of mercury was done in 2014, when two flasks were found in Nieuw Nickerie. In addition to these two flasks, another four confiscated flasks have been stored at the Nieuw Nickerie police station for many years, though it is unclear when exactly those were confiscated. The Police Commander for region West reported that NIMOS visited the police station in 2016 and promised to take care of the mercury. No further action has been undertaken by the police since then. A NIMOS representative though, explained that the Police Commander at the time had been advised to bring the flasks to Kaloti, which is the only location in Suriname with a room specifically for mercury storage¹⁷. Upon request of NIMOS, Kaloti has indicated willingness to store this mercury, until proper procedures to get rid of it have been identified. NIMOS is quite concerned about the storage of this mercury at the police station, as it is unclear how and where it is stored, and if there is an active human health hazard.

Coast Guard Authority Suriname

The Coast Guard Authority Suriname was established by the government in 2013 and has the mission to prevent, detect and act in emergency situations and against undesirable behaviour. The Coast Guard executes daily control of vessels at sea, including smaller fishing vessels and trawlers, to check for

¹⁷ G. Griffith, legal advisor of NIMOS. Pers. com., 14/05/20019

contraband¹⁸. Within its working area, the Coast Guard never encountered mercury among contraband. In the case that it would be encountered, and is on its way to a Suriname harbour, it will be confiscated¹⁹.

Customs

Customs falls under the Active Service of Taxes (*Actieve Dienst der Belastingen*) of the Ministry of Finance and is the organization that in general is responsible for checking the correct levying of duties on import, export, and transit of goods in Suriname. Customs is active at border posts and at other inspection points where people and entities are checked on the possession of illegal goods and substances. There is no border post at the landing in Nieuw Nickerie, where people take a small boat to travel to Guyana (the backtrack route). When arriving in Guyana passengers are subject to baggage and passport control, but the Guyanese border control staff do not necessarily stamp passports²⁰.

According to a representative of Customs, no mercury has been intercepted in the past 1.5 years²¹. There is also no active search for mercury.

At the local airport Zorg en Hoop, where the flights from Guyana arrive, and from where one flies to the gold mining areas further in the interior, the authorities seldom check for prohibited items. Flying to the interior, people working in the gold business typically take only small quantities of mercury, which are hidden, for example in a bag of rice or other supplies. But, conveyed a Brazilian respondent, even if they would check and find something, you would have no problem getting it through: “Everything passes with money”.

2.2 LAWS AND REGULATIONS ON MERCURY USE

Suriname does not have an umbrella Environmental Law. Environmental regulation is fragmented and specified per (economic or public) sector. A draft Environmental Law was presented to the Council of Ministers in 2002, but has never been adopted and has been revised numerous times since. In January 2019, the draft Environmental Framework Law (*Ontwerp Milieu Raamwet*) was submitted to parliament. Once the Environmental Law has come into force, mercury and mercury compounds will legally labelled as ‘contaminants’, which means that a license will be required for its production, storage, transport and use²².

¹⁸ Container ships are not controlled at sea; only at the harbour.

¹⁹ Kol. J. Slijngard, director Coast Guard, 15/05/2019

²⁰ Policy of Guyanese customs was not researched. In practice Suriname passport holders can pass the border without an exit stamp from the Surinamese authorities.

²¹ Mr. Profijt, Chief of customs, Pers. com., 11 March 2019.

²² G. Griffith, legal advisor, Office of Environmental Legal Services, NIMOS. Pers. com. 25/03/2019 (per e-mail)

In the Mining Decree²³, the section on small-scale mining (Ch. VII) does not specify any regulations with regard to environmental and human health. For the mining sector in general, the Decree stipulates that mining must be carried out with “consideration for valid norms in terms of safety and health of employees specifically and of the community in general, as well as norms for the protection of ecosystems” but it does not define these norms. The 1986 Mining Decree also stipulates in Article 16.1 that upon terminating a mining right, “the right holder shall, to the approval of the Minister, execute all necessary measures in the interest of public safety [...] and protection of the environment”. When the right holder fails to execute such measures, the State has the right to execute such measures on cost of the right holder. To our knowledge, the State has never applied this Article. Mercury is not mentioned in this law. The above mentioned GoS report acknowledges that “... the Mining Decree, 1986 must be revised and updated with regulations put in place to reduce mercury releases and phase out mercury use in mining processes such as small-scale gold mining”.

The Hindrance Law²⁴ stipulates that a license is required for the establishment of a gold or silver shop. In most cases, the National Institute for Environment and Development (NIMPS) is asked for environmental-technical advice (NIMOS, 2014). NIMOS developed guidelines for gold and silver smiths, which are part of the advice provide to the District Commissioner’s (DC) office. The DC advises the government on whether or not establishment of this type of business is appropriate or acceptable at the proposed location. This advice is required for obtaining the license.

Like any other business, businesses that might expose employees to mercury (e.g. cement factory, goldsmith, gold buying house) must obtain a license from the Ministry of Trade, Industry and Tourism (HI&T), as stipulated in the Decree Licenses Firms and Occupations²⁵. The NIMOS guidelines for gold and silver smiths can be used as directive. The labour law states that employees may not be exposed to “harmful gasses and fumes”. Article 12 of the Labour Inspection Law stipulates²⁶ that work that endanger the health or safety of employees must be terminated immediately. The Occupational Accidents Regulation of 1947 (*Ongevallenregeling*)²⁷ names in Art. 24-25 under illnesses: “diseases caused by mercury or substances containing mercury, when these reveal themselves in employees in firms working with mercury or substances containing mercury”. In the case of such illness the employee must be compensated, unless this illness can be blamed on his or her misconduct. There are no cases of employees that have brought a case to Suriname court because of mercury-induced health risks, nor of any cases

²³ DECREET van 8 mei 1986, houdende algemene regelen omtrent de opsporing en ontginning van delfstoffen (Decreet Mijnbouw) (S.B. 1986 no. 28), S.B. 1997 no. 44.

²⁴ Hinderwet (G.B.1930 no. 64, laatstelijk gewijzigd bij S.B. 2001 no. 63)

²⁵ Decreet Vergunningen Bedrijven en Beroepen (S.B. 1981 no. 145, z.l.g. bij SB 2006 no. 64)

²⁶ Decreet Arbeidsinspectie (E35) (S.B. 1983 no.42);

²⁷ Ongevallenregeling. G.B. 1947 no. 45. WET van 10 September 1947, houdende vaststelling van de verplichting van de werkgever tot en van de aanspraken van de in bepaalde bedrijven door enig ongeval of enige beroepsziekte getroffen werknemer op schadeloosstelling (G.B. 1947 no. 45), gelijk zij luidt na de daarin aangebrachte wijzigingen bij G.B. 1949 no. 90, G.B. 1950 no. 62, S.B. 1975 no. 164d, S.B. 1980 no. 116, S.B. 1983 no. 8, S.B. 2001 no. 66.

where (an) employee(s) had been compensated for illness caused by working with mercury²⁸. The former Inspector General of the Medical Bureau of the Ministry of Labour brought forward that the lack of such cases is partly related to employees not being aware of their labour rights²⁹.

The Ministry of Labour maintains a database with all gold buying shops and executes control. Since 2011, all legal gold buying shops are obliged to use a wet scrubber to capture mercury vapour and since 2015, gold shops need to have two wet scrubbers. The Medical Bureau of the Ministry of Labour is responsible for monitoring safe and healthy working conditions. This Bureau possesses an instrument to measure mercury vapours (e.g. in gold shops). Up to 2016, the Medical Bureau has been taking sample measurements inside the shops, with the measurement instruments calibrated to reflect the work location norm. Due to a lack of resources, however, this program has been discontinued³⁰.

Prior to execution of systematic measurements in gold shops, the representative of the Medical Bureau had worked with these shops to help them improve their safety standards with regard to mercury contamination. Among others, it was established that the working room where gold is burned must be separate from the room where clients enter, and that employees only walk in one direction.

In the various years that measurements have been taken, the Medical Bureau found only one case of a gold shop where mercury vapour values exceeded the norm for a safe working environment. The owner of this shop was requested to make certain adaptations, but even with these changes, the measurements mercury vapour remained too high. The Medical Bureau advised the District Commissioner to close this shop, but that did not happen³¹. Informed sources suggest that the owner of the shop is a very influential person in the Chinese community, and that this fact may have affected the lack of follow-up on the negative advice.

2.3 STATUS OF THE MINAMATA CONVENTION

In 2013, the National Institute for Environment and Development in Suriname (NIMOS) started a process to advise the government with regard to signature and ratification of the Minamata Convention on Mercury. This process included stakeholder consultations and resulted in an advisory document and a roadmap with activities for the gradual elimination of mercury from Suriname. In the advisory document³², NIMOS identifies limitations to human and financial resources as among the main challenges in efforts to regulate, and gradually phase out, the use of mercury in the Artisanal and Small-scale Gold Mining sector.

²⁸ Mr. J. Courtar, former Inspector General of the Medical Bureau (on leave), pers. com. 15/05/2019

²⁹ Ibid.

³⁰ Ibid.

³¹ Ibid.

³² Advies document betreffende het Minamata verdrag (NIMOS, 2014)

On 30, May 2016, the legislative proposal to become a member of the Minamata Convention was approved by the council of Ministers. In that same year, in preparation for ratification of the Minamata Convention, the government of Suriname produced a report titled “Mercury release inventory, waste storage and disposal in the republic of Suriname” (Inventory Level I) (Van Ravenswaay/Office of the President of the Republic of Suriname-Coordination Environment, 2016). In 2018, a follow-up study, the National Inventory of Mercury Releases in the Republic of Suriname (Quik and Sabajo, 2018) was produced (Inventory Level II). This latter report used UNEP’s Toolkit for identification and quantification of mercury releases (Level II). Based on this methodology, it was estimated that 97 percent of estimated total mercury release in the Republic of Suriname are the result of primary (virgin) metal production.

