

ILLEGAL GOLD MINING IN MADRE DE DIOS: EVALUATING CURRENT  
AND PROSPECTIVE SOLUTIONS

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## ABSTRACT

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Title: Illegal Gold Mining in Madre de Dios: Practical Policy Considerations

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This thesis investigates public policies and action plans that would help address the growing issue of illegal gold mining in the Amazonian Madre de Dios region of Peru. Devastating environmental and public health problems affect the region as a direct result of illegal mining and the mercury-reliant gold extraction process used by miners in the region. This thesis project will employ cost-benefit analysis on potential strategies for the Peruvian government or international entities to help curtail the prevalent activity of illegal gold mining in the bio-sensitive region of Madre de Dios. The best solution(s) will be cost effective, produce high impact, be highly efficient, promote fairness, be politically acceptable, robust, and replicable so that other countries can learn from and adopt practices from Peru to combat the destructive consequences of informal and/or illegal small-scale gold mining in a practical way.

## DEDICATION

The thesis is dedicated to my grandmother and grandfather and our many long road trips to *El Repartidor*.

## ACKNOWLEDGEMENTS

Above all, I would like to thank Dr. Bencivenga for encouraging me to finish strong and holding me to high expectations. From the Plan II Honors Program, I would like to thank Dr. Wettlaufer, and my advisors, Katie O'Donnell and Melissa Ossian, who have helped me navigate my thesis journey and plan out my course schedule to somehow fit all of my academic pursuits into three amazing years at the University of Texas and one wonderful year at Oxford University. Through Plan II, I have had the opportunity to explore Rome and the Vatican with Prof. Sean Theriault, engage in the world of social enterprise and civic engagement with Prof. Lee Walker, and spend a year at Oxford. More than anything, Plan II has challenged my ideas and the way I approach the world through our many round-table discussions with my classmates facilitated by thought leaders from across the university. Lastly, I would also like to thank my parents for providing unconditional love and support and my friends who have struggled alongside me as we remember our dear friend, Nicky, who passed away tragically last year.

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## I. INTRODUCTION

In 2018, Pope Francis visited Madre de Dios, a province in the southern Amazon of Peru, bringing with him a dire warning of “a false god which demands human sacrifices.”<sup>1</sup> The pontiff was referring to gold and the at-risk communities in Peru and elsewhere in the world that engage in destructive practices for economic gains. Artisanal and small-scale gold mining (ASGM, or SSM, referring specifically to small-scale mining) in Peru causes detrimental health and environmental effects, creating an urgent public problem with no foreseeable solution. The gold ore extraction and processing techniques used by small-scale miners in Peru have devastating consequences, subjecting miners to toxic mercury exposure and hazardous working conditions while also wreaking havoc on the fragile Amazonian ecosystem and native communities that rely on it. Women and underage girls are trafficked into bars and brothels, catering to the high proportions of men in the mining camps. The gold extracted from Madre de Dios at a high human and environmental cost is smuggled out of Peru where it is bought by international jewelers, tech companies, and national treasuries, who are either unaware or unbothered by the source of the gold. Drug cartels use Amazonian gold to launder cash from drug sales in the U.S. Illegal gold mining is a complex and persistent problem involving individuals and large entities on every level of the gold supply chain, and it is an issue that desperately needs solutions from Peruvian and international policymakers. The Pope’s visit to Madre de Dios brought much-needed international attention to the issue, but more is left to be done. Peru’s *Operación Mercurio* (Operation Mercury) is currently underway to prevent illegal gold mining in the

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<sup>1</sup> “Pope’s Meeting with Local Citizens of the Amazon Region: Full Text of Papal Discourse - Vatican News,” January 19, 2018, <https://www.vaticannews.va/en/pope/news/2018-01/peru-journey-meeting-with-local-citizens-full-text-.html>.

southern Amazonian region, but the plan could benefit from strategic support and more effective use of its remaining budget.

The goal of this thesis is to apply proven management consultant problem-solving methods and policy analysis evaluation criteria to pinpoint the root causes of illegal gold mining in Peru and evaluate multi-actor solutions to identify opportunities for positive impact. After defining the problem and gathering information, I will evaluate current strategies and prospective solutions based off of the following criteria: (1) Cost-Effectiveness, (2) Impact, (3) Overall Efficiency, (4) Fairness, (5) Political Acceptability, (6) Robustness, and (7) Replicability. First, I will evaluate policies and procedures currently in place in Peru such as Operation Mercury's triple-pronged approach of military action, formalization, and investment in sustainable alternative industries in Madre de Dios as well as international mercury controls and the projectGOLD education initiatives supported by the Minamata Convention and the international community. I will then explore promising opportunities to help alleviate the illegal mining problem in Madre de Dios offered by technology-driven strategies for gold supply chain management. The Kimberley Process Certification Scheme and Fairtrade Gold Certification are two schemes that could be adapted to serve the gold supply chain. Blockchain is the technology behind digital currency that records transactions in an online distributed ledger, and it has many potential business applications such as supporting a Fairtrade gold supply chain and ensuring end-to-end traceability. Chile supports small- and medium-scale copper miners with a centralized ore-processing scheme. All of these systems would create a traceable gold supply that would hold businesses and governments accountable for their gold sourcing practices preventing criminal networks from using illegally mined gold to launder money. As we will discover, likely no one solution can effectively address all of the problems caused by illegal gold mining in

Madre de Dios, but an optimal combination of these programs can support each other and create lasting change in the region.

This thesis is exploratory, providing only an overview of the positive and negative consequences of the solutions discussed. Additionally, I acknowledge that some of my data points, especially those regarding black markets and criminal networks, are estimated from secondary sources, leaving considerable room for improving accuracy in estimations because of the limited availability of this data or difficulty of access. Through my work, I hope to explore high-efficiency strategies to help alleviate the current rate of destruction in Madre de Dios.

## II. METHODOLOGY: APPROACHING THE PROBLEM

This thesis will combine management consulting and public policy problem-solving processes to develop and propose a practical and effective solution to combat illegal mining in Peru and elsewhere. A management consulting problem-solving approach is an effective way to approach business problems, but illegal gold mining is not purely a business problem. Effectively addressing the issue requires multilateral collaboration from private and public actors. Therefore, I will also incorporate aspects of public policy evaluation to ensure that my ultimate recommendation is thorough in addressing the diverse problems posed by illegal gold mining.

### Chapter 1. Forming the Approach

The management consulting industry developed around the premise of helping large corporations solve their most pressing problems from declining profitability to developing products and entering new markets, so the key to success in the \$500 billion global industry<sup>2</sup> is developing an effective problem-solving approach. The generalist management consultant can be staffed on a project in any industry across various capabilities, but their problem-solving approach usually takes the same universal structure. One former management consultant, Kenneth Albert, structures his approach using the following steps: (1) define the problem, (2) gather necessary information, (3) perform analysis and draw conclusions, and finally, (4) present recommendations and prospective implementation plans to the client.<sup>3</sup> Defining the problem involves preliminary discussions with the client to help determine underlying causes of the

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<sup>2</sup> “Consulting Industry Market Research,” *Plunkett Research, Ltd.* (blog), accessed February 14, 2020, <https://www.plunkettresearch.com/industries/consulting-market-research/>.

<sup>3</sup> Kenneth J. Albert, *How to Solve Business Problems :The Consultant’s Approach to Business Problem Solving* /, 1st McGraw-Hill paperback ed. (New York :, 1983), 22, <http://hdl.handle.net/2027/mdp.49015001247106>.

problem, as well as limiting the scope of the project to make it manageable. Within this step, Albert also highlights the importance of setting objectives to give the project purpose, stressing that “[objectives] not only define what is expected when the study is completed, but they are extremely useful in guiding the program during the execution of the study effort.”<sup>4</sup> Ultimately, Albert contends that his management consulting approach can be applied universally to any problem that a business faces, making it a good springboard for our purposes, but we can continue to further refine and adapt our approach to the issue at hand.

| <b>Management Consultant Approach (Albert)</b>         |
|--|
| 1. Defining the Problem                                |
| 2. Gathering Necessary Information                     |
| 3. Analyzing and Drawing Conclusions                   |
| 4. Making Recommendations and Effecting Implementation |

Figure 1: The management consulting problem-solving approach.<sup>5</sup>

Some critics would argue that Albert’s approach lacks structure, but the management consulting problem-solving approach is an appropriate starting point for our project because (1) it is a proven method based on sound research, and (2) it provides enough flexibility to add additional sub-steps where required, in our case public policy considerations.

Albert’s approach closely resembles the Lyles Method. The Lyles Method is used for problem-solving and decision making in a management environment and was developed by a management expert Richard Lyles to combine the simplicity of the Traditional Five-Step Approach with the thoroughness of the Kepner Tregoe Method. The Five-Step Approach is similar to Albert’s consultant method in that it is simple and straightforward. The goal of this

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<sup>4</sup> Albert, 24.

<sup>5</sup> Albert, 4–5.

approach is to generate multiple solutions and then weigh them against each other to arrive at a solution.

| <b>Traditional 5-Step Approach</b> |
|------------------------------------|
| 1. Define the Problem              |
| 2. Generate Alternatives           |
| 3. Select the Best Alternative(s)  |
| 4. Implement                       |
| 5. Monitor the Results             |

Figure 2: The traditional 5-Step problem-solving approach.<sup>6</sup>

The Kepner Tregoe (K/T) Method is unique in its dichotomy between Problem Analysis and Decision Analysis. The K/T Method’s Problem Analysis steps cater more specifically to problems arising in the work environment, so the only relevant steps for our purposes are those that aid in identifying root causes. The Decision Analysis process is useful for determining how to proceed after a problem is identified, although Lyles argues that the K/T method is “cumbersome” and is “of little help in developing creative solutions to complex problems.”<sup>7</sup> In our approach, we want to follow a structured, logical process that allows for flexibility to incorporate situational factors and creativity.

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<sup>6</sup> Richard I. Lyles, *Practical Management Problem Solving and Decision Making* (New York: Van Nostrand Reinhold, 1982), vi.