On March 8, 2018 the legislative proposal concerning accession to Minamata was also approved by Parliament³³. On 2 August 2018, the Government of Suriname deposited its instrument of accession, thereby becoming the 95th Party to the Minamata Convention. National Focal Point for the Minamata Convention is the Ambassador at Large in charge of Environment at the Environmental Office of the Cabinet of the President (Mr. W. Lackin). The Focal Point for the purpose of exchange under article 17, paragraph 4, is the Acting General Director of NIMOS.

Ratification of the Minamata Convention has not had immediate consequences for the Suriname mercury market. At this moment, Suriname is working to complete all required instruments to start the process of phasing out mercury from its various applications. The country has completed and validated the Mercury Inventory level I (2016) and II (2018). NIMOS also has completed the Minamata Initial Assessment (MIA), which still needs to be validated, and is working on the National Action Plan (NAP), which will include a proposed timeline³⁴. Once these documents are validated, it will become clearer how and when the GoS plans to reduce and ultimately eliminate mercury use.

³³ Wet van 16 maart 2018, houdende ratificatie van het verdrag “Minamata Convention on Mercury”, Staatsblad van de Republiek Suriname, No 2018/30

³⁴ As per Article 7 of the Minamata Convention on Mercury, a Party that determines that Artisanal and Small-scale Gold Mining (ASM) and processing in its territory is more than insignificant is required amongst others to notify the Minamata Convention Secretariat and develop and implement a National Action Plan (NAP) in accordance with Annex C of the Convention.

3 ENTRY INTO SURINAME

There are several possible routes by which mercury could enter Suriname. This chapter discusses these various routes and their likely role in the Suriname trade in mercury.

3.1 GUYANA

All consulted stakeholders named Guyana as the primary, if not only, source of mercury used in Suriname. This route for the smuggle of mercury, among other merchandise, has been known for over ten years, reported a consulted police officer. The most common routes of import, according to those involved, are over land, over water, or a combination of these two.

3.1.1 Over land

Suriname cab drivers and others drive to Guyana to buy the mercury, but also Guyanese men and women bring it in. Mercury is bought either in flasks (2.55 l; 34.47 Kg) or in regular recycled 1-liter or 1.5-liter bottles.

In order to get mercury from Guyana to Suriname, it must cross the Corantijn River. One can either cross with the regular ferry, or take the backtrack route. The backtrack route is serviced by small boats. Traveling backtrack, one bypasses Suriname border control and customs agents. In February 2019, the Suriname Ministry of Justice and Police declared that by the end of March 2019, police, military and customs will be permanently present on the so-called Corantijn beach, where boats servicing the backtrack route moor. The goal of this initiative is to prevent transboundary criminal activity, including smuggling drugs, people, cigarettes, food items, and other illegal substances³⁵.

At present, the main control post to get from Guyana to Suriname is a check point at Burnside. Occasional newspaper articles report on mercury that have been seized at this post³⁶. However, these reports are scarce and according to the Chief Inspector responsible for the check point of Burnside, no seizures were reported since 2014. It is likely that most mercury passes this post undiscovered or unseized.

3.1.2 Travel by water

One respondent specifically referred to speed boats that bring mercury over sea from Guyana to Suriname. In support of this statement, a representative of the Police Corps reported that about ten years ago, a large supply of contraband coming from Guyana was encountered in the Calcutta Police Station, Saramacca district. This supply, which included a lot of mercury, had arrived here by boat from Guyana. The contraband had been transported along the coast, then entered the Jossi creek (Saramacca district) where it was brought to shore, and subsequently was waiting to be transported further to Paramaribo. During the investigation, it was discovered that large Schooner boats had been used to transport the contraband, which was later transferred to smaller fishing boats to be able to enter the creek. Twenty-

³⁵ Radio 10, January 2019. <http://www.radio10.sr/nieuws/controlepost-back-track-eind-maart-eeen-feit/83330>

³⁶ For example, newspaper reports on 10 April 2013 (35 Kg), 13 January 2013 (18 Kg), September 2015 (128 kg).

five persons were arrested, included eight policemen and eight military staff. The confiscated mercury was sealed, and ultimately the prosecution decided that it was to be sold by the police, at very low prices. We have no evidence of this route still being used by smugglers of mercury.

In front of the Suriname and Guyana coasts artisanal fishing vessels are active. The crew of the Suriname artisanal fishing fleet is dominated by Guyanese, and also many boat owners are Guyanese by origin. When asked about the possible involvement of fishing vessels in smuggle of mercury, the chair of the Fishers' Collective of Paramaribo and Commewijne reported that he had never heard about involvement of fishers in the transport of mercury. Also, there are not any news records of mercury seized from fishing vessels, or other proof of fishers/fishing vessels being involved in mercury smuggle.

A representative of the water police conveyed that in the past year, no mercury had been confiscated on the water. Moreover, there is no news reporting about the seizure of mercury on boats arriving from Guyana. We conclude that the transport of mercury from Guyana to Suriname by boat has occurred in the past, but we have no proof of current water transportation of mercury from Guyana.

3.1.3 Coming from Guyana by air

Transporting mercury by air is most likely not the preferred travel route, given its weight and the various places along the route where luggage may be checked. Nevertheless, an informant working for many years in the air travel business (anonymous), reported that mercury is smuggled in with the small airplanes on the Suriname Guyana route. These airplanes leave from, and land on the local airports. In Suriname, flights to the interior mining areas leave from this same local airport.

To support his argument, the respondent mentioned the corrosion encountered in the storage space of the airplanes flying on the Suriname-Guyana route. It is known that that the vapour pressure of metallic mercury even at low temperatures is sufficient to permit the mercury vapours to alloy with many commercial metals. This amalgamation of such metals can result in stress cracking or severe corrosion.

3.2 BRAZIL

3.2.1 Over land

There are three land routes from Brazil to Suriname. The first route is on foot, crossing the mountain ranges that form the border between Suriname and Brazil. Occasionally, we hear of Brazilians who enter Suriname this way. However, given the length and difficulty of traversing the rainforest by foot, and the weight of mercury, it is extremely unlikely that these *garimpeiros* carry mercury. This possibility is ruled out.

The other two routes from Brazil to Suriname over land, are either through Guyana or French Guiana. In Guyana, mercury is imported legally at larger quantities than are needed for the local small-scale gold mining market. This makes it unlikely that mercury is smuggled from Brazil to Guyana.

Garimpeiros regularly enter French Guiana from its eastern border, for example at the crossing of the Oyapock River between Oiapoque (Br.) and Saint Georges (FG). A recent inquiry found prices of mercury

in French Guiana small-scale gold mining sites ranging from 10 g Au/Kg Hg (Eau Claire) to 15 g Au/Kg Hg (Sikini Creek³⁷), the equivalent of approximately USD 350-525 per Kg of mercury³⁸. The high price in French Guiana reflects the high risks of illegal small-scale gold mining in French Guiana, where the gendarme burns every gold mining camp and destroys related equipment upon encounter. Given the substantial risks for gold miners traveling through French Guiana and the high price of mercury in French Guiana small-scale gold mines, it is unlikely that mercury is traded from Brazil, through French Guiana, to Suriname.

Another consideration is that on the Brazilian version of Mercado Livre, Latin America's most popular e-commerce site, mercury for small-scale gold mining (*azougue para garimpo*) sells for between USD 130 and USD 900 per Kg³⁹. This price is not competitive enough to justify the long travel and risk to smuggle mercury through Brazil, French Guiana/Guyana and Suriname.

Travel by air also can be ruled out, given the fact that this is an international flight with considerable control of luggage.

3.2.2 Over water

Brazilian schooners regularly travel between Brazil and Suriname (Paramaribo) with diverse loads. These schooners are widely known for two-way smuggle. Chinese clothing and electronics that have been imported in Suriname are smuggled to Brazil, and food products and cigarettes, among others, go from Brazil to Suriname.

A well-informed former mining officer from the Geology and mining Department, reported that there are well established Brazilian gold miners –who he knows in person- who own their own schooners. They use these vessels to bring mining supplies to Suriname. Hence, if people can get a competitive price for mercury in Brazil, it would be likely that they would bring mercury with their other supplies to Suriname.

A representative of the Maritime Police Paramaribo reported that the Maritime Police controls vessels in the Suriname River mouth, including Brazilian schooners, artisanal fishing boats, trawlers, and other fishing vessels (but not freight transportation vessels). In the past year, they have not encountered any mercury during these controls⁴⁰. For the preceding period, there has been news reporting on contraband being seized from Brazilian schooners, mostly cigarettes (most recent case March 15, 2019)⁴¹. However there is no single report on seizure of mercury on boats coming from Brazil. In other words, there is no hard evidence for smuggle of mercury over water from Brazil.

³⁷ This site depends on Brazil and Ilha bela for its logistics.

³⁸ F.M. Le Tourneau, geographer. Pers. com. 21/03/2019

³⁹ Website of Mercado Livre, consulted 21-03-2019.

⁴⁰ Representative Maritime Police Paramaribo, phone conversation, 14/03/2019

⁴¹ Suriname online news site: <http://www.starnieuws.com/index.php/welcome/index/nieuwsitem/51713>

3.3 CHINA

Different respondents eluded to China as a possible source country. China is among the world's biggest miners and consumers of mercury (Reuters, 2017), and mercury is relatively easy to obtain in this country⁴². One source reported as a fact the name of one specific large Chinese business man, who imports crates of mercury together with equipment and parts for the small-scale gold mining industry from China. The source suggested that this Chinese business man is very well connected with the political establishment, and hence his containers can enter without inspection. An informal seller of mercury from Guyana source lamented that that his sales have decreased because Chinese people offer mercury for a lower price.