<sup>7</sup> Lyles, vii.

| <b>Kepner Tregoe Method</b> |   |
|-----------------------------|---|
| <b>A.</b>                   | <b>Problem Analysis</b>   |
|                             | 1. Define an expected standard of Performance   |
|                             | 2. Recognize a deviation from the Standard  |
|                             | 3. Precisely Identify, Locate, and Describe the Deviation   |
|                             | 4. Identify the Distinctions and Changes  |
|                             | 5. Find Relevant Changes that are Producing Unwanted Effects  |
|                             | 6. Deduce Possible Causes from the Relevant Changes   |
|                             | 7. Identify the Cause that Exactly Explains all the Facts in the Specification of the Problem   |
| <b>B.</b>                   | <b>Decision Analysis</b>  |
|                             | 1. Establish the Objectives of the Decision   |
|                             | 2. Classify the Objectives as to Importance   |
|                             | 3. Develop Alternative Actions  |
|                             | 4. Evaluate Alternatives Against Established Objectives   |
|                             | 5. Tentatively Choose the Best Alternative  |
|                             | 6. Explore Tentative Decision for Future Possible Adverse Consequences  |
|                             | 7. Control Effects of the Final Decision by Taking Actions to Prevent Possible Adverse Consequences and by Making Sure Actions Decided on are Carried Out |

Figure 3: The Kepner Tregoe Method of problem-solving in a business setting.<sup>8</sup>

Enter the Lyles Method. Developed by management expert Richard Lyles, the Lyles Method is an often-used management problem-solving and decision-making process that combines the straightforwardness of the Five-Step Approach with the comprehensiveness of the K/T Method. Referring to Figure 4, steps (1) through (7) are used for problem-solving situations, while (2) through (7) are primarily used for decision-making. The process is cyclical because according to Lyles, oftentimes “decisions create new problems for which new solutions are

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<sup>8</sup> Lyles, vii.



required,”<sup>9</sup> hence the need for further analysis and monitoring once an action plan is established. The goal of this process is to determine causality and effectively address those root causes. **If the problem continues to occur, then the root causes have not been sufficiently addressed.**

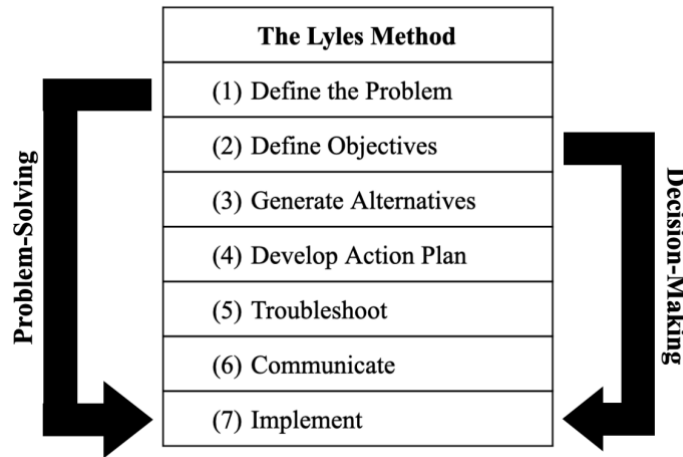


Figure 4: The Lyles Method problem-solving approach.<sup>10</sup>

Albert’s management consulting approach is largely based on a combination of these three methods, and this approach is flexible enough to adapt to the problem at hand. Additionally, approaching the issue from a consultant’s standpoint allows us to view the issue from the lens of a neutral third party when recommending certain policy actions, which is a huge advantage for legislators and interest groups promoting issues of illegal mining in a politicized environment, and it allows us to weigh the actions of different public and private sector groups in real terms without bureaucratic red-tape limitations, although we will consider the bureaucratic process to an extent. Our consultant can recommend policies to both public and private entities instead of being limited to serving one client.

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<sup>9</sup> Lyles, ix.  
<sup>10</sup> Lyles, vii.

To effectively weigh the solutions of our multi-actor problem, established public policy problem-solving approaches should also be included within the analysis to account for prospective policies and their efficiency in creating impact. Choosing appropriate criteria is crucial to assessing effective action plans. In policy analysis, we should consider both evaluative and practical criteria.<sup>11</sup> There are many metrics or standards that we could use to examine policies at hand, but for these purposes, I have narrowed them down to the following assessment categories:

|                                  |
|----------------------------------|
| <b>Evaluative Considerations</b> |
| 1. Efficiency                    |
| 1.1. Cost-Effectiveness          |
| 1.2. Potential Impact            |
| 2. Fairness                      |
| <b>Practical Considerations</b>  |
| 3. Political Acceptability       |
| 4. Robustness                    |
| 5. Replicability                 |

Figure 5: Evaluative and practical criteria for policy analysis.

For each prospective solution, I will generate a report card that measures how well the solution satisfies each criterion. Where possible, I will quantify the measurement, but most categories will be qualitatively assessed on a high-medium-low scale (green-yellow-red, respectively). Each assessment category is defined as follows:

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<sup>11</sup> Eugene Bardach, *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving* (New York: Chatham House Publishers, Seven Bridges Press, 2000), 20.

- **Cost:** This measurement considers overall cost at a project level as well as a practical level, or the ability for different solutions to acquire funding. Considered alongside impact, we can measure the overall efficiency of the solution.
- **Impact Potential:** This category measures to what extent the proposed solution addresses our known root causes under favorable circumstances, where the maximum potential impact is achieved. Section III outlines the root causes of illegal gold mining, which will form the baseline for effective impact. Prospective solutions should address root causes, the underlying causal factors, instead of focusing on surface-level issues.
- **Overall Efficiency:** This metric measures how well the prospective solution maximizes overall benefit relative to the cost of implementation. Combining the degree of overall cost and potential impact of a solution reveals the degree to which it is efficient (See Figure 6.). A highly efficient solution will deliver a high impact at a low cost, while a low impact and high-cost solution is considered highly inefficient.

|             | High Cost          | Low Cost         |
|-------------|--------------------|------------------|
| High Impact | Efficient          | Highly Efficient |
| Low Impact  | Highly Inefficient | Inefficient      |

Figure 6. A highly efficient solution should produce a high impact at a low cost. Scale from green to red indicates best to worst solutions, respectively.

- **Fairness:** An evaluative metric that is highly subjective, fairness will be used to take into account the welfare of the miners on an individual level and their communities by considering social justice. Fair solutions will not force miners to give up their livelihoods

but rather offer them options and opportunities to improve their practices or transition into sustainable economic alternatives.

- **Political Acceptability:** To be feasible, a policy must not be politically unacceptable—have too much opposition and/or too little support.<sup>12</sup> To evaluate this metric, we will have to consider the political process in Peru and the interactions between national and regional governments. The national legislature will support solutions that make them seem effective in the eyes of the public and international organizations. Regional mining interests will oppose any programs that threaten their livelihoods and economic opportunities.
- **Robustness:** This metric measures the ability of a policy to be implemented in an effective form. Policies often are not enacted as designed due to large administrative systems and distortion by bureaucratic interests, so an effective policy should anticipate and prevent adverse implementation outcomes like the capture of program benefits to an unintended constituency or misuse of program resources.<sup>13</sup>
- **Replicability:** This metric considers the ability for a policy or solution to be effectively replicated by a different entity facing the same problem(s). Replicability is desirable in an effective solution, so other countries facing the same problems can look to Peru and other involved actors as models of success.

Assembled into a report card, these metrics will be able to identify opportunities to improve program effectiveness in reducing illegal gold mining activity and its harmful practices in Peru and elsewhere. The hope is that this report will be able to shed light on some of the complexities surrounding this issue and the challenges that the international community faces with regard to

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<sup>12</sup> Bardach, 24.

<sup>13</sup> Bardach, 25.

setting out a plan of action. As with any opportunity to enact new policies, the ultimate limitation in problem-solving and policymaking is the process. This thesis essentially applies a static, systematic process to a dynamic, ever-evolving situation like illegal gold mining in Peru. The end goal is to identify causal level events, circumstances, or phenomena that create the conditions for illegal gold mining to occur in the first place and to develop solutions that could potentially prevent this activity.

As a result of exploring commonly used management consulting problem-solving methods and public policy criteria, I will utilize the following plan:

1. Define the problem.
2. Identify root causes and set objectives.
3. Perform analysis of current and prospective solutions using policy evaluation criteria that align with our stated objectives.
4. Present the report card with final recommendations.

### **III. DEFINING THE PROBLEM: ILLEGAL GOLD MINING**

The first step in our approach is to define the problem by highlighting surface-level problems. We will then attempt to identify their root causes. The objectives we set will take these revelations into consideration while determining the course of our solutions analysis.

#### **Chapter 2. The Visible Problems**

##### **OVERVIEW: THE PERUVIAN GOLD MINING INDUSTRY**

Peru has one of the fastest-growing economies in Latin America with an average real GDP growth rate of 6.1% over the last decade.<sup>14</sup> Rich in natural resources, Peruvian economic development has long relied on extractive industries that exploit the country's metals and minerals. Gold and silver mining have existed for thousands of years in the region, even before the Incas. The Spaniards systematically exploited native labor to reach the valuable metals lying beneath the Andes and in turn, became an imperialist world power. Jump to 2017, and Peru produced 155 tons of gold, making it the largest gold producer in Latin America and the sixth-largest producer globally.<sup>15</sup> In 2018, gold production comprised ~16% (\$7.13 billion)<sup>16</sup> of Peru's net exports, making it considerably more important to the Peruvian economy as a whole when compared to neighboring countries like Mexico, another large gold producer in Latin America whose \$5.1 billion in gold exports only account for 1.2% of its net exports.<sup>17</sup> The Peruvian economy heavily relies on gold production.

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<sup>14</sup> "Peru," World Bank, accessed April 2, 2020, <http://www.worldbank.org/en/country/peru>.

<sup>15</sup> "Mineral Commodity Summary 2018," accessed April 23, 2018, <https://minerals.usgs.gov/minerals/pubs/commodity/gold/mcs-2018-gold.pdf>.

<sup>16</sup> "OEC - Peru (PER) Exports, Imports, and Trade Partners," accessed May 15, 2020, <https://oec.world/en/profile/country/per/>.

<sup>17</sup> "OEC - Mexico (MEX) Exports, Imports, and Trade Partners," accessed May 20, 2020, <https://oec.world/en/profile/country/mex/>.

Gold mining operations in Peru are classified by the following legal parameters: artisanal mines are those that hold mining concessions of less than 1,000 hectares with a production capacity of less than 25 metric tons per day (TMD); small-scale mines comprise up to 2,000 hectares and have a capacity of up to 350 TMD; medium-sized mines have a capacity of 350-5,000 TMD; large-scale mines have a capacity of over 5,000 TMD.<sup>18</sup> Medium- and large-scale mining operations are typically formalized entities; however, much of the small-scale mining activity operates outside of the formal economy and is considered either informal or illegal economic activity. The Peruvian government makes a legal distinction between informal and illegal mining. Informal miners operate on mining concessions with or without permission from concession holders or in any area where mining is allowed using authorized equipment. Miners are considered illegal when they operate in areas where gold mining is banned such as native lands and the buffer zones of protected reserves in Madre de Dios or use prohibited machinery and mining equipment such as *dragas*, or dredges. Dredges are illegal because of the significant environmental damage that they cause, although miners still use them because of their high processing capacity of around 1000 TMD per day.<sup>19</sup> In 2012, the government established a formalization process for small-scale miners, requiring: “a title to the concession or an agreement with the concession owner, authorization to work the land, an approved environmental impact study, water rights, a certificate of the non-existence of archaeological artifacts, authorization to carry out exploration and/or processing activities, and accreditation as a small-scale or artisanal miner, among other things.”<sup>20</sup> Any miner that did not officially declare an intent to formalize was

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<sup>18</sup> “Indicators of Forced Labor in Gold Mining in Peru,” accessed April 22, 2018, [http://www.verite.org/wp-content/uploads/2016/11/Indicators-of-Forced-Labor-in-Gold-Mining-in-Peru\\_0.pdf](http://www.verite.org/wp-content/uploads/2016/11/Indicators-of-Forced-Labor-in-Gold-Mining-in-Peru_0.pdf).

<sup>19</sup> José Álvarez et al., “INFORME PREPARADO POR EL INSTITUTO DE LA AMA ZONÍA PERUANA - IIAP Y EL MINISTERIO DEL AMBIENTE,” n.d., 54.

<sup>20</sup> “Indicators of Forced Labor in Gold Mining in Peru.”

categorized as illegal, so many small-scale miners that were previously classified as informal became illegal under the new decree, leaving the legal status of many mining operations in limbo. It is estimated that illegal and informal mining comprises ~20% of Peru's total gold production<sup>21</sup> and directly employs over 500,000 Peruvians with 40,000 in Madre de Dios alone.<sup>22</sup> In 2011, Peru's illegal mining exports were estimated to generate \$1.79 billion in revenue or 22% of Peru's total gold exports that year.<sup>23</sup>

In the past, the taxes collected from large, formalized mines have contributed to almost one quarter of internal tax revenues for the Peruvian government and are distributed to municipal governments in mining regions to be used for infrastructure projects.<sup>24</sup> In this manner, large-scale mines create opportunities for economic development in rural regions of Peru while also providing direct employment that pays laborers almost double of what they would earn working in other industries in Peru.<sup>25</sup> Despite these advantages, Peru has not been able to fully unlock the potential benefits from formal mining activity. The government is unable to raise and collect taxes effectively. While some revenue is gained, a significant amount of potential revenue is lost. In 2011, then-presidential candidate Ollanta Humala vowed to raise taxes on formal mines to fund rural development projects. Taxes across the industry were raised by \$1 billion, but the

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<sup>21</sup> David J.X. Gonzalez, "Opportunities, Not Oppression, to Stop Illegal Mining in the Peruvian Amazon | YaleGlobal Online," February 18, 2016, <https://yaleglobal.yale.edu/content/opportunities-not-oppression-stop-illegal-mining-peruvian-amazon>.

<sup>22</sup> "Peru Fights Gold Fever with Fire and Military Force - The Washington Post," accessed April 9, 2020, [https://www.washingtonpost.com/world/peru-fights-gold-fever-with-fire-and-military-force/2014/08/18/2c9db976-bfd5-4217-a846-31bde9871e21\\_story.html](https://www.washingtonpost.com/world/peru-fights-gold-fever-with-fire-and-military-force/2014/08/18/2c9db976-bfd5-4217-a846-31bde9871e21_story.html).

<sup>23</sup> Elyssa Pachico, "'Illegal Mining Bigger than Drug Trade in Peru': Analyst," *InSight Crime* (blog), May 17, 2012, <https://www.insightcrime.org/news/brief/illegal-mining-bigger-than-drug-trade-in-peru-analyst/>.

<sup>24</sup> Jane Korinek, "Managing the Minerals Sector: Implications for Trade from Peru and Colombia," no. 186 (December 2, 2015): 11, <https://doi.org/10.1787/5jrp6wrc2r71-en>.

<sup>25</sup> Korinek, 14.



government failed to collect approximately \$877 million.<sup>26</sup> The lost tax revenue could be invested into development projects, bringing additional prosperity to mining regions. It could also be used to help rural communities near mining operations mitigate the negative environmental impacts of mining such as contaminated water sources, redirection of water sources, lead poisoning, and take-over of agricultural land. While large mining operations are subject to strict environmental and worker safety regulations from the Ministry of the Environment (MINAM) and the Ministry of Energy and Mining (MINEM), environmental contamination still, creating tensions between mining corporations and local communities where local livelihoods have been affected. Additionally, the distribution of the municipal tax dollars from mining is largely ineffective because of corruption and lack of government accountability. In Peru, government institutions are largely concentrated in the capital, Lima, where almost one half of the entire Peruvian population lives. This means that regional and municipal government officials in rural mining regions lack accountability. Nine out of 25 regional governors were accused of corruption in 2014 alone.<sup>27</sup> Also, the fragmented distribution of funding prevents large government-sponsored infrastructure projects from taking shape in mining regions. While many imperfections exist the government's ability to collect taxes and use them for the benefit of mining communities, informal mining remains an important source of potential tax revenue for rural areas that has not yet been tapped into. Small-scale gold mining could provide an estimated \$305 million in taxes per year across Peru<sup>28</sup> and between S/50 and 200 million (\$14.6-58

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<sup>26</sup> Alina Buccella, "Can the Minamata Convention on Mercury Solve Peru's Illegal Artisanal Gold Mining Problem?," *Yearbook of International Environmental Law; Oxford* 24, no. 1 (2013): 182, <http://dx.doi.org/10.1093/yiel/yvu063>.

<sup>27</sup> Korinek, "Managing the Minerals Sector," 32.

<sup>28</sup> Elie Gardner, "Peru Battles the Golden Curse of Madre de Dios," *Nature News* 486, no. 7403 (June 21, 2012): 306, <https://doi.org/10.1038/486306a>.

million) in Madre de Dios alone.<sup>29</sup> Finding ways to mitigate the negative effects of small-scale mining with the positive benefits from tax revenue is an important challenge that policymakers face in managing the small-scale gold mining sector in Peru.

While various governmental agencies regulate large-scale mining operations, their regulatory capacities have failed to address small-scale mining, which has become a burgeoning public health and environmental disaster across Peru. This problem has worsened since the booming gold prices in 2005, but the spotlight has only recently intensified on illegal and informal Peruvian mining practices because of increased concerns about the environmental destruction in the sensitive southern Amazon region. The Amazon jungle is nicknamed the “lungs of the earth” because of the vast amounts of carbon dioxide it is able to convert into breathable oxygen. Madre de Dios is a concentrated hub of biodiversity, so environmentalists fear the destructive nature of illegal mining and its inevitable effects on the natural environment. In 2010, 370,000 acres of forest had already been cut down by illegal and informal mining activity.<sup>30</sup> But some argue that international organizations are only concerned with the environmental damage and ignore the human costs of illegal gold mining. This thesis will explore the full extent of the damage that illegal gold mining activity causes in the following section.

The Madre de Dios region will be the particular focus of this paper. It is located in the southeastern Amazonian region of Peru. The capital is a town called Puerto Maldonado that serves as a hub for illegal gold mining activities. It is worth noting that illegal and informal mining is prevalent in most areas of Peru such as Piura (on the northern coast) and La Rinconada

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<sup>29</sup> Álvarez et al., “INFORME PREPARADO POR EL INSTITUTO DE LA AMA ZONÍA PERUANA - IIAP Y EL MINISTERIO DEL AMBIENTE.”

<sup>30</sup> “Gold Mining Fact Sheet,” accessed May 2, 2018, [http://www.amazonconservation.org/pdf/gold\\_mining\\_fact\\_sheet.pdf](http://www.amazonconservation.org/pdf/gold_mining_fact_sheet.pdf).

(in the southern Andes), showing that illegal mining is a deep-rooted issue across the country. La Rinconada is the highest populated settlement in the world, and miners dig through glaciers and rock to reach the valuable gold ore beneath. In La Rinconada alone, over 60,000 Peruvians are employed in the mines, risking their lives every day for the opportunity to discover gold.<sup>31</sup> But miners in La Rinconada do not get as much attention because they do not threaten the Amazon. Over 500,000 Peruvians engage in small-scale mining activities across the country and this number increases every year as men and women flock to gold producing regions seeking new economic opportunities.<sup>32</sup> It is the use of harmful and exploitative mining practices that poses huge risks to miners, indigenous communities, and the environment.

#### **DAMAGE REPORT: ENVIRONMENTAL COST**

Amazonian ecosystems are fragile and, therefore, can only support small-scale gold mining on a limited and regulated scale. The surging price of gold combined with the construction of the Interoceanic Highway from the Peruvian Pacific coast to Brazil created a gold rush. Miners flocked to Madre de Dios and invaded protected lands or empty concessions for gold mining. In Madre de Dios, mining is allowed in a strip of land called the “mining corridor.” Any mining activity here is considered informal and not illegal when miners declare their intent to formalize and use only authorized equipment. Miners can expect to extract 12-18g of gold per day in the mining corridor.<sup>33</sup> Right across the Interoceanic Highway is La Pampa, a hub of illegal mining consisting of a 20km strip of land along the highway in the buffer zone of the National Reserve of Tambopata. Alluvial gold is much more concentrated in illegal areas like La Pampa

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<sup>31</sup> Walker Dawson and Nick Neumann, *La Rinconada - Chasing the Peruvian High*, Youtube Video (Breaking Borders, 2015), <https://www.youtube.com/watch?v=RLPPiiG3seM>.

<sup>32</sup> David Gagne, “With Election Looming, Peru’s Fujimori Courts Illegal Miners,” *InSight Crime* (blog), June 3, 2016, <https://www.insightcrime.org/news/brief/with-election-looming-peru-fujimori-courts-illegal-miners/>.

<sup>33</sup> Suzanne Daley, “Peru Scrambles to Drive Out Illegal Gold Mining and Save Precious Land,” *The New York Times*, July 25, 2016, sec. World, <https://www.nytimes.com/2016/07/26/world/americas/peru-illegal-gold-mining-latin-america.html>.

and Tambopata than in the designated mining corridor. In La Pampa, miners are able to extract 60-80g of gold per day, and in the Tambopata Reserve itself, as much as 150-200g of gold can be extracted per day.<sup>34</sup> In protected areas and buffer zones, all forms of mining activity are illegal, but the lure of more gold and profits attracts more miners.



Figure 7. Map of Madre de Dios showing the mining corridor, where mining is allowed, and La Pampa with Tambopata National Reserve, where all mining activity is banned.<sup>35</sup>

Deforestation is a major environmental issue in Madre de Dios, since miners clear cut forests to access the alluvial gold held in the topsoil underneath. MAAP, a satellite mapping project, has uncovered the true extent of the damage caused by illegal gold mining over time. Between 1985, when the project began, and 2017, 95,750 hectares (~240,000 acres) of land was deforested in the southeastern region of Peru.<sup>36</sup> The same study reported that more than two-thirds of that deforestation occurred between 2006 and 2017, an area equivalent to 90,456 soccer fields. Figure 8 shows the extent of the spread of deforestation in La Pampa from illegal gold mining activity in recent years.

<sup>34</sup> Daley.

<sup>35</sup> “MAAP #115: Illegal Gold Mining in the Amazon, Part 1: Peru,” *MAAP* (blog), January 17, 2020, [https://maaproject.org/2020/mining\\_frontiers\\_peru/](https://maaproject.org/2020/mining_frontiers_peru/).

<sup>36</sup> “CINCIA Research Brief: Three Decades of Deforestation,” accessed May 15, 2020, <http://cincia.wfu.edu/wp-content/uploads/CINCIA-Research-Brief-1-Three-Decades-of-Deforestation.pdf>.