A consulted police officer reported that mercury has never been intercepted on the route from China. But, he added, it is very likely that mercury enters Suriname this way, as “virtually all Chinese wholesalers pay off customs staff too not check everything”. He indicated that the route from China is very easy; the containers are delivered to the store or other place of final destination. There is evidence that other products are smuggled from China to Suriname, including, for example, medication. The Chinese business man mentioned above was the first to open a large Chinese store in the Benzdorp gold mining area, and later bought out competitors to establish a marketing imperium in that area. He also owns Chinese supermarkets in other mining areas. Given his position as key deliverer of products and equipment in ASM areas, it is very likely that mercury would be among those products.

A government official reported that the government has its eyes on this same Chinese business man for importing Jinchan⁴³, a Chinese gold ore dressing agent to be used for heap leaching). In different Suriname ASM areas, Chinese mining teams have been observed using this gold extraction method. .

It is less likely that mercury is smuggled from China to Suriname in planes, given the various stops and luggage checks along the way.

3.4 OTHER POSSIBLE PORTS OF ENTRY

3.4.1 The Netherlands

Thirty years ago, a study revealed that the Netherlands was the main supplier of mercury to the ASM sector in Brazil (Lacerda and Salomons, 1991). Moreover, UN Comtrade statistics suggest that the Netherlands have been a main supplier of mercury to Suriname between 1997 and 2004. Much has changed since that time though. Today, in the Netherlands, it is prohibited to manufacture, import or trade mercury and products containing mercury, including measuring instruments (e.g. thermometers

⁴² China will ban the production and trade of a range of products containing mercury by 2020, including thermometers and blood pressure monitors, and ban primary mercury mining by 2032 (Reuters, .

⁴³ The producer of JINCHAN gold ore dressing agent claims this this product allows for “Green Mine, Environmentally-friendly Gold Metallurgy”, but this claim is questionable. See its website at:

https://jinchan.en.ecplaza.net/products/jinchan-gold-ore-dressing-agentleaching-reagentsodium_4092507

and manometers), light sources and electronic products (e.g. switches). Products for which no comparable alternatives are available are excluded from this ban. The use of mercury and mercury compounds is not banned in laboratories or in manufacturing processes, for example. In 2017, the Netherlands imported 70.1 tonnes of mercury and mercury-added products, which in that year represented 5.4 percent of global mercury imports (OEC, 2018)⁴⁴. This mercury was mainly imported from Indonesia (79%) and Germany (20%). In that same year, the Netherlands exported 196 tonnes of mercury and mercury-added products, mainly to Germany (38%), the United Kingdom (5.6%) and Spain (5.2%). This mercury is typically traded in the form of fabricated products, and very little –if any- in the form of liquid mercury that would make it applicable to the ASM sector.

A consulted staff member of Integra Port Services (port handler) shared that long ago, they occasionally found mercury in shipments, but in recent years nothing has been encountered in shipments from around the world. In the past 20 years, one case was brought to court (2015, with appeal in 2019), of a person who had attempted to send mercury by air transport from the Netherlands, in paint containers, for his sister in Suriname⁴⁵. Given the substantial control at airports, especially on flights between Suriname and the Netherlands, it is unlikely that mercury is frequently sent by air. Furthermore, the ever stricter regulations on mercury and difficulty of obtaining liquid mercury in the Netherlands, make it not very likely that this product is currently sent in substantial quantities by sea freight.

3.4.2 Other European countries

A 2015 EU report on gold and mercury in the Guiana shield points at the EU as a possible source of mercury smuggled to Suriname (Veening et al., 2015). However, the report quotes no sources or evidence for this statement. Theoretically, it is possible the mercury comes to Suriname with mining equipment and many other items that are shipped from European countries to Suriname, but without evidence this is just speculation. Particularly given the 2018 ban on mercury exports from Europe, one would expect that those in need of mercury might as well get it just across the border in Guyana, where it is legally imported.

⁴⁴ https://atlas.media.mit.edu/en/visualize/tree_map/hs92/import/show/all/280540/2017/

⁴⁵ Search on court cases at rechtspraak.nl

4 MERCURY IN SURINAME'S SMALL-SCALE GOLD MINING SECTOR

4.1 SMALL-SCALE GOLD MINING IN SURINAME

In the 1990s, Artisanal and Small-scale gold Mining (ASM) became an attractive income generating activity for Maroons in East Suriname; the area that had been hit hardest by the interior war and hosts the country's gold deposits (Heemskerk, 2000). Around the same time, increasing numbers of Brazilian miners (*garimpeiros*), who were confronted with more stringent restrictions on small-scale gold mining in their own country, moved into Suriname (ibid.). Nowadays Brazilian *garimpeiros* and Maroons dominate the work force in the ASM sector (Heemskerk et al., 2016). The areas where they work include areas that Maroons, and to a lesser extent Indigenous peoples, consider as their traditional homelands, to which they claim customary rights. ASM has become the main source of income for a significant share of Maroon communities (and some Indigenous families) in especially East Suriname, but also causes environmental problems in these same, and neighbouring communities.

Nowadays most ASM takes place on legal mining concessions (Figure 4) but under illegal circumstances. In many cases, for example, title holders of an exploration or reconnaissance right allow ASM mining teams to work on their concession in exchange of a percentage share of their earnings (typically 10-12.5%), a practice that is not legally allowed without explicit permission from the Minister of Natural Resources and under specified conditions. Moreover, few concession title owners comply with the legal reporting requirements (NIMOS et al., 2017).

4.2 USE OF MERCURY IN SMALL-SCALE GOLD MINING

As in most of the greater Amazon region, the most common ASM processing methods involve the use of hydraulic equipment and sluicing (with or without excavator), sometimes with the addition of crushing, using hammer mills, to further increase gold liberation and recovery. Because mercury is not legally imported, it may be inferred that the use of mercury in ASM is not permitted. Nevertheless, during a 2014 survey among small-scale gold miners, virtually all gold miners (97.8%) admitted they used mercury in the mining process. There is no regular or consistent control on the possession or use of mercury in ASM areas.

Gold miners working with a crusher system typically place mercury in the "safe" (*brandkast*); a metal container with riffles attached after the crusher. In sluicing (Br: *chupadeira*) systems, mercury is added during different stages of the mining cycle. Moreover, a large share of gold miners use whole ore amalgamation, where mercury is applied to the unprocessed ore (71.2% in the 2014 study). This technique is renowned for low mercury efficiency and high losses to the surrounding environment. The use of mercury using different mining methods has been discussed extensively elsewhere (Heemskerk et al, 2016) and is graphically depicted in Figure 3.

Figure 3. ASM processing cycle for sluicing systems (red arrows) and milling systems (blue arrows), with the places when mercury is added (yellow arrows). Source: Heemskerk and Duijves, 2017.

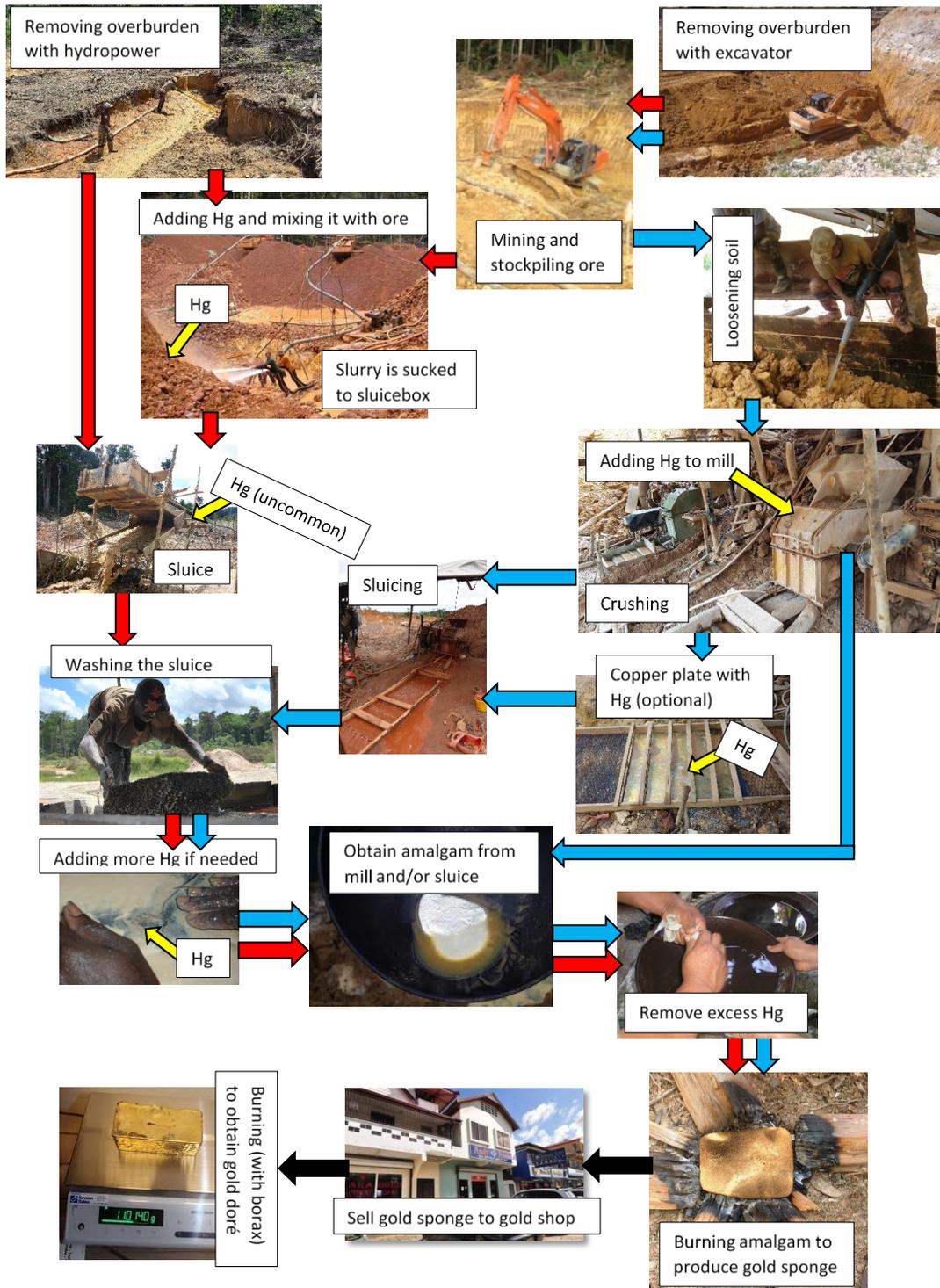
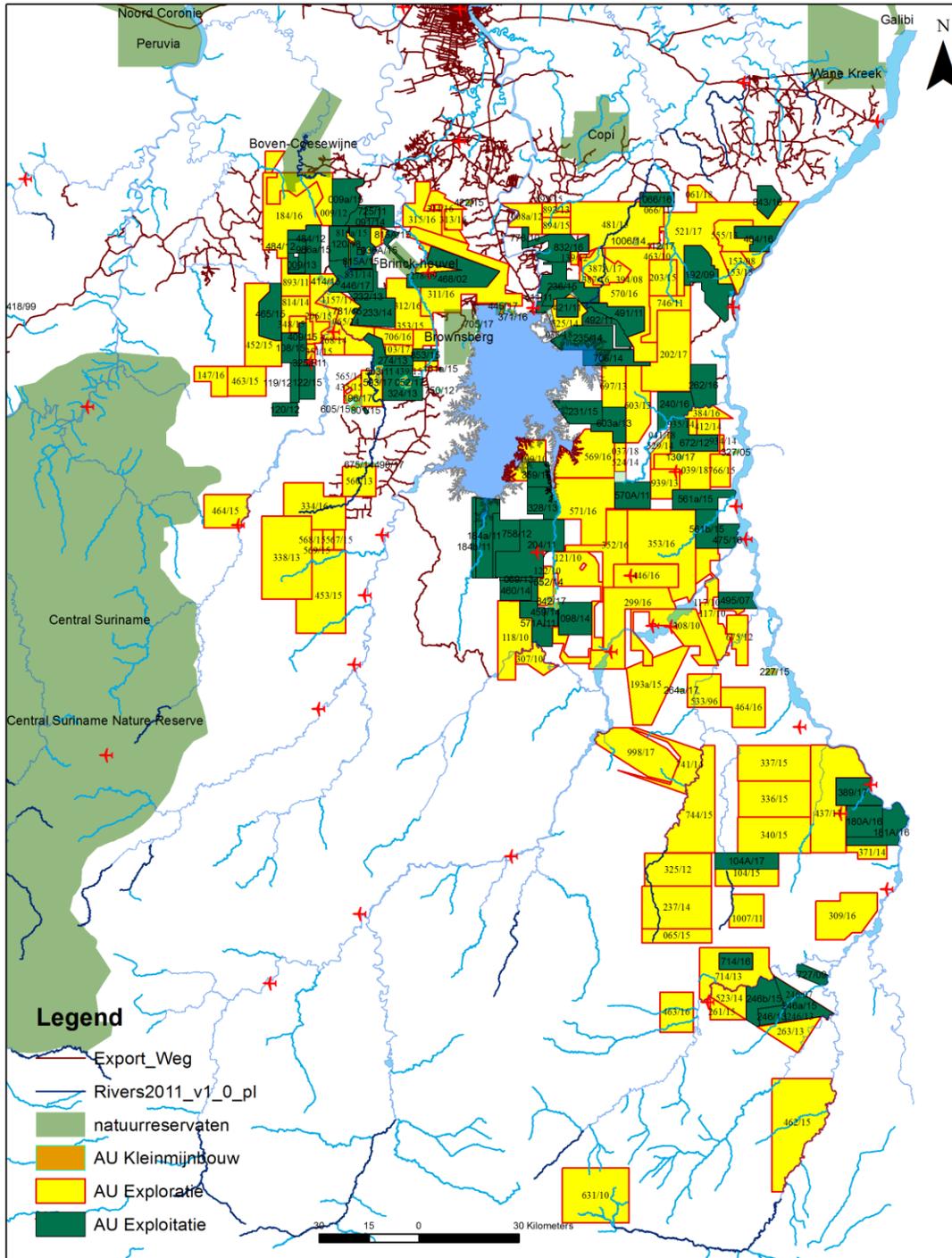


Figure 4. Map of gold exploration and exploitation concessions in East Suriname



Source: Geology and Mining Department, received by e-mail 10-08-2018

It is difficult to estimate how much mercury gold miners use and loose per Kg gold extracted because so many factors play a role in each individual processing case, including mining method, grain size (of the gold), characteristics of the ore, whether or not the place has been mined before, amount of recycling, and the personal experience and perceptions of the mine manager or boss.

Not all mercury used by small-scale miners is lost into the environment, because gold miners recapture mercury in different stages of the processing cycle (Heemskerk and Duijves, 2017) (Figure 3). Based on interviews with gold miners, Heemskerk et al. (2016) estimated the Hg: Au ratio for Suriname ASM at 3.3:1. That is, for every Kg of gold produced, an estimated 3.3 Kg of mercury is emitted into the natural environment. This estimate is in line with an earlier estimated Hg: Au ratio for the Guianas by Legg et al. (2015) of 3:1.

In 2016, we estimated annual mercury emissions in Suriname at 63 T Hg/yr. Details on the observations, measurements, assumptions and calculations on which this estimate was based are available in Heemskerk et al., 2016⁴⁶. This same amount (63 T Hg) would be the amount of mercury needed, and hence imported, in 2015 to produce the 2015 production figure of 18.9 T of Au for the ASM sector (Table 2).

Because the minimum amount of mercury needed to amalgamate gold is 1:1, the minimum amount of mercury used for the 2015 ASM gold production of 18.9 T would have been 18.9 T. This low-end estimate assumes no loss to environment during amalgamation, and 100% loss of Hg in the amalgam ball during burning. The 100% loss during burning is realistic as retorts are rarely used and amalgam is commonly burned in an open-air environment. Sometimes miners cover amalgam with leaves during burn to condense vapour, but the amount, if any, mercury recovered in the process is unknown. The assumption that no mercury is lost during the amalgamation process in the 1:1 ratio is not realistic, as many miners practice whole ore amalgamation in an unconfined system.

If we apply this same reasoning to the ASM production figures of the past five years, a minimum and likely estimate of the amount of mercury needed to produce Suriname's total annual gold production may be estimated as in Table 2 below. It is important to note that in this table, the listed production volumes for gold in the years 2016 to 2018 reflect the volume of gold mined by ASM, which has been exported by six legal gold exporters with a license from the Currency Committee (*Deviezencommissie*). These values may differ somewhat from actual ASM production values for different reasons. In the first place, many ASM miners who work in western French Guiana sell their gold in Suriname, so the figures will include French gold. Secondly, a small part of the gold mined by ASM is made into jewellery or hoarded, so it does not leave the country (and hence is not registered by the Currency Committee). Third, some gold may leave the country unregistered and hence also stays out of the national statistics. Despite these intervening

⁴⁶ Available at: <http://social-solutions.net/data/index.php/menu-styles/reports/90-publications/reports/152-study-on-the-knowledge-attitudes-and-practices-of-malaria-and-malaria-treatment-in-the-small-scale-gold-mining-sector-in-suriname-2016>

factors, the figures presented in table 2 are the best estimates of ASM gold production in Suriname, and we are confident that they are a rather accurate representation of real gold production.

Table 2. Annual production volume of gold in small-scale gold mining and estimated mercury used (and imported) between 2014 and 2018.

	2014	2015	2016	2017	2018
Approximate production volume ASM (Kg)	20,142	18,852	10,485	14,529	17,035
Minimum amount of mercury needed, in tonnes, with Hg:Au ratio of 1:1, 0% loss during mining and 100% loss during amalgamation (Tonnes)	20 T	19 T	10 T	15 T	17 T
Estimated mercury lost, with Hg:Au ratio of 3.3:1 and no recycling (Tonnes).	66 T	63 T	33 T	50 T	56 T

Source 2014-2015: Central Bank of Suriname ; Source 2016-2018: Deviezencommissie, pers. com. 23/05/2019

4.3 KNOWLEDGE OF MERCURY AMONG SMALL-SCALE GOLD MINERS

In recent years, different studies have assessed small-scale gold miners' knowledge about mercury and its potential health effects (Duijves and Heemskerk, 2014; Radboud UMC and MZ, 2017). A 2004 study in Suriname Maroon communities found that most interviewed Maroon gold miners (N=173) were reasonably aware of the general health risks of exposure to mercury; 83.7 percent could name behaviours that pose one at a risk for mercury poisoning (Heemskerk and Olivieira 2004). The largest share of miners (80.2%) knew that the mercury vapour that develops as a result of burning the mercury–gold amalgam is hazardous. Smaller numbers of Maroon gold miners knew that the consumption of polluted fish and skin contact with mercury also posed a health risk (resp. 48% and 24.5%).

On the other hand, interviewees were poorly informed about the types of fish and fish parts that contain the highest levels of mercury; about what happens to mercury once it has entered the human body; and about the clinical symptoms of mercury contamination. At the time, very few gold miners were aware of the existence of retorts to recycle mercury, or of methods to work without any mercury.

A 2014 mercury Knowledge, Attitudes and Practices (KAP) study among small-scale gold miners commissioned by the World Wildlife Fund showed that after one decade, very little had changed in terms of small-scale gold miners' general knowledge about mercury and its effects on human health (Duijves and Heemskerk, 2014).