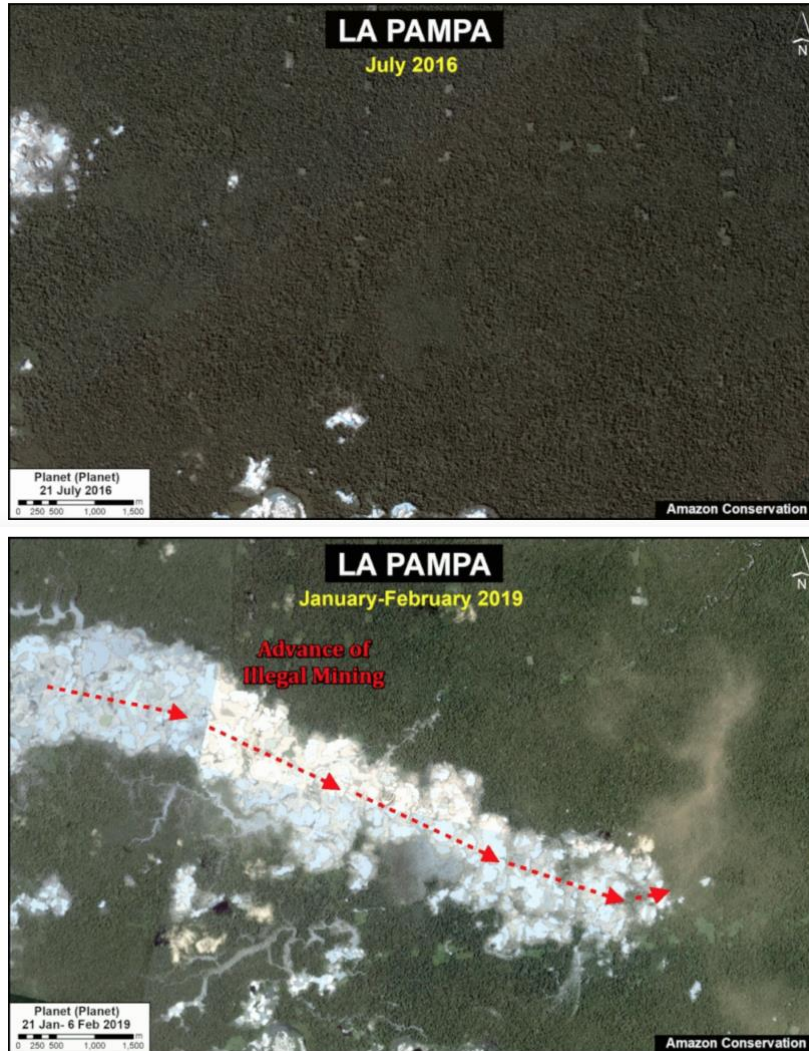


Figure 8. Satellite images show the extent of deforestation in La Pampa from illegal gold mining activity.<sup>37</sup>

The Interoceanic Highway that was constructed to give Brazil access to Chinese markets (but that some allege was built for political favors<sup>38</sup>...), was constructed through Madre de Dios from 2006 to 2011. The highway runs along the border between the mining corridor and the La Pampa/Tambopata area, giving ASGM operations easy access to the acres. Deforestation from illegal mining increased by 425% in the region during the construction of the road from 2,010

<sup>37</sup> “MAAP #115.”

<sup>38</sup> Gagne, “With Election Looming, Peru’s Fujimori Courts Illegal Miners.”

hectares/year to 8,536 hectares/year; deforestation peaked in 2017 with 9,860 hectares of Amazon deforested.<sup>39</sup>

Some argue that focusing on the deforestation from ASGM in Madre de Dios is an elitist perspective that ignores the importance of small-scale gold mining for wealth distribution to the region (because trees can be replanted and denying Peruvians the right to extract their gold is unfair), and that the environmental safeguards that are required for formalization are burdensome; however, mercury used in gold ore processing by small-scale miners causes severe human health complications as well as additional negative environmental consequences that need urgent attention.

### **ASGM AND THE MERCURY PROBLEM**

While typical mining processes vary according to regional conditions, in Madre de Dios gold extraction practices are particularly harsh on the miners as well as the environment. Amazonian miners use a rudimentary mercury amalgamation process called whole ore amalgamation (WOA) to extract and refine gold ore. Wide tracts of forested land near riverbanks are slashed and burned, and gold-containing mud is extracted leaving behind open pits. This mud is then pumped through sluices layered with a thick carpet that traps heavy sediment in the crevices—gold is heavier than the silt and gets trapped. Miners then gather the sediment in large barrels into which they also dump mercury. Mercury binds to the gold particles with the help of miners who partially immerse themselves in these mercury-filled barrels (or enlist child workers) to stomp around in the mixture, creating a gold-mercury amalgam. This amalgam is poured into a bowl where the mercury is then burned off, leaving behind 99.9% pure gold. The burning-off

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<sup>39</sup> “CINCIA Research Brief: Three Decades of Deforestation.”

process often takes place inside miners' huts, adjacent to where they cook their own meals, meaning that miners often directly inhale toxic mercury fumes.<sup>40</sup>

Part of what makes small-scale mining so detrimental to public and environmental health is the vast amount of mercury dumped into the Amazon ecosystem. Peru stopped importing mercury in 2015 and banned the use of domestically produced mercury for mining, yet mercury is still readily accessible to miners through black markets.<sup>41</sup> In 2016, President Ollanta Humala was forced to declare a 60-day state of emergency in Madre de Dios due to extremely high levels of mercury contamination from mining activities.<sup>42</sup> An estimated 44 to 50 tonnes of mercury are used for small-scale mining in Madre de Dios per year, almost all of which is released into the environment.<sup>43</sup> For reference, the U.S. Environmental Protection Agency advises to contact a hazardous waste specialist if any mercury spill larger than that produced by a broken thermometer, which contains ~0.7g of mercury, occurs.<sup>44</sup>

People living in or near SSM operations are often exposed to mercury from vapors produced by burning the amalgam or from consuming fish or drinking water contaminated with methylmercury (what mercury turns into after release into the environment). As an element, mercury does not break down but accumulates in riverbanks, plants, fish, and, farther up the food chain, in people. Nine out of every 15 fish sold in Puerto Maldonado's marketplace were found

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<sup>40</sup> *Americas Now-- Time Is Dust: Peru's Illegal Gold Mining 03/07/2016*, 2016, [https://www.youtube.com/watch?v=eYATY2j\\_Ago](https://www.youtube.com/watch?v=eYATY2j_Ago).

<sup>41</sup> David J.X. Gonzalez, "Treaty Does Not Stop Illicit Mercury Trade in South America | YaleGlobal Online," YaleGlobal Online, February 13, 2018, <https://yaleglobal.yale.edu/content/treaty-does-not-stop-illicit-mercury-trade-south-america>.

<sup>42</sup> Cecilia Jamasmie, "State of Emergency in Peru over Mercury Poisoning from Illegal Gold Mining," *MINING.Com* (blog), May 24, 2016, <http://www.mining.com/state-of-emergency-in-peru-over-mercury-poisoning-from-illegal-gold-mining/>.

<sup>43</sup> David J.X. Gonzalez, "Treaty Does Not Stop Illicit Mercury Trade in South America | YaleGlobal Online."

<sup>44</sup> "Peru Fights Gold Fever with Fire and Military Force - The Washington Post."

to contain high levels of mercury.<sup>45</sup> Hair follicle tests to measure mercury concentration have also been conducted on native communities that mostly rely on local fish as their primary source of protein, and the results showed concerning levels of mercury in local members. 78% of adults in Puerto Maldonado had hair concentrations of mercury that were higher than the international reference limit, and women of childbearing age had the highest overall average concentration.<sup>46</sup> This is particularly concerning because mercury can have serious effects on developing fetuses, causing severe neurological damage when transferred to the fetus through the placenta.

The devastating health effects of mercury are well documented. Miners are often engaged in this industry for years, often starting as teenagers. Both forms of mercury, elemental (which is used in the mining processes) and methylmercury are toxic to the central and peripheral nervous systems. In SSM communities in Burkina Faso, the World Health Organization reports common symptoms of individuals involved in mercury-gold amalgamation or gold dealing and selling included frequent headaches, sleep disorders, unusual tiredness, trembling and vision disorders.<sup>47</sup> Inhaled mercury vapors are rapidly absorbed into the bloodstream and negatively affect the nervous, digestive, and immune systems, lungs, and kidneys. Neurological disorders such as mental retardation, seizures, vision and hearing loss, delayed mental or physical development, language disorders, and memory loss are commonly reported long-term side effects of mercury exposure.<sup>48</sup>

If the health risks of mercury exposure are so serious, why do small-scale miners continue to use it? For many miners, mercury is quick and easy to use for the purpose of

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<sup>45</sup> “Carnegie Department of Global Ecology,” accessed April 23, 2018, <https://dgc.carnegiescience.edu/research/CAMEP/Findings.html>.

<sup>46</sup> “Carnegie Department of Global Ecology.”

<sup>47</sup> “Mercury ASGM,” accessed April 22, 2018, [http://www.who.int/ipcs/assessment/public\\_health/mercury\\_asgm.pdf](http://www.who.int/ipcs/assessment/public_health/mercury_asgm.pdf).

<sup>48</sup> “Mercury ASGM.”



isolating gold particles in an amalgam. Mercury is also cheaper to use than most alternative techniques, such as gravimetric ore processing technology, which requires significant investment and does not process as much ore. Only one person is needed to process the amalgam, so independent miners can easily use this technique, especially because a single miner can process small batches of ore at a time which helps manageability of this process. Many miners are unaware of the risks associated with mercury exposure and simply follow their boss's instructions; other miners are aware of the health risks but are unable to afford more expensive alternative methods.<sup>49</sup> Some miners don't believe the warnings and were reportedly willing to drink mercury to prove its safety.<sup>50</sup>

The effects of mercury use in SSM are not limited to mining localities. Mercury cycles globally. Mercury that is burned from amalgam is highly mobile in the environment, eventually depositing in soil and sediments where bacteria and microbes convert elemental mercury into methylmercury that concentrates at high levels of the food chain because of biomagnification. This can contaminate seafood that people eat as well as agricultural products because 95% of ingested methylmercury is absorbed by the body. In 2010, global emissions of mercury from anthropogenic sources were estimated at 1,400 tonnes with artisanal and small-scale mining being the largest anthropogenic contributor to this atmospheric mercury, comprising 37% of total atmospheric mercury output.<sup>51</sup> Mercury from SSM accounts for much of the mercury released into aquatic environments. In addition to that, deforestation from clearing land for mining

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<sup>49</sup> "Reducing Mercury in Artisanal Gold Mining," accessed April 22, 2018, [https://wedocs.unep.org/bitstream/handle/20.500.11822/11524/reducing\\_mercury\\_artisanal\\_gold\\_mining.pdf?sequence=1&isAllowed=](https://wedocs.unep.org/bitstream/handle/20.500.11822/11524/reducing_mercury_artisanal_gold_mining.pdf?sequence=1&isAllowed=).

<sup>50</sup> Gardner, "Peru Battles the Golden Curse of Madre de Dios."

<sup>51</sup> Louisa J. Esdaile and Justin M. Chalker, "The Mercury Problem in Artisanal and Small-Scale Gold Mining," *Chemistry (Weinheim an Der Bergstrasse, Germany)* 24, no. 27 (May 11, 2018): 6905–16, <https://doi.org/10.1002/chem.201704840>.

releases mercury held in soils.<sup>52</sup> The mercury disposal from SSM puts Amazonian communities, particularly miners and indigenous groups that rely on river ecosystems for water and fish, at serious risk.

### **LABOR CONDITIONS AND CRIMINAL ACTIVITY IN MADRE DE DIOS**

Soaring prices of gold have managed to attract young men to Madre de Dios with the promise of profitable earnings. Some were convinced by their own family members to join the gold rush; however, upon arrival, many were forced into hazardous labor conditions and practices, sometimes through debt bondage and other times at gunpoint.

The remoteness of the mining camps leaves miners vulnerable to exploitation by concession owners or wealthy, more established miners. Multiple reports have found evidence of forced labor and child labor in the gold mining in Madre de Dios. Some workers are exploited through debt bondages. Established miners provide deceptive loans to newcomers. These new workers are then forced to pay back the loans through free or reduced-pay labor. Rich miners and concession owners easily exploit smaller, self-employed miners because some level of formalization is required to sell mined gold. Other shady or coercive middlemen buy illegal gold at low prices and sell it off at higher prices to international buyers, serving as a market access point to miners in the most remote regions of the country.