4.4 ACQUISITION OF MERCURY BY GOLD MINERS

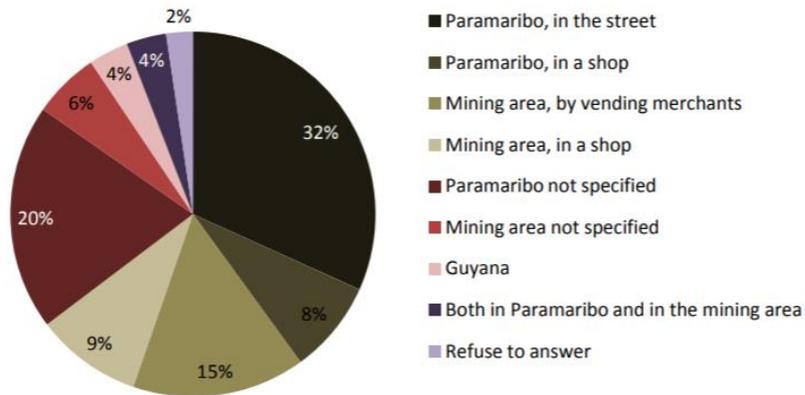
In the mining team, the boss or equipment owner (POR: *Dono de máquina*) is the person who owns the machines that are used for mining (e.g. excavator, pumps, hoses, mills etc.), and who decides where the operation will be set up, who takes all technical decisions, and who assigns tasks within the team. In the physical absence of the equipment owner, a manager may (temporarily) take over these tasks in his name. It also is the equipment owner who decides when, how, and how much mercury is applied. And he or she is the person who buys the mercury, or sends someone to buy it. This is logical because the equipment owner is responsible for all expenses of the team; the equipment, fuel, food, sleeping arrangements, satellite TV (or not) – and mercury. In return, the boss takes typically 70 to 80 percent of the earnings (depending on the technology), while the workers share the remaining 20-30 percent (Heemskerk and Duijves, 2017). With four to six workers on a team, each person earns 4-6 percent of the total earnings. This may seem like a small part of the pie, but the workers do not have any expenses and hence their financial risk is relatively small. They can come with just their clothes and a hammock, and will receive their daily meals, a place to sleep and –typically- a decent income.

All products needed for the mines, ranging from food to fuel, are much cheaper in Paramaribo than they are in the mining areas, where prices are double, triple, or even ten-fold the city prices. The amount of price inflation depends on the location of the mining area, and the relative ease and expense of getting there. Like other products, also mercury is usually bought in Paramaribo, in the streets (Heemskerk and Duijves, 2014. Figure 5). Both earlier studies and our present inquiries suggest that a particularly popular place to buy mercury is the “Little Belem” neighbourhood in north Paramaribo. This neighbourhood is characterized by a large number of Brazilian shops and bars, and the substantial number of Brazilians that can be found here to sell gold, buy supplies, meet others, and look for a work spot. In 2014, we found that informal sales persons (*hosselaars*) and cab drivers were the main vendors of mercury in Paramaribo, and they were usually Suriname nationals.

By 2019, this situation has not changed much. Consulted small-scale gold miners reported that they typically buy mercury in the streets of Paramaribo, and specifically in the Little Belem neighbourhood, from Suriname informal vendors – who are often cab drivers. A couple of selected Chinese (mining equipment) stores in this same general neighbourhood also were said to sell mercury to small-scale gold miners. One person reported that he had occasionally bought mercury from Guyanese people in Paramaribo, including women who come to hustle. In addition, consulted gold miners and inhabitants of ASM areas reported that it is possible to buy mercury in the Chinese shops in mining areas.

Mercury is usually bought by the owner or manager of an ASM operation. In the mining camp, mercury is often stored in a small bottle with water floating on top. The water reduces/prevents evaporation. Mercury is typically stored out of sight, and sometimes hidden or buried, to prevent theft and the possibility of confiscation in the rare case that control would take place.

Figure 5. Place where gold miners last bought mercury (N=86), 2014 data



Source: Duijves and Heemskerk, 2014

5 MERCURY LEAVING SURINAME

5.1 FORMAL MERCURY EXPORTS FROM SURINAME

According to the trade statistics database of the United Nations, Suriname exported 1.300 Kg mercury (USD 4,000) to the Netherlands in 2010, and 102 Kg (USD 850) of mercury to the United States in 2016. No other mercury exports have been reported for subsequent years (UN Comtrade 2016).

Suriname does not produce chemical mercury, but mercury used to be found as a by-product from the mining of other minerals such as bauxite and gold. Bauxite mining firm Suralco, a daughter firm of the US mining giant ALCOA, used to collect mercury that was liberated during the mining process. There are accounts that gold miners used to – illicitly - buy mercury from employees in the bauxite industry, but it is difficult to verify these accounts and establish a quantity. Suriname’s bauxite industry has closed down, and can no longer be a source of primary mercury.

Multinational gold mining firm Newmont Suriname reported that they “have not recovered any elemental mercury through our operations at Merian”⁴⁷. The firm does have the infrastructure in place to capture mercury if it enters its processing plant. In that event, its management strategy is to collect and store it securely onsite until a viable final disposal repository is identified, which is compliant with the Basal Convention and Newmont Standards relating to mercury. At this time, identifying such a viable disposal repository is underway by Newmont at a corporate level; no such facility has been officially identified for the Merian plant at this stage. The Environmental coordinator at Rosebel Gold Mines N.V., a subsidiary of Iam Gold Corp., reported that also in this firm, no mercury is found as by product. The firm does not have data on possible mercury releases during the mining process⁴⁸.

The Kaloti Mint House handles gold prior to export. Handling of gold is the minting, casting and melting into bars, the assaying to determine purity and the stamping of gold by the company. Waste products, including remnants of mercury, end up in scrubbers with carbon filters. These filters are collected by authorized persons from Kaloti’s headquarter in Dubai and transported to Dubai. Waste is stored in special containers and collected every 2-3 year, depending on the production of the Mint House⁴⁹. A consulted Kaloti representative reported that no visual mercury is found during the process because the mercury remains have already been removed during the process at the gold buyer shops⁵⁰. Also, during monthly measurements, no mercury vapour is encountered. Kaloti harbours to only place in Suriname where mercury can be safely stored. In conclusion, the available information suggests that no elementary mercury is recovered in Suriname, and there are no formal mercury exports.

⁴⁷ M. Graham, Manager Environment Newmont Suriname. Pers. com. 7 March 2019, by e-mail.

⁴⁸ R. Pollack, Environmental Coordinator at IAMGOLD Corporation. Pers. com. 13 May 2019.

⁴⁹ R. Ramdoel, Lab Technician Kaloti Mint House. Pers. Com 16 April 2019.

⁵⁰ Ibid.

5.2 MERCURY LEAVING SURINAME INFORMALLY

In French Guiana, an overseas department of France, gold mining is bound by European environmental regulations including, since 2006, a ban on the use of mercury. In 2015, French Guiana counted valid 39 mining titles (concessions, exploitation licenses and exclusive research permits). Its entire formal mining sector employed 550 workers, who were primarily employed by small and middle size enterprises (PME, *Petites et Moyennes Entreprises*) (Thomassin et al., 2017). Counting also service providers, about 1,000 persons may be working legally in small and medium scale gold mining and the direct service economy.

A much larger part of French Guiana's gold sector, both in terms of the number of persons involved and the amount of gold produced, is made up of *orpailleurs*; small-scale gold miners who are working illegally. It is estimated that about 5,000-10,000 undocumented and untitled small-scale gold miners are active in French Guiana -virtually all of them Brazilian *garimpeiros*- extracting 8 to 10 tonnes of gold annually (Heemskerk, 2011; Thomassin et al., 2017). Meanwhile legal operations have extracted between 1-2 tonnes of gold annually in recent years (Thomassin et al., 2017). In the past decade, in an effort to stop illegal gold mining, the French government has launched a series of military operations; the present one named "Operation Harpie". Using helicopters, boats, and field troops, these operations aim to close supply routes, and track and completely destroy (burn) illegal mining operations in the vast, forested French Guiana interior. In 2018, operation Harpie destroyed 765 illegal small-scale gold mining sites in the French Guiana forest. The effects of these actions, however, has been short-lived.

Given the many restrictions in French Guiana, and the relatively lenient attitude towards gold miners in Suriname, many *garimpeiros* working in the small-scale gold mining areas of western French Guiana regularly travel to Suriname. Some have their permanent home and/or family in Paramaribo, but others come to rest, sell their gold⁵¹, buy supplies, and/or meet people. When gold operators working in French Guiana buy equipment, parts, and supplies in Suriname, mercury is part of this shopping list. It is easy to obtain in Suriname, and brought across the border together with all the other products that are smuggled across. Additional mercury can be bought in one of the many Chinese supermarkets that occupy the Suriname banks of the Suriname-French Guiana border. In Albina/Papatam (North Suriname) and in Antonio do Brinco/Peruano (South Suriname), large enclaves of Brazilian gold miners and mining service providers have formed, staying for a couple of days, and awaiting their chance to venture into French Guiana. Each night, boats packed with *garimpeiros* cross the river – with mercury among their supplies.

Gold operators working in French Guiana, and shop owners in the border enclaves, typically send their supplies/merchandise by car to Albina, and from there by boat to the mining areas. Mercury is probably often part of these supplies. Nevertheless, mercury has never been seized at the police control post on the route to Albina and French Guiana (Stolkertsijver Post)⁵².

⁵¹ In French Guiana, gold buying shops request proof of legality of the gold and its owner, making it difficult for illegally mined gold to be sold. In Suriname, no questions are asked when selling gold to the gold shops.

⁵² Regional Police Commander East, pers. com. March 22, 2019

6 ENVIRONMENTAL AND HEALTH IMPACTS OF MERCURY USE IN SURINAME⁵³

6.1 ATMOSPHERIC CONTAMINATION

Globally, artisanal and small-scale gold mining is the main source of anthropogenic mercury emissions to air. Mercury vapours are not only emitted into the air in the mining areas where gold miners burn the amalgam, but also in the gold shops (mostly in Paramaribo city), where the sponge gold produced by gold miners is burned again to remove residual mercury remaining in the sponge (often ~5%; Persaud and Veiga, 2015). A 2013 study on mercury emissions in Paramaribo noted that the collectors of surveyed gold shops were in very bad condition and that the fume hoods did not seem to function properly (Wip et al., 2013).