But miners have other eager buyers willing to buy their gold: criminal organizations. The disparity between middlemen prices and international gold market prices incentivizes small miners to sell their gold to criminal networks who are willing to pay higher prices for illegally

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<sup>52</sup> United Nations Environment Programme, *Mercury: A Time to Act*, 2013, [http://www.unep.org/PDF/PressReleases/Mercury\\_TimeToAct.pdf](http://www.unep.org/PDF/PressReleases/Mercury_TimeToAct.pdf).

mined gold. Illegal gold can be used by these criminal groups to launder drug profits and for ease of transporting funds. One regular-sized brick of gold is equivalent to over \$500,000.

Illegal and informal miners do not operate in accordance with any kind of occupational safety measures. This makes mercury exposure inevitable. Other health and safety risks include exposure to sunlight for prolonged periods of time which causes skin damage, dehydration, and severe sunburns that increase the risk for cancer. Accidents are also common because of the rudimentary technology often employed. Workers have no form of social security or medical coverage, and miners interviewed by Verité, a labor rights watchdog group, reported that fatal accidents were common. Miners killed on the job were often buried in unmarked graves and no information was provided to their families.<sup>53</sup> The remote and isolated locations of many of the mining camps make it impossible for authorities to closely monitor labor conditions and enforce occupational safety standards.

Sexual exploitation is also a serious issue in Madre de Dios. The region has a high proportion of young men, and ramshackle bars and gentlemen's clubs line the roads near mining communities. Many of the women working are underage or come from abroad without documentation. They are recruited to move to Madre de Dios to work as cooks or in other supporting jobs but, upon arrival, are forced into prostitution. Moving people throughout the region is easy because rivers are used daily by thousands of people and are sparsely policed. In October 2011, the police in Madre de Dios managed to rescue 293 female trafficking victims, seven of whom were minors.<sup>54</sup>

In addition to deceptive labor recruitment tactics and sex trafficking, child labor is also a major issue when it comes to illegal gold mining, especially because of mercury exposure.

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<sup>53</sup> "Indicators of Forced Labor in Gold Mining in Peru."

<sup>54</sup> "Indicators of Forced Labor in Gold Mining in Peru," 22.

Children commonly work alongside their own family members or even independently. Estimates of how many children work in the illegal and informal mines of Madre de Dios are conflicting, but because of the extremely dangerous conditions and labor tasks assigned to children such as using mercury to process amalgam and carrying heavy loads, children working in mining are at high risk of serious injury and reduced health and mental development, leading the International Labor Organization to categorize child labor in mining as a Worst Form of Child Labor.<sup>55</sup>

Extensive criminal networks support the burgeoning illegal gold mining industry in Madre de Dios. As previously mentioned, criminal organizations buy illegally mined gold at high prices because gold holds its value and is a useful alternative to banking systems for hiding and storing profits from drugs and weapons trafficking. Additionally, vast smuggling networks exist to provide miners with capital goods and regulated resources like gasoline. The deeply intertwined relationship between criminal groups and gold miners makes formalization, a process which requires cooperation with government entities, unlikely and policing efforts dangerous. A “no rules apply” type of system has developed on protected lands like La Pampa and Tambopata National Reserve. This is because miners who operate in protected territories are openly engaging in illegal mining activities that are more likely to be tied to criminal networks. They are more likely to counter police raids with their own weapons.

The issue of illegal gold mining in the Amazon region in Peru requires urgent attention to reduce the environmental burden and human health and safety risks posed by dangerous working conditions and criminal threats.

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<sup>55</sup> “Indicators of Forced Labor in Gold Mining in Peru,” 23.

### Chapter 3. Identifying Root Causes

The economy of Madre de Dios is closely tied to gold mining—legal, illegal, and informal—with it representing 41% of the region’s total GDP.<sup>56</sup> Including industries related to gold mining like fuel and transportation, 70% of Madre de Dios’ GDP, or 7 out of every 10 soles (the Peruvian currency), is thought to be influenced by gold extraction. The gold production from Madre de Dios is also important for the national economy; a recent news article reported that Madre de Dios produces 11% of Peruvian gold exports even though one-third (~412,000 oz) of this gold is illegally mined.<sup>57</sup>

My first step is to break down the gold market of Madre de Dios into supply and demand factors to examine the workings of its regional gold economy at a more detailed level. Institutional weaknesses also contribute to the proliferation of illegal gold mining, but these issues require long-term structural changes that are out of scope of this project. For now, corruption and lack of government authority at the levels that they currently exist are additional factors to consider in our analysis.

#### CAUSAL FACTORS: SUPPLY SIDE

On the supply side, one factor that contributes to the proliferation of small-scale gold mining is poverty. The lack of alternative economic opportunities elsewhere in Peru and in the region means that prospective miners are left with few options to sustain themselves. Lack of education also limits the miners’ alternatives and means that many miners are either unaware of the risks of mercury use or simply do not know to take the warnings seriously. One report found that 70.6% of Peruvians living in extreme poverty live in the *Sierra*, or highland regions of Peru,

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<sup>56</sup> Jorge Falen, “Madre de Dios: una economía relacionada con la actividad minera [INFORME],” *El Comercio*, April 11, 2018, <https://elcomercio.pe/peru/oro-brillo-selva-informe-noticia-510835>.

<sup>57</sup> Falen.

where most miners report being from.<sup>58</sup> While national poverty rates increased nationally from 2016 to 2017, poverty rates in Madre de Dios decreased 3% overall within the same time period.<sup>59</sup> Additionally in 2016, 51.9% of people above the age of 15 and living below the poverty line reported either some primary school completion or no education level attained at all.<sup>60</sup> Miners can earn lucrative salaries through illegal mining as compared to agriculture or fishing, and it does not require an education, only familiarity with the extraction and refinement processes, which are learned on the job. One report estimated that miners can earn between \$100 and \$200 in a 24-hour shift, or the equivalent of the average of one month's wages in Madre de Dios.<sup>61</sup> For comparison, a farm laborer earns between \$10-15 per day. The difference is enough to lure men, especially uneducated men from the poorest highland regions, to Madre de Dios.

With few economic opportunities and without education, many people seek gold mining in Madre de Dios as an opportunity to earn a decent wage. This is supported by the positive relationship between gold prices and level of small-scale gold mining in Madre de Dios. When the price of gold spiked in 2008, as investors in developed countries sought value-preserving investments in gold amidst the economic crash, mining activity increased in Madre de Dios (See Figure 9 below.), demonstrating that higher gold prices are associated with more illegal mining activity in the region. The lure of gold and prosperity incentivizes young men to move to the Amazon with the promise of sizeable profits offsetting the inherent risks associated with illegal gold mining.

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<sup>58</sup> "Perfil de La Pobreza," accessed May 15, 2020, [https://www.inei.gob.pe/media/MenuRecursivo/publicaciones\\_digitales/Est/Lib1425/cap04.pdf](https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1425/cap04.pdf).

<sup>59</sup> Luis Alegría, "Pobreza en el Perú: ¿Cómo combatirla?," *El Comercio*, April 25, 2018, <https://elcomercio.pe/economia/peru/cusco-lidero-alza-pobreza-combatirla-noticia-514809>.

<sup>60</sup> "Perfil de La Pobreza," 64.

<sup>61</sup> Seth Robbins, "Illegal Mining Crackdown May Push Peru's Former Miners to Coca, Timber," *InSight Crime* (blog), June 18, 2019, <https://www.insightcrime.org/news/analysis/illegal-mining-crackdown-peru-former-miners-coca-timber/>.

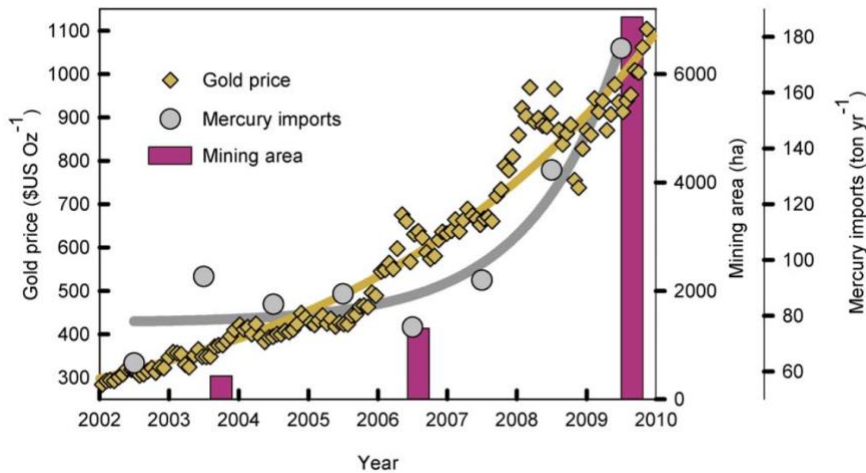


Figure 9. Shows the correlation between gold prices, mercury imports, and mining area from 2002 to 2010, revealing a clear positive relationship between the three variables.<sup>62</sup>

Lastly, the lack of access to financing for miners means that they face few options for the technology that they use to extract and process gold ore. Mercury is cheap, does not require expertise to use, and is readily available. Gravimetric processors that use gravity to sort heavier gold particles from lighter silt can actually recover a higher amount of gold from ore, but the equipment is expensive (~\$5,000-10,000 per machine<sup>63</sup>) and cannot process the same volume of ore as illegal technology such as dredges that can process 1000 tonnes of ore per day.<sup>64</sup> Miners try to process as much ore per day as possible to extract the most amount of gold. Allowing miners to use only equipment that is more expensive and less profitable is not a practical solution without providing financial support and technical assistance to encourage miners to use more responsible practices.

<sup>62</sup> Jennifer J. Swenson et al., “Gold Mining in the Peruvian Amazon: Global Prices, Deforestation, and Mercury Imports,” *PLoS One; San Francisco* 6, no. 4 (April 2011): e18875, <http://dx.doi.org/10.1371/journal.pone.0018875>.

<sup>63</sup> “Reducing Mercury in Artisanal Gold Mining.”

<sup>64</sup> Álvarez et al., “INFORME PREPARADO POR EL INSTITUTO DE LA AMA ZONÍA PERUANA - IIAP Y EL MINISTERIO DEL AMBIENTE.”

## CAUSAL FACTORS: DEMAND SIDE

On the demand side, gold is a global commodity used by central banks, governments, and investors as a safe, value-preserving investment. Times of high risk and uncertainty cause capital flight from stock markets to gold bullion, and as previously mentioned, the increased price for gold creates greater profit potential for miners. As the Peruvian government made it more difficult for informal and illegal miners to sell their gold through formal markets by banning the purchase and sale of illegally mined gold, criminal organizations have realized its money laundering potential. Miners have been able to sell to criminal organizations who pay more than smaller middlemen and who use the gold to launder billions of dollars' worth of trafficked drugs and weapons sales. This is a huge problem and cause for concern that is not limited to Peru. It has recently been reported that terrorist organizations such as ISIS have been using similar tactics with illegal gold miners in Africa to finance their insurgencies.

Here is how money laundering using illegal gold works. Drug cartels with excess cash on hand from selling trafficked goods in the U.S. set up shell gold-buying companies in Peru. They pay for the illegally mined gold with cash, and then they in turn sell the gold to international refineries, who do not ask questions about where the gold is sourced from. In exchange for the gold, the shell company receives a wire transfer to a bank account, thus the money becomes "clean." Recently, three gold buyers in Miami were arrested for a \$3.6 billion gold laundering scheme.<sup>65</sup> Their company, NTR Metals, was U.S. gold refiner based in Miami and a gold supplier for companies like Apple and Tiffany & Co.