Measurements of atmospheric mercury have not been performed for Suriname mining areas. Such measurements may also not be useful because mercury vapours from burning amalgam are rapidly diluted. Atmospheric mercury has been measured in Paramaribo, but not consistently. The Suriname physicist Ir. D. Wip found mercury emissions in Paramaribo (both maximum and average) to be comparable with those in world cities in Asia and North America (Wip et al., 2011). These levels posed no public health risks. Inside and in the close vicinity (<100m) of gold buying shops, however, he measured mercury concentration levels that surpassed the US National Institute for Occupational Safety and Health recommended exposure level of 50 µg/m³ inside, and the minimal risk level of 0.2 µg/m³ of the US Agency for Toxic Substances and Disease Registry outside (ibid.). More scientifically robust, longitudinal measurements of atmospheric mercury in Paramaribo must be performed to be able to draw definite conclusions.

6.2 CONTAMINATION IN FRESHWATER ECOSYSTEMS: WATER, SEDIMENTS AND FISH

6.2.1 Fresh water

Mercury enters the freshwater ecosystem both directly, with tailings from mining areas, and indirectly, when evaporated mercury is deposited with rainfall. In the aquatic ecosystem, traces of mercury can be found in water, sediments and aquatic biota. Measurements in Suriname fresh water bodies show that mercury levels are slightly higher than global background levels (Ouboter, 2015). Nevertheless, mercury content in fresh water is generally low, in part because elementary mercury poorly dissolves in water⁵⁴. If mercury is found in water, it is most often present in, or connected to, sediment particles. Micro-organisms transfer mercury into methyl-mercury but also this form dissolves poorly in water, and rapidly enters the food chain where it is better dissolvable in fat tissue (Legg et al. 2015). Indeed, the highest mercury level measured in Suriname waters (1.11 µg/L at the south side of Brokopondo Reservoir) is still below the Environmental Protection Agency (EPA) drinking water standard of 2 µg/L (Ouboter et al. 2012).

⁵³ This chapter was adapted from Heemskerk and Duijves, 2017

⁵⁴ Dr. P. Scheepers, toxicologist Radboud University of Nijmegen, Netherlands. Pers. com. 01/03/17.

It can be concluded that filtered river water is not an important source of mercury and if consumed, metallic mercury will not enter the human body through the intestines.

6.2.2 River sediments

For river sediments, available studies suggest that the sediments in virtually all Suriname rivers and streams, with the exception of northwestern Suriname, have mercury levels well above global background levels of 0.01-0.05 µg/g (Ouboter, 2015). Sediments in many locations approach or exceed the Canadian Interim Sediment Quality Guideline for Protection of Aquatic Life of 0.17 µg/g soil. High mercury levels were encountered in gold mining areas, upstream from gold mining areas (rainy season), in the mouth of the Marowijne River (eastern border river) and, surprisingly, in pristine areas of central, western and southern Suriname⁵⁵ – particularly in the Upper Coppename Basin (Ouboter, 2015). Research by Ouboter and colleagues explains the high mercury levels in sediments and fish in seemingly undisturbed streams by:

1. Atmospheric transportation of mercury from the gold mining areas to the southwest by the northeastern trade winds;
2. Wet deposition of atmospheric mercury, with the highest amounts polluting streams draining mountain ranges with high precipitation;
3. Mercury in pristine streams is freely available for methylation and bioaccumulation. In comparison, mercury in mining areas is to a large extent bound to fine sediment particles and therefore not freely available for bioaccumulation.
(Ouboter et al., 2012)

Available data suggest that these high mercury levels found in Suriname riverine ecosystems are not natural but rather have an anthropogenic origin (ibid. 2012).

6.2.3 Fish

Aquatic ecosystems are a major site of mercury methylation and biomagnification (Legg et al. 2015). Methylated mercury moves up the food chain via micro-organisms to small fish, to larger fish, and eventually to people and fish-consuming mammals (e.g. river otters) and birds. Measurements of mercury in fish show elevated to high mercury levels in tissues of predatory fish in most gold mining localities, as well as in many other locations. Extreme high levels were measured in the Brokopondo Reservoir, where particularly piranhas displayed mercury contamination levels that were six to seven times the norm for human consumption (on average two to three times) (Ouboter, 2015).

No measurements have been performed of mercury levels in Suriname's aquatic and terrestrial wildlife, birds, reptiles, amphibians and insects. Adverse effects of mercury ingestion on these different species have been recorded for other countries (Kessler, 2013).

⁵⁵ In these seemingly unaffected areas far from ASM areas, researchers measured average Hg levels in sediment of 0.20 µg g⁻¹, with a maximum of 0.28 µg g⁻¹

6.3 ELEVATED MERCURY LEVELS IN PEOPLE

Several studies have looked at mercury traces in the hair, urine and blood of possibly affected populations. Interestingly, few of these studies have focused on gold miners. Notwithstanding, in the early years of the present gold rush, De Kom et al. (1998) measured mercury content in blood and urine samples of Maroon gold miners and a control group of Maroon men. They found elevated mercury levels in the urine samples but not in the blood, suggesting exposure to an elemental or inorganic source of mercury through the inhalation of fumes⁵⁶. Another study that was conducted around the same time found elevated levels of mercury contamination among both gold miners and community members from communities in the vicinity of gold mining areas (Pollack et al., 1998, cited in Ouboter, 2015).

Other studies mostly took place in possibly affected communities. In most Maroon communities that have been studied, researchers have found elevated mercury levels in hair samples⁵⁷; above the EPA reference dose for hair mercury concentration of 1.0 µg/g but generally remaining below the WHO safety limit of 10 µg/g. Elevated mercury levels have been reported for the Matawai communities of Njoeng Jacobkondre and Poesoegroenoe⁵⁸ (Ouboter et al., 2007), the Matawai community of Kwakoegron (Peplow and Augustine, 2007; Hawkins et al., 2012), and the Indigenous community of Pikin Saron (Hawkins et al., 2012). As mentioned above, fish and sediments from the Brokopondo hydropower lake contain some of the highest mercury levels measured in Suriname. Nevertheless, researchers found that mercury levels in hair samples of inhabitants of Brownsweg, a Maroon community on the edge of the Brokopondo Lake, generally remained well below the WHO safety limit (Ouboter and Landburg, 2010)⁵⁹. This finding was explained by the limited reliance of villagers from the Brownsweg area on the lake for protein intake.

A 2017 study among pregnant women from Marowijne district (East Suriname) found that the majority of the participants had mercury levels in blood and urine below the reference level (HBM I), respectively 73.7% and 94.7 % (Quik, 2017). For hair the majority of the participants (60.5 %) had mercury levels

⁵⁶ While urine samples can be used to measure total mercury (organic plus inorganic), results of urine testing are a better indicator of inorganic mercury than organic (methyl)mercury. On the other hand, elevated mercury in blood usually indicates exposure to organic mercury (such as from eating fish containing methyl-mercury) or recent exposure to a high level of elemental mercury vapour. For most people, an elevated blood mercury level is associated with eating fish and other seafood containing organic mercury (New York State Department of Health, 2016). Since gold miners do not typically eat a lot of fish, it is understandable that their blood samples did not differ from those of the control group.

⁵⁷ Hair samples are particularly effective for measurement of longer-term average exposures. Mercury circulating into the body is incorporated into hair as it grows, and once there the concentration doesn't change. Concentrations in hair have been found to correlate well with concentrations in organs where mercury may accumulate, such as the brain and kidneys, particularly for methylmercury.

⁵⁸ Both along the Saramacca River, with the more upstream Poesoegroenoe displaying highest mercury values.

⁵⁹ Only 2 of 172 participants displayed Hg levels in hair above 10 µg/g.

between reference and action level (HBM⁶⁰ I and HBMII); two participants (2.6 %) had a mercury level above HBM II. No adverse birth outcomes, stillbirth, preterm deliveries or small for gestational age (SGA), were reported. Neither were there any defects reported in the newborns. The study recommends follow up of the women with high mercury levels in the hair because of their greater risk for adverse health effects and for adverse birth health outcomes.

At present, the Suriname Academic hospital with support from Tulane University (USA), and with funding from the American National Institute of Health, is executing a 5-year long project (started in 2015) on the health effects of mercury and other chemicals on large groups of people, including pregnant women and young children. Preliminary results of this study find that women from the interior of Suriname display significantly higher levels of mercury than women from the coastal area, the former group often exceeding the WHO safe norm⁶¹.

Alarming high levels of mercury have been measured in the Wayana Indigenous population along the Tapanahony and Lawa Rivers – in both Suriname and French Guiana communities. Already in 1997, French researchers found that 58 percent of the Indigenous population in four Wayana villages along the Lawa river had Hg levels above the World Health Organization (WHO) safety limit (10 µg/g) (Fréry et al. 2001). Dietary research in this group showed that all those over 1 year of age had an Hg intake greater than the WHO safety limit (200 µg MM Hg/week for a 60-kg male) (ibid.). Another study that was performed around the same time among the French Guiana Wayana concluded that overall, 12% of the samples contained mercury levels in excess of 10 µg/g (Cordier et al. 1998). In some communities, however, up to 79% of the children had hair mercury levels that exceeded the WHO safety standard. Also the results of this study indicated that diet played a predominant role in total mercury burden. In Suriname Wayana communities, results of mercury measurements have been similarly worrisome. A 2008 analysis of hair samples from adults and children in the Wayana communities of Apetina and Kawamhakan found that 58% of the people who submitted hair samples had Hg levels above the World Health Organization safety limit, some even two to three times this limit (Peplow and Augustine, 2011). A follow-up study documented neurologic dysfunction consistent with mercury poisoning among the Wayana of Apetina (Peplow and Augustine, 2014).

⁶⁰ HBM stands for Human Biomonitoring. The HBM Commission defines two levels: HBM-I and HBM-II. The HBM-I-value represents the concentration of a substance in human biological material below which there is no risk for adverse health effects and, consequently, no need for action. At a concentration level higher than the HBM-I- and lower than the HBM-II-value the result should be verified by further measurements. If these measurements confirm the initial result a search for potential sources of exposure should be undertaken. The HBM-II-value represents the concentration of a substance in a human biological material above there is an increased risk for adverse health effects and, consequently, an acute need for exposure reduction measures and the provision of biomedical advice. The HBM-II-value should thus be regarded as an intervention or action level.

⁶¹ Presentation by Dr. W. Zijlmans, MD, PhD., from the Scientific Research Center Suriname, at UNDP meeting 14/05/2019.

Figure 6. The size and lay-out of mining operations make it difficult to obtain a good understanding of soil contamination



6.4 SOILS

Not much research has been conducted and published on ASM-induced contamination of terrestrial soils. In 2006, Arets et al. measured mercury in soil sediments at several sites within one mining area. Even though the values they recorded varied widely, they found that the highest mercury levels were encountered at the site of the sluice box (Arets et al., 2007). Other studies, however, have not confirmed these findings.

In 2016, soil scientist Noordam and team analyzed soil samples from an abandoned ASM site within the concession of a multinational gold mining firm. Samples were taken with a hand auger, on 1-2 m depths, on different locations (e.g. in the mining pit, in the tailing field, at various distances from the sluice box, and around the sluice box). Contrary to expectation, the team found hardly any traces of mercury in the samples (Noordam, soil scientist, pers. com. February 2017). Possible explanations for this finding are that given the huge size of some mining pits (Figure 6) samples were not obtained from the most polluted locations; that due to repetitive re-mining most traces of mercury have been captured by the miners

themselves; that the tailings with mercury (from mine sections with gold) are "diluted" with large quantities of tailings without mercury (mine sections without gold); or that ASM miners spill little mercury in the tailings.

Especially for of milling systems, the latter seems a plausible explanation because the gold miners check their loss of mercury amalgam in the sluices behind the milling system (R. Finkie, mining instructor ADEK University, 09/03/17). In sluicing systems, most mercury (amalgam) will settle in the mats. While mercury is lost during burning, gold miners make an effort to capture all of it during the mining process (ibid.).

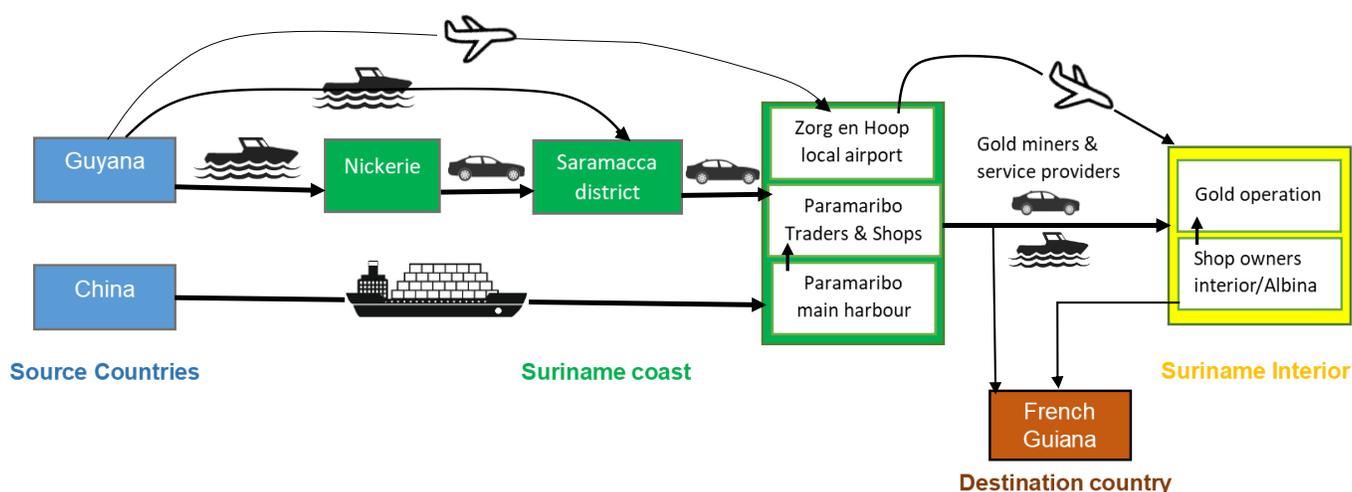
7 CONCLUSIONS

Since the mid-1990s, Suriname is part of a gold rush that swept from Brazil to other Amazon countries. In Suriname, an estimated 10 to 15 thousand individuals are mining for gold or providing services in mining areas, including sex workers, bar and brothel owners, transport providers, shop owners, traveling merchants, and churches. About two-thirds to three-quarters of inhabitants of small-scale gold mining areas are foreign gold miners, mostly Brazilian *garimpeiros*. The majority of the remaining people are Suriname Maroons, in addition to smaller numbers of Surinamese of other ethnic groups, and people of other nationalities.

Virtually all small-scale gold mining operations in Suriname use mercury in the mining process, in an estimated Hg:Au ratio of 3.3:1. Mercury amalgamates with gold, and its use in the mining process is cheap, fast, simple, and effective. The use of mercury also negatively affects the natural environment and human health though. In 2003, Suriname placed mercury on the so-called Negative List, making it a legal requirement to obtain a special permit for the import of this substance. Since that year, no single permit has been requested or obtained, and hence all mercury that enters Suriname, is illegally brought into the country. In 2016, it was estimated that Suriname small-scale gold mining operations released annual mercury emissions of 63.0 T Hg/yr. The present report investigated what are likely source countries for mercury entering Suriname, through what channels is mercury traded, and how and where does mercury leave Suriname again?

Because of the illegality surrounding mercury imports, it is difficult to obtain truthful information from people involved in the mercury trade, and to obtain exact figures about quantities. The information we were able to distil is visually depicted in Figure 7 and explained in further detail below.

Figure 7. Mercury marketing chain



Every single gold miner who was asked where mercury in Suriname comes from, both Surinamese and Brazilians, named Guyana as the main or only source. Most consulted gold miners had bought their mercury from Surinamese suppliers who had obtained it in Guyana, but other gold miners had travelled themselves to Guyana to buy it, or bought it from Guyanese in Suriname. Different sources in Guyana quoted mercury prices between USD 55 and 160 per Kg of mercury, depending on location (more expensive in the interior) and quality.

From Guyana, the largest share of mercury is most likely first taken by boat to Nickerie. From there it is brought over land to Paramaribo. This land-travel can happen in small cars from Paramaribo vendors, or in small trucks, hidden between bags of rice or rice bran. Sometimes Nickerie-based middlemen are involved, who buy mercury in Guyana and sell it in Nickerie to those who do not want to cross the border. But in other cases, Paramaribo vendors themselves cross the Corantijn River into Guyana to get a better price. Even though a representative of the Suriname Police corps indicated that every car on the Nickerie-Paramaribo route is checked, very little mercury has been confiscated in past years on this route. A large catch of mercury at Calcutta some years ago suggests that mercury also travels -or did so in the past- by speedboat over sea to one of the inlets prior to reaching Paramaribo. From here, the mercury is loaded into cars or small trucks, and brought to Paramaribo.

In Paramaribo, mercury is sold by informal vendors (often cab drivers) in the neighbourhood where many Brazilians stay and buy gold supplies. The Surinamese Paramaribo vendors typically do not travel to the interior to sell mercury. Instead, gold miners working in the interior of Suriname or French Guiana come to Paramaribo to buy supplies, including mercury. In Paramaribo city, mercury sells for between USD 110-130/Kg Hg.

Probably smaller quantities of mercury are smuggled from Guyana to Paramaribo in the small airplanes on the daily flight service between Georgetown (Ogle airport) and Paramaribo (Zorg en Hoop). Zorg en Hoop airport also is the airport from where small passenger planes leave to the gold mining areas in the interior, and it is likely that mercury travels onward that way.

One of the Paramaribo vendors reported that a powerful Chinese entrepreneur smuggles mercury from China in container ships, hidden between other merchandise. This entrepreneur sells mining equipment in Paramaribo and owns a significant number of Chinese supply stores in different mining areas. It is likely that at least part of the Chinese mercury finds its way to such interior stores. Gold miners from different mining areas reported that mercury can be purchased in virtually all Chinese supermarkets in the mining areas - though at a significantly higher price than in Paramaribo city. Mentioned prices ranged from 6 to 10 gr Au/Kg Hg (~210-350 USD/Kg Hg). Some of these supermarkets are located right on the border between Suriname and French Guiana, (e.g. in Albina/Papatam in the north, and Antonio do Brinco/Peruano in the South), and mostly cater to Brazilian gold miners working illegally in French Guiana. A visited large vendor in Guyana, just across the border from Suriname, lamented that the Chinese vendors were destroying their (Guyanese vendors') market for the sale of Hg in Suriname.

Other countries, such as Brazil, the Netherlands, and other European countries, are presently very unlikely sources of mercury used in Suriname – even though some of these countries supplied mercury to the Suriname gold sector in the past, either informally or formally.

Given the open borders between Suriname and its neighbouring countries, the understaffed and underpaid police force, and willingness of some law enforcement agents to turn a blind eye in exchange for a *tjuku* (bribe), bringing mercury into Suriname is rather easy. Added to these factors is the apparently low ranking of stopping mercury imports among national policy priorities. In the context of Suriname's economic recession, a tough stance on mercury import, trade and use would affect the livelihoods of many persons in the small-scale gold mining sector, including both some of the most marginalized and some of the wealthiest population segments.

It is yet unclear how Suriname's recent (2018) signing of the Minamata convention will be translated into concrete policy actions. NIMOS, which is the national focal point for implementation of the Convention, is completing the Minamata Initial Assessment (MIA) and working on a related National Action Plan (NAP). Once these documents are completed, planned policy measures and a related timeline will be more explicitly defined.