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<sup>65</sup> "How Drug Lords Make Billions Smuggling Gold to Miami for Your Jewelry and Phones," Miami Herald, accessed May 15, 2020, <https://www.miamiherald.com/news/local/community/miami-dade/article194187699.html>.



## **CAUSAL FACTORS: INSTITUTIONAL WEAKNESSES**

Institutional weaknesses in rural areas of Peru also encourages illegal mining activity. Corruption and lack of trust in government officials lead some miners to prefer to work informally or illegally, outside of traditional authority. Regional environmental features like rivers and dense vegetation make small-scale mining regulation enforcement in the region difficult. Locals report miners returning to their camps only a few days after police raids. Difficulties with enforcement also allow black markets to thrive, providing miners with easy access to mercury and illegal mining equipment. The sheer number of small-scale miners makes them a powerful political force in an institutionally weak area, with some arguing that the construction of the Interoceanic Highway was a ploy for Peruvian politicians to curry favor with small-scale miners in the region. The highway gives miners prime access to deep jungle regions that were previously inaccessible. Unfortunately, the intrinsic nature of institutional weakness makes it a problem that is difficult to root out because of challenges posed by corruption; therefore, our proposed solutions will not seek to address this problem directly. To do so would require sweeping institutional reforms that are unlikely to transpire in the near future. We are therefore forced to work with the political and legislative system in place, and an effective solution will incorporate measures to reduce the possibility of corruption and inefficient bureaucratic processes as much as possible.

Supply and demand market factors, as well as institutional weaknesses, create an environment that encourages the proliferation of illegal gold mining in off-limits areas of Madre de Dios. Effective solutions must be all-encompassing and will address these underlying factors, not only the surface-level consequences described in Chapter 2.

## Chapter 4. Objectives

After a thorough evaluation of surface-level problems and root causes allowing for the proliferation of illegal mining activity, it is important to consider what we ultimately would like to accomplish when thinking about possible solutions. Setting objectives is an important sub-step within problem defining because our objectives direct the course of the project.<sup>66</sup> In some sense we've already done this step by outlining our policy analysis criteria, but it is worth explicitly stating our ultimate objectives because some are obvious while others are not. Our policy evaluation criteria shed some light on our ultimate goals for a solution: efficiency, fairness, and practical considerations like political acceptability, robustness, and replicability. An ideal solution would fully satisfy all of these criteria, but it is important to ask why. Efficiency and practical considerations are obvious—a solution should solve the given problem effectively—but fairness is a highly subjective metric. Throughout my research, I've noticed a glaring pattern: international organizations and publications emphasize the negative environmental impacts and are quick to villainize the miners operating in Madre de Dios. The reality is that mining in all forms—small-scale, artisanal, large-scale—has occurred in Peru since ancient times, and there is still a lot of gold left. Gold mining will occur in some form for as long as both supply and demand for exist. As a country, Peru is rich in natural resources, and its gold could be a huge source of economic wealth for Peruvians if properly mined and managed. Illegal mining alone is said to produce between \$1.7 and 3 billion annually across Peru, twice as much as the country's drug trade which brings in an estimated \$1.2 billion,<sup>67</sup> so eliminating mining activity altogether

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<sup>66</sup> Albert, *How to Solve Business Problems*.

<sup>67</sup> Marguerite Cawley, "Illegal Gold Mining in Peru Worth \$3 Billion Annually: Govt," *InSight Crime* (blog), October 29, 2013, <https://www.insightcrime.org/news/brief/illegal-gold-mining-in-peru-worth-billion-annually-govt/>.

would place an undue burden on Peruvians. Additionally, gold mining can spread wealth to rural regions with miners receiving around 70% of the international price of gold for their production, helping to address issues of rural poverty and regional inequality that many countries suffer from.<sup>68</sup> So, if gold mining should not be eliminated completely, those that do engage in mining activities must do so in a sustainable way to mitigate the negative impacts of current practices. Thus, a “fair” solution does not completely outlaw or prevent gold mining, but it does encourage people who choose to mine to do so responsibly, adhering to recommended labor, technology, and environmental standards and staying away from protected, biologically sensitive areas. The burden imposed by measures necessary to achieve this goal should not be placed solely on the miners and instead should be shared by government and international organizations who can help alleviate the problem. I would judge this distribution of burden to be fair, especially given the direct and indirect roles in the proliferation of illegal gold mining that each actor contributes. Obviously, there will be some who disagree with this notion and claim that gold mining in the Amazon region should be halted altogether, but I would challenge this view because it ignores the human aspect of the issue, namely that considerations about miners and community members need to be taken into account. My definition of fairness will give human-centered concerns precedent over environmental ones; however, both are important.

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<sup>68</sup> “Reducing Mercury in Artisanal Gold Mining.”

## IV. SOLUTIONS ANALYSIS

Now that we have defined our problem and set objectives, the next step is to analyze current mechanisms through which the government aims to address illegal gold mining and evaluate potential solutions using the metrics that we established. Note: many observations, cost figures, plan details are sourced from second-hand sources such as newspapers and blog posts from people on the ground.

### Chapter 5: Current Solutions

*Operación Mercurio 2019* (Operation Mercury) is the most recent attempt of the Peruvian government to combat illegal mining after previous missions failed to effectively address the issue. While previous efforts mainly focused on destroying mining encampments and equipment, Operation Mercury 2019 has four many objectives:<sup>69</sup>

1. Evicting illegal mining operations.
2. Formalizing SSM in limited areas with responsible environmental and labor standards.
3. Addressing human trafficking and child labor.
4. Investing in the development of sustainable alternative occupations.

To achieve these objectives, Operation Mercury utilizes a three-pronged approach that includes short-term military action to establish authority in the region followed up with medium-term funding to advance formalization initiatives and long-term investment in sustainable development. Parts A through C will analyze each “prong” separately based on the criteria established in Section II. Additionally, Part D evaluates Peru’s approach to thwarting illegal gold

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<sup>69</sup> “Operación Mercurio 2019 | Public Policy Peru,” accessed May 9, 2020, <https://umdpolicyperu2016.wordpress.com/2019/04/03/operacion-mercurio-2019/>.

mining by implementing controls on the domestic mercury supply as a participant in the Minamata Convention. A summary report card will identify areas where each strategy could benefit from further support or complementary solutions.

#### **A. OPERATION MERCURY—SHORT-TERM IMPACT MILITARY OPERATIONS IN MADRE DE DIOS**



Figure 10: Peruvian National Police detonate explosives at a mining camp to destroy mining equipment.<sup>70</sup>

#### **Background**

This section evaluates the impact of the military campaigns that Peruvian presidents have used to confront illegal mining head on. Prior to Operation Mercury, the Peruvian government would periodically send military raids to Madre de Dios to disperse illegal miners and destroy their camps, but overall, these smaller raids achieved little. Illegal miners were still active in the

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<sup>70</sup> “Peru Fights Gold Fever with Fire and Military Force - The Washington Post.”

area, and deforestation continued at alarming rates. After years of mounting pressure from international organizations and frustration with the lack of formalization in the region (See Solution B.), the Peruvian government launched a larger “no-mercy” military campaign in 2014 with the aim of completely driving out the estimated 40,000 miners from Madre de Dios.

The 2014 military campaign confronted illegal miners in La Pampa, a corridor of concentrated illegal mining activity in Madre de Dios, and received public support in Lima and from international environmental activists, while angering the miners whose livelihoods were affected. The four-month-long operation did manage to stamp out illegal mining for a time—the country’s gold output dropped 14% that year because of the decreased gold output from Madre de Dios<sup>71</sup>—but the effects were only short term. An anonymous military commander spoke to the Washington Post about the raids, reporting that even though they had hit an estimated half of the illegal mining sites in La Pampa, helicopter flyovers a few days after revealed “the camps rebuilt and the dredgers running again.”<sup>72</sup> Allegedly, miners were tipped off about the raids beforehand, which allowed them to flee and to leave behind less valuable equipment to be destroyed or confiscated by the military, while taking their valuable machinery with them. Overall, only four illegal miners were prosecuted and sent to prison by authorities as a result of the 2014 raids.

The ongoing military engagements in Madre de Dios had little to show for, only serving to ingrain the miners’ anti-government sentiment. One study showed that deforestation actually increased by 240% during the period when military operations were ongoing,<sup>73</sup> indicating that the raids were largely ineffective in thwarting illegal mining activity.

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<sup>71</sup> “Peru Fights Gold Fever with Fire and Military Force - The Washington Post.”

<sup>72</sup> “Peru Fights Gold Fever with Fire and Military Force - The Washington Post.”

<sup>73</sup> “CINCIA Research Brief: Three Decades of Deforestation.”

## **Evaluating Military Raids: Plan Breakdown**

In 2019, the Peruvian government launched the initial phase of Operation Mercury that included immediate action in the form of military interventions at a much larger scale than previous raids. To kick off the operation, president Martín Vizcarra declared a 60-day national emergency and dispatched 1200 National Police and an additional 300 Navy military members to combat illegal mining in Madre de Dios, especially in the La Pampa area.<sup>74</sup> The operation was to be carried out in three phases. Phase one dedicated 14 days to evict illegal miners from a 2 km tract on the Interoceanic Highway. Phase two allotted 180 days to set up military bases in the area to prevent miners from re-entering, and phase three devotes two years to further establish the military bases and their long-term sustainability. Currently, the operation is in the midst of phase two. It is worth noting that the military raids targeted illegal miners operating in off-limits areas, like La Pampa within the Tambopata Reserve buffer zone, not informal miners operating within legal concessions or those who have initiated the formalization process.

## **Cost: Expensive and Constant Drain on Resources**

S/200 million (~\$60 million) were allocated to carry out this two- and half-year long military intervention, doubling the budget between 2013 and 2016 that saw 106 interdictions at the cost of S/93 million (~\$27 million).<sup>75</sup> The S/200 million in funds goes towards paying for the 1500 police and military officers as well as their equipment, transportation, housing, and other living costs throughout phase one. Interventions were conducted by air, land, and water, and teams from special forensic and explosives units were also onboarded. These are direct and high costs that cannot be recouped. Phase two is the “consolidation” phase, wherein the presence of

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<sup>74</sup> “Madre de Dios: 1200 policías y 300 militares realizarán operativos contra minería ilegal,” *SPDA Actualidad Ambiental* (blog), February 19, 2019, <https://www.actualidadambiental.pe/madre-de-dios-1500-policias-y-300-militares-realizaran-operativos-contra-mineria-ilegal/>.

<sup>75</sup> “Madre de Dios.”

the State is meant to be strengthened through the establishment of three temporary military bases, each one housing 100 military officers and 50 members of the National Police.<sup>76</sup>

Maintaining an active military force in the region is an expensive endeavor that requires constant funding. Additionally, there seems to be no plan to exit the region anytime soon, indicating that this military engagement will be ongoing and require continuous injections of expensive resources. If funding were to be cut, a sudden removal of military forces could destabilize the area by creating a power vacuum that criminal organizations could step into. In a visit to La Pampa in May 2019, Minister of the Interior, Carlos Morán, announced that Operation Mercury would not cease to operate until illegal mining was completely eradicated in the region.<sup>77</sup>

### **Impact: Operation Mercury Seeks to Address Surface Level Problems, Not Causal Factors**

The stated goal of this military operation is to completely eradicate mining in illegal areas in the region by driving out the miners and re-installing government authority in the region.<sup>78</sup> So far, findings show that the military raids are having significant, but short-term, effects. A report from the Monitoring of the Andean Amazon Project (MAAP) announced that since February of 2019, the initiation of Operation Mercury, deforestation attributed to illegal mining is down 92%.<sup>79</sup> During the first phase of the operation, military personnel rescued 51 trafficking victims, arrested 80 illegal miners, and confiscated S/53 million worth of goods and mining equipment. This represents a significant jump from the smaller 2014 operation where only four miners were

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<sup>76</sup> Redacción Peru21, “Madre de Dios: Inician segunda fase en operación Mercurio 2019 contra la minería ilegal,” Peru21, March 5, 2019, <https://peru21.pe/peru/madre-dios-inician-segunda-fase-operacion-mercurio-2019-mineria-ilegal-463719-noticia/>.

<sup>77</sup> “Madre de Dios: Operación Mercurio 2019 no cesará hasta erradicar minería ilegal,” accessed May 10, 2020, <https://www.gob.pe/institucion/mininter/noticias/28518-madre-de-dios-operacion-mercurio-2019-no-cesara-hasta-erradicar-mineria-ilegal/>.

<sup>78</sup> Cooperacción, “Madre de Dios: Inician Megaoperativo Contra Minería Ilegal - CooperAcción,” CooperAcción, February 19, 2019, <http://cooperaccion.org.pe/madre-de-dios-inician-megaoperativo-contra-mineria-ilegal/>.

<sup>79</sup> “MAAP #115.”



arrested; however, as suggested by the results of the previous raids, the impacts are likely only short term if miners return shortly after military officers depart.

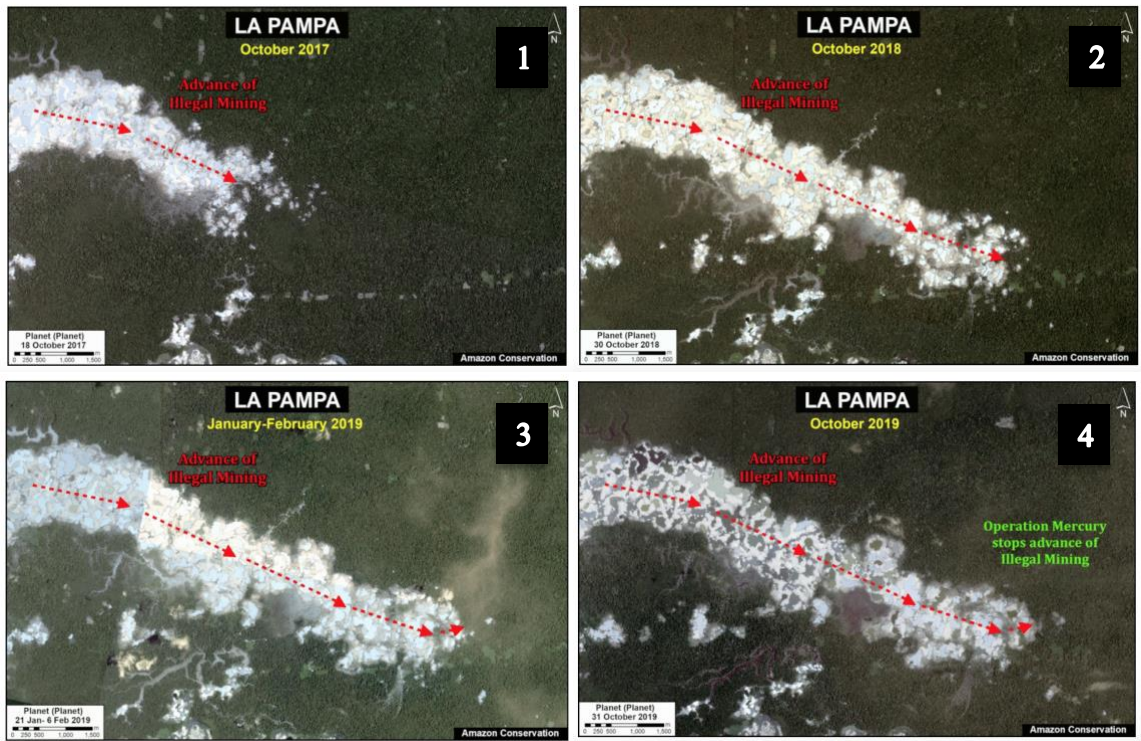


Figure 11: During *Operación Mercurio* (image 3 to 4), the rate of deforestation from illegal mining was reduced 92% compared to the rate of deforestation during the same time period last year (image 1 to 2).

If miners continued their operations shortly after military raids, we can predict that widespread illegal mining would continue shortly after the conclusion of this military operation. The military base would have to actively combat the illegal miners to deter their activity. Not only is this plan unsustainable from a funding perspective, but the miners' quick return indicates that the root causes of illegal mining are not being appropriately addressed, namely supply-side and demand-side factors. Institutional weaknesses are being side-stepped by direct federal intervention through the use of military force, as regional governments have been unable to effectively police the area and much less address the underlying causes of illegal gold mining. Overall, the 2019 raids as part of Operation Mercury have significantly reduced mining activity

and deforestation in the area, but for now, these results are only temporary. As long as there is still gold in the ground, there will be people seeking it out. Long-term strategies are crucial for the success of Operation Mercury.

### **Efficiency Score: High Cost + Low Impact = Highly Inefficient**

Operation Mercury was twice as expensive as the total cost of the intermittent military raids that occurred from 2013 to 2016. However, if the new military bases create lasting impact by establishing authority in the region and thwarting illegal mining activity, then the military operation could be categorized as efficient: high-impact and high-cost. As the operation is still ongoing, the final efficiency score is yet to be determined.

### **Fairness: Military Intervention Undermines Democracy**

The military is directly confronting the miners in La Pampa, destroying their machines and burning their camps. Community members, who are obliged by law to report incidents of illegal mining and logging on their privately-owned forest concessions, are caught in the middle, threatened by miners who accuse them of reporting their activity to the police while facing steep fines for not disclosing illegal mining activity.<sup>80</sup> Additionally, miners resent the military encroachment, further ingraining their anti-government sentiment. The military intervention claims to support formalization, but miners are less likely to cooperate with officials if they view the government negatively. This building resentment between small-scale miners and authority figures is evident in the escalation of violence during protests in Madre de Dios. In 2012, a pro-mining protest in Puerto Maldonado turned deadly, resulting in 3 deaths and 55 injuries,

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<sup>80</sup> “Peru: Madre de Dios Land Defenders Face Trouble Whether They Report Crimes or Not,” Mongabay Environmental News, July 5, 2019, <https://news.mongabay.com/2019/07/environmental-defenders-in-perus-madre-de-dios-face-double-jeopardy/>.

including 16 police officers.<sup>81</sup> Small-scale miners organized by the Mining Federation of Madre de Dios (FEDEMIN) were unhappy with the newly announced Supreme Decree N° 1102 that criminalized illegal mining for the first time, meaning that miners could face up to 10 years in prison instead of receiving a fine as was previously the case.<sup>82</sup> In the protest, one mininfederation leader blamed the demonstrations on the government for “sataniz[ing] us and criminaliz[ing] us” through the new law.<sup>83</sup> In 2015, another supreme decree established quotas on gasoline to prevent its use in illegal mining and logging, sparking months-long protests, road blockades, and tire burnings led by the illegal miners’ union.<sup>84</sup> Miners have a history of reacting to legislative changes and government restrictions on their livelihoods by mobilizing against new punitive regulatory measures through protests, roadblocks, and general strikes, mechanisms they use to protect their livelihoods. If formalization is successful through the new military-backed program, then miners ideally should receive assistance in the transition to sustainable mining in approved areas, but the barriers to formalization are big and efforts to formalize have been largely unsuccessful as we will examine in the medium-term plans of Operation Mercury. Government entities should be cautious in further alienating the illegal miners through military operations, as they will be less likely to cooperate with formalization efforts later on.

### **Political acceptability:**

The use of force and military operations sends a clear message to the miners: you should not be here. The show of strength makes the national government and the president in power

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<sup>81</sup> “Peru Pro-Mining Protest Turns Deadly,” The World from PRX, accessed May 10, 2020, <https://www.pri.org/stories/2012-03-15/peru-pro-mining-protest-turns-deadly>.

<sup>82</sup> “Decreto Legislativo N° 1102,” accessed May 11, 2020, <http://www.minam.gob.pe/wp-content/uploads/2017/04/Decreto-Legislativo-N%C2%B0-1102.pdf>.

<sup>83</sup> “Peru Pro-Mining Protest Turns Deadly.”

<sup>84</sup> “Illegal Gold Miners in Madre de Dios, Peru, Paralyze the Region with Protests,” Mongabay Environmental News, December 4, 2015, <https://news.mongabay.com/2015/12/illegal-gold-miners-in-madre-de-dios-peru-paralyze-the-region-with-protests/>.

look good to the general public—Humala (populist) enacted formalization efforts in 2012, PPK (center-right) pushed for Operation Mercury in 2019, and Vizcarra (also center-right) set his agenda to continue this plan. Despite having different political backgrounds, these presidents all pushed for immediate solutions to the illegal mining problem because it was a popular issue with voters in Lima and because they faced pressure from international actors such as the UN. Many anti-illegal mining efforts have been enacted through supreme decree, which functions similar to a U.S. executive order wherein the acting president can declare new laws and initiatives while bypassing the legislature. They send a message of presidential strength and effectiveness by enacting an action on paper, but in Latin America, these moves can be seen as authoritarian power grabs that undermine democracy and civil rights.

The state of emergency in Madre de Dios was extended on February 14, 2020 for another 60 days. During a state of emergency, constitutional civil liberties relating to personal liberty and security, inviolability of the domicile, freedom of assembly, and transit in the territory are suspended.<sup>85</sup> Latin America has a long history of authoritarian leaders who concentrate power and leadership in themselves, ruling through supreme decrees that undermine the legislative process. Suspension of civil liberties was often used as a method of oppression and control of the opposition in countries with military dictatorships in place, such as Argentina’s military junta and Chile’s Pinochet regime, which carried out systematic human rights violations to assert control and weed out opposition. Vizcarra recently dissolved Congress after it failed to agree on anti-corruption reforms, instituting a temporary legislative council in its place. Alberto Fujimori

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<sup>85</sup> “Prórroga del Estado de Emergencia declarado en los distritos de Madre de Dios y Huetupe de la provincia del Manu, y en los distritos de Tambopata, Inambari, Las Piedras y Laberinto de la provincia de Tambopata, departamento de Madre de Dios-DECRETO SUPREMO-N° 147-2019-PCM,” accessed May 10, 2020, <http://busquedas.elperuano.pe/normaslegales/prorroga-del-estado-de-emergencia-declarado-en-los-distritos-decreto-supremo-n-147-2019-pcm-1798195-2/>.

used the same executive power with military backing in the 1990s when he was fighting Sendero Luminoso and MRTA terrorist organizations in Peru. Currently, Fujimori is serving the remainder of a 25-year prison sentence for human rights violations that occurred during his presidency. Vizcarra is already facing legal questions surrounding his dissolution of Congress with some accusing him of abusing his powers as president and undermining Peruvian democracy.<sup>86</sup> Additionally, studies show that in Mexico, the military operations to stamp out the drug trade and instill public order resulted in a rapid spiral of human rights violations.<sup>87</sup> Right now, Vizcarra's moves in the region have generally been popular, but if Operation Mercury goes awry and violence escalates in the region (See "Other Considerations"), Vizcarra would be one step closer to suffering the same fate as Fujimori.