8 RECOMMENDATIONS

This report illuminated the import of, trade in, and use of elementary mercury in Suriname, South America. Virtually all of this mercury is both used and released in the country's ASM sector. In light of:

- IUCN NL's global efforts to help improve governance of the mercury value chain,
- Intentions by the Suriname government to gradually phase out mercury from ASM practices, as demonstrated by its ratification of the Minamata Convention,
- The data presented in this report and the conclusions drawn therefrom,

The researchers recommend that IUCN NL aligns its interventions with existing initiatives from other NGOs, the Suriname government, and other stakeholders in Suriname, in order to maximize impact and minimize NGO-tiredness among the target group.

Recommendations for specific areas where IUCN NL can make a difference are listed below.

1. **Contribute to existing projects that are looking at ways to introduce mercury-free mining techniques to Suriname gold miners.** Existing projects are all in the starting phase, and include Social Responsibility projects of gold mining multinationals IamGold (Rosebel Gold Mines) and Newmont Suriname; an Artisanal Gold Council project with support from the US Department of State; and the GOS/UNDP "Improving Environmental Management in the mining Sector of Suriname, with Emphasis on Artisanal and Small Scale Gold Mining" (EMSAGS) project. Based on conversation with the lead executing agents, the IUCN NL can define the most effective way to contribute to one or more of these existing projects.
2. For many inhabitants of Paramaribo, mercury contamination is not an immediate concern and perceived as a problem of people from the interior. Without it being a problem for many urban residents, policy makers are not under a lot of pressure to take measures against mercury contamination. General media campaigns have not been very effective in mobilizing urban residents. Two other actions are proposed:
 - a. **Increase urban awareness of the possible impact of mercury contamination on their own families, by taking measurements of mercury vapour in gold buying enterprises and of airborne mercury around these shops,** which are mostly situated in residential neighbourhoods. Irregular, occasional measurements of mercury in Paramaribo have been performed by the University of Paramaribo. In gold shops, measurements have been performed by the Medical bureau of the Ministry of Labour. These organizations could be supported to collect more systematic, regular measurements, in different seasons and on different times of the day, to provide conclusive evidence that mercury contamination also may affect children and adults in the city.
 - b. Work with the Ministry of Health and the Ministry of Agriculture, Animal Husbandry and Fisheries (LVV) to **develop mercury advisory signs for placement along rivers and lakes where fish have been found to contain high levels of methylmercury.** Such signs, which are used commonly in the US, along the canals in Paramaribo, or at the boat landings of the Brokopondo hydropower lake –where many urban



residents come in weekends to fish - may help [people make a connection between mercury use (somewhere, far away, not my business) and their personal health and that of their families.

- c. **Contribute in cash or kind to the Meki Tamara project** of the Scientific Research Center of the Academic Hospital Paramaribo, Suriname, which is executed by the Caribbean Consortium for Research in Environmental and Occupational Health (CCREOH) with financial support from the United States National Institute of Health, Fogarty International Center. This project measures neurotoxins (incl. mercury) in pregnant women and their new-borns, and follows the children for several years to detect possible developmental impacts

Align with Radboud University, Netherlands, to execute a previously proposed project to measure mercury contamination in small-scale gold miners, and strengthen local health workers in interior communities in providing mercury-related advice. In 2015-16, the Dutch Radboud University Medical Centre and Medical Mission Suriname (MZ) executed a project to develop educational materials on mercury contamination and related health effects, tailored to community knowledge and awareness levels. In addition, MZ health workers were trained to provide mercury-related information in communities, and small-scale gold miners were asked about their interest in participating in biomedical research to measure their personal mercury levels. A follow-up proposal for this project, whereby small-scale gold miners would be tested for mercury and obtain personalized advice, was not funded.

REFERENCES

- Cairo, Ivan (2018). Corruptie bij douane diepgeworteld. De Ware Tijd online, 25/12/2018. Available at: <http://www.dwtonline.com/paramaribo-post/2018/12/25/corruptie-bij-douane-diepgeworteld/>
- Cordier, Sylvaine, Christine Grasmick, Michel Paquier-passelaigue, Laurence Mandereau, Jean-Philippe Weber and Michel Jouan (1998). Mercury Exposure in French Guiana: Levels and Determinants. Archives of Environmental Health: An International Journal 53(4): 299-303.
- De Kom, J.F.M, G.B. van der Voet & F.A. de Wolff (1998). Mercury exposure of Maroon workers in the small-scale gold mining in Suriname. Environmental Research 77: 91-97.
- Duijves, C. and Heemkerk, M. (2014). Gold Miners' Knowledge, Attitudes & Practices with regard to Mercury. A study in four small-scale gold mining regions in Suriname. Report produced for GOMIAM and WWF-Guianas. Paramaribo, Suriname.
- Fréry, N., R. Maury-Brachet, E. Maillot, M. Deheeger, B. de Mérona, and Alain Boudou (2001). Gold-Mining Activities and Mercury Contamination of Native Amerindian Communities in French Guiana: Key Role of Fish in Dietary Uptake. Environmental Health Perspectives 109:449–456
- Hawkins, Bradley, Oubouter, Paul, and Lichtveld, Maureen (2012). An assessment of mercury exposure in populations for two vulnerable indigenous communities in Suriname, South America. Poster presented at the American Public Health Association meeting, October 29, 2012.
- Heemskerk, M. and M. Oliviera. 2004. Perceptions of small-scale gold mining impacts II. A survey in mining camps and affected communities in Suriname and French Guiana. WWF Guianas project FG64. Paramaribo, Suriname. March 31, 2004.
- Heemskerk, M. Negulic, E. and Duijves C. (2016). Reducing the Use and Release of Mercury by Artisanal and Small Scale Gold Miners in Suriname. Report produced for the Artisanal Gold Council, Canada.
- Heemskerk, M. and C. Duijves (2017). Socio-economic, health and environmental impacts of mining in Suriname, with a focus on Artisanal and Small-scale gold Mining. Report produced for the Global Environmental Facility /United Nations Development Program.
- IPEN (2017). Brief on Article 3 Mercury Supply Sources and trade. Report for Mercury Convention COP 1. Authored by Bell, L. and Y. Ismawati (August 2017).
- Kessler, Rebecca (2013). Mercury's Silent Toll On the World's Wildlife. Yale environment 360. URL: http://e360.yale.edu/features/mercurys_silent_toll_on_the_worlds_wildlife
- Lacerda, L.C. en W. Salomons (1991) Mercury in the Amazon: a chemical time bomb? Report for the DLO-Instituut voor Bodemvruchtbaarheid, Haren, Netherlands.
- Legg, E.D., Ouboter, P.E. and Wright, M.A.P. (2015). Small-Scale Gold Mining Related Mercury Contamination in the Guianas: A Review. Prepared for WWF-Guianas.

Mol, J.H.; Ouboter, P.E. Downstream effects of erosion from small-scale gold mining on the instream habitat and fish community of a small neotropical rainforest stream. *Conservation Biology* 18: 201–214. New York State Department of Health (2016) Understanding Mercury Exposure Levels. Website. URL: https://www.health.ny.gov/environmental/chemicals/hsees/mercury/mercury_exposure_levels.htm. Access date: 02/03/17.

NIMOS (2014). Advies Document betreffende het Minamata verdrag. Report produced by the Nationaal Instituut voor Milieu en Ontwikkeling in Suriname, August 2014.

NRCS (1995). Effects of Sediment on the Aquatic Environment: Potential NRCS Actions to Improve Aquatic Habitat - Working Paper No. 6. Natural Resources Conservation Service. United States Department of Agriculture

Ouboter, Paul (2015). Review of mercury pollution in Suriname. *Academic Journal of Suriname* 2015, 6, 531-543.

Ouboter, Paul and Chantal Landburg (2010). Mercury poisoning: A Threat to Brownsweg Villagers. Research Paper. NZCS/CMO. Anton de Kom University of Suriname

Ouboter, P.E., G. Landburg, J. Quik, J. Mol and F. v.d. Lugt (2012). Mercury Levels in Pristine and Gold Mining Impacted Aquatic Ecosystems of Suriname, South America. *Ambio* 41(8): 873-882.

Peplow, Daniel and Sarah Augustine (2014). Neurological abnormalities in a mercury exposed population among indigenous Wayana in Southeast Suriname. *Environmental Science: Processes Impacts*, 16: 2415-2422

Persaud A., and Telmer K. (2015) Developing Baseline Estimates of Mercury Use in Artisanal and Small-Scale Gold Mining Communities: A Practical Guide (Version 1.0), Artisanal Gold Council. Victoria, BC. ISBN 978-0-9939459-4-6.

Quik, J. (2017). Determination of exposure to mercury, lead and aluminum amongst pregnant women in district Marowijne. a pilot study. Study report for the Bureau voor Openbare Gezondheidszorg (Suriname), the Stichting Regionale Gezondheidszorg (Suriname), the Centre Hospitalier de l'Ouest Guyanais (French Guiana) and the French Development Organisation AFD. April 2017.

Radboud UMC and Medical mission (2017). Bevorderen van Gezondheid in de Kleinschalige Goudwinning (PROSAMIGO). Effectiviteit en haalbaarheid van een gezondheidsvoorlichtings- en blootstellings-monitoring-programma aangaande de gezondheidsrisico's van kwik. Final report for the PROSAMIGO-UTSN Program.

Reuters (2017). China to ban primary mercury mining by 2032 as convention comes into force. Reporting by M. Xu and D. Stanway; T. Hogue (Ed.), August 16, 2017. URL: <https://www.reuters.com/article/us-china-mercury/china-to-ban-primary-mercury-mining-by-2032-as-convention-comes-into-force-idUSKCN1AWORI>

Veening, W.J. et al. (2015). Mining gold and mercury pollution in the Guiana Shield: A case study on the

role of the European Union in fighting environmental crime. A study compiled as part of the EFFACE project. The Hague: Institute for Environmental Security

Wip, Dennis, Thorsten Warneke, Anna Katinka Petersen, Justus Notholt, C. Temme, H. Kock, and P. Cordy (2011). Urban Mercury Pollution in the City of Paramaribo, Suriname. *Air Quality Atmosphere & Health* 6(1)