### **Robustness and Replicability: Little Cause for Concern**

I do not foresee any major issues with robustness and replicability under the present circumstances. As the result of direct military intervention, the federal government has essentially circumvented regional actors in order to pursue enforcement efforts, applying direct force where the military sees fit and reducing the potential for administrative inefficiencies hurting or slowing down action. The program should ensure that the promises for formalization assistance are honored, as the form in which these programs are administered affects the program's overall level of impact. Any government could adopt a similar approach to combating illegal mining within their borders, and countries like Mexico and Colombia have resorted to

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<sup>86</sup> Anatoly Kurmanaev and Andrea Zarate, "Who's in Charge in Peru? Peruvians Can't Agree - The New York Times," *The New York Times*, October 15, 2019, <https://www.nytimes.com/2019/10/01/world/americas/peru-congress-dissolved.html?searchResultPosition=6>.

<sup>87</sup> Markus-Michael Müller, "Violence, Coercion, and State-Making in Twentieth Century Mexico. The Other Half of the Centaur," *Revista Europea de Estudios Latinoamericanos y Del Caribe*, no. 95 (2013): 150.

military force in efforts to control criminal activity, so the plan is replicable given appropriate funding but not ideal.

### **Other considerations: Potential for Further Escalation of Violence**

I mentioned that miners have in the past resorted to violence to defend their livelihoods. The government should be leery of using violent force to disperse the miners and destroy their operations because of the risk of further escalation of violence, especially given the involvement of criminal organizations in the region. It is well documented that violence increased substantially in Mexico after military forces cracked down on narcotraffickers. Illegal enterprises are known to utilize violence more readily since they operate outside of the law, meaning that they cannot rely on authorities to enforce contracts and agreements and protect themselves against other criminal actors.<sup>88</sup> Additionally, illegal operators such as cartels rely on informal means such as violence to resolve conflicts or enact punishment on people who impede their proceedings.<sup>89</sup> When Calderón became president in Mexico in 2006, he immediately launched military campaigns across Mexico to fight drug violence, sending out 45,000-50,000 troops to areas most affected by narcotrafficking. While homicide rates remained somewhat stable in the two years following the military incursion, national homicide rates rose 50% in 2008 and another 50% in 2009.<sup>90</sup> The same study shows that violence was exacerbated in areas of military operations. In 2006, the homicide rate in the Mexican state of Chihuahua was 19.6 homicides per 100,000 habitants. Military officers began to patrol Ciudad Juarez, the most populous city in

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<sup>88</sup> Peter Andreas and Joel Wallman, "Illicit Markets and Violence: What Is the Relationship?," *Crime, Law and Social Change* 52, no. 3 (2009): 225–229, <https://doi.org/10.1007/s10611-009-9200-6>.

<sup>89</sup> David Shirk and Joel Wallman, "Understanding Mexico's Drug Violence," *Journal of Conflict Resolution* 59, no. 8 (2015): 1348–76, <https://doi.org/10.1177/0022002715587049>.

<sup>90</sup> Fernando Escalante Gonzalbo, "Homicidios 2008-2009 La muerte tiene permiso," accessed May 10, 2020, <https://www.nexos.com.mx/?p=14089>.

Chihuahua, in 2007. Homicide rates temporarily dipped to 14.4 homicides per 100,000 people, and then sharply increased to 75.2 and 108.5 homicides per 100,000 people in 2008 and 2009, respectively.<sup>91</sup> Calderón’s initiative was the largest anti-drug campaign in Mexico, but not the first. Previous operations not only resulted in more instances of violence but also its spread from previously concentrated regions due to a “balloon effect.” By dispersing the narcotraffickers through military force, levels of violence in newly occupied geographic areas increased, revealing a pattern between the use of military force and escalation of violence in regions where illicit activity takes place. As mentioned earlier, drug cartels are thought to be active as gold buyers in Madre de Dios, using illegally mined gold as a means to launder drug profits in the U.S., so the use of military force could incite more violence in the region.<sup>92</sup>

| Report Card             |        |
|-------------------------|--------|
| Efficiency              | Red    |
| Cost-Effectiveness      | Red    |
| Potential Impact        | Yellow |
| Fairness                | Red    |
| Political Acceptability | Yellow |
| Robustness              | Green  |
| Replicability           | Green  |

Figure 12. Operation Mercury–Military Incursions Evaluation.

While flexing military muscle poses social risks, the end goal still allows gold mining to happen in the region but in pre-approved concessions or mining areas. By first re-establishing order and authority in the region, the government authorities will wield more power in the region

<sup>91</sup> Escalante Gonzalbo.

<sup>92</sup> Javier Osorio, “The Contagion of Drug Violence: Spatiotemporal Dynamics of the Mexican War on Drugs,” *Journal of Conflict Resolution* 59, no. 8 (2015): 1403–32, <https://doi.org/10.1177/0022002715587048>.

to more effectively enact formalization programs and sustainable alternative industries in Madre de Dios.

## **B. OPERATION MERCURY—MEDIUM-TERM STRATEGY: FORMALIZATION**

Operation Mercury, enacted by Peruvian president Martin Vizcarra in 2019, takes a multi-pronged approach to combat the issue of illegal mining in Madre de Dios through direct military intervention in the region, evaluated in the previous section, and by pushing for long-term sustainability investment and the continuation formalization efforts that have been ongoing since 2012.

Peru has long struggled with the question of what to do about its informal sector. Between 1985 and 2011, the informal economy was thought to comprise between 30% and 45% of the official GDP.<sup>93</sup> Informality in the gold mining sector is particularly prevalent with an estimated 22% of gold mining exports representing approximately \$1.79 billion in revenue estimated to come from illegal or informal sources.<sup>94</sup> Formalizing the informal gold mining sector in Madre de Dios could be key not only for controlling environmental damage and managing public health risks but also for generating higher tax revenue for the region. The challenge lies in getting informal miners to actually complete the formalization process and eventually introducing mercury-free mining methods or ushering informal miners into other, more sustainable, industries such as agroforestry or ecotourism.

The push for formalization kicked off in 2012 under president Ollanta Humala who sought to increase formalization to boost tax revenue in the region. Supreme Decree N° 1105 establishes a formalization process for miners. To further urge miners to formalize, Humala

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<sup>93</sup> Roberto Machado, “The Informal Economy in Peru: Magnitude and Determinants, 1980-2011,” *Apuntes* 41, no. 74 (2014): 191–227.

<sup>94</sup> Pachico, “Illegal Mining Bigger than Drug Trade in Peru.”



enacted Supreme Decree N° 1102 which made illegal mining a criminal offense punishable by up to 10 years in prison when previously the infraction was treated as a civil violation subject to a fine. Despite establishing formalization procedures and criminalizing miners who did not initiate the process, only 3% of miners had formal concessions and environmental permits in 2012.<sup>95</sup> Currently, MINEM is pushing for the formalization of 4,500 miners in Madre de Dios who have already enrolled in the REINFO (*Registro Integral de Formalización Minera*).<sup>96</sup> These miners would be allowed to mine in the mining corridor, an area of 5,000km<sup>2</sup> with space for up to 2,800 mining concessions. They would not be allowed to operate in La Pampa or other off-limits regions like national preserves and buffer-zone areas.

### **Cost Factors: Expensive**

The Peruvian government has allocated \$160 million (\$/500 million) for formalization and sustainable development efforts under Operación Mercurio. As of February 2019, 4,500 miners in Madre de Dios have begun the formalization process out of an estimated 40,000 miners.

### **Impact: Low Adoption Rates as of Yet, But Some Progress**

Informal ASGM causes harm in two ways: (1) working and living conditions and (2) lost tax revenue. Miners are often uneducated and/or use rudimentary tools and processes for gold extraction and processing, creating health risks from mercury exposure and environmental damage outlined in Chapter 2. Formalization creates a platform through which governments can better manage and mitigate health and environmental impacts by banning certain practices,

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<sup>95</sup> “Peru Pro-Mining Protest Turns Deadly.”

<sup>96</sup> Redacción El Comercio Perú, “MEM busca formalizar a más de 4.500 mineros en Madre de Dios,” El Comercio Perú, February 20, 2019, <https://elcomercio.pe/economia/peru/mem-busca-formalizar-4-500-mineros-madre-dios-noticia-609722-noticia/>.

providing technological assistance, requiring environmental impact reports, etc.<sup>97</sup> Informality is also a lost revenue opportunity, especially for poor regional governments such as Madre de Dios. Tax revenue from small-scale gold mining could generate an estimated \$305 million per year across Peru.<sup>98</sup> This money could be reinvested in the local economy, used to educate miners about mercury-free methods, and support sustainable development initiatives in gold mining and in other local industries such as fishing and agriculture as well.

Because formalization does not aim to eradicate illegal gold mining, we cannot measure its impact based on the reduced mining activity. Instead we should measure the impact by the reduced negative environmental and health consequences of formalized small-scale mining as well as the estimated increased in tax revenue. Due to the barriers that miners face to formalize, adoption has been slow with few miners holding valid mining concessions and environmental permits. Low adoption = low impact.

### **Overall Efficiency: Highly Inefficient**

If 40,000 to 50,000 small-scale miners operate in Madre de Dios, our calculations would indicate that roughly 10% (4,500) of ASGM miners have at least initiated the formalization process since the beginning of Operation Mercury. For formalization to be a sustainable strategy from an economic perspective, each formalized miner would have to generate enough revenue for the government to recoup the initial costs of the formalization initiative, \$160 million. Assuming that all 40,000 miners successfully completed the formalization process and paid their taxes every year, each miner would have to generate at least \$400 per year in annual tax revenue ( $\$160 \text{ million} / 40,000 \text{ miners} / 10 \text{ years} = \$400/\text{year}$ ) for the government to be able to recover its

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<sup>97</sup> “Local Perspectives on the Formalization of Artisanal and Small-Scale Mining in the Madre de Dios Gold Fields, Peru | Elsevier Enhanced Reader,” accessed May 11, 2020, <https://doi.org/10.1016/j.exis.2016.10.001>.

<sup>98</sup> Gardner, “Peru Battles the Golden Curse of Madre de Dios.”

initial investment in a 10-year period. One estimate places the annual income for a small-scale gold miner in Madre de Dios between \$10,800 and \$8,400.<sup>99</sup> \$9,600 is the midpoint between the maximum and minimum annual salaries and will serve as a proxy for our average annual income of a small-scale gold miner. The government would have to raise and collect a 4.17% income tax rate on miners ( $\$400/\$9,600*100 = 4.17\%$ ) to generate \$400 per year per miner and recoup the costs over a 10-year period. However, the persistent informal nature of ASGM has frustrated formalization efforts, and effective tax collection is only possible through strong institutions. Operation Mercury will be unable to recover its formalization investment if it is unable to convince miners to formalize and pay taxes.

Part C will provide evidence that governments can charge higher tax rates on miners to offset the environmental damage caused, so if all of the miners formalized, then the government could quickly recover its initial investment.

### **Fairness: Respects Mining as an Occupation but Burdensome**

While formalizing requires bureaucratic procedures, tax contributions, and miners' adherence to environmental, safety, and labor standards, which are expensive for small-scale miners to implement in their current practices, formalization still provides ASGM as an economic option rather than forcing miners to halt their livelihoods completely. Formalization provides miners with the opportunity to enter the formal economy with full legal rights and responsibilities as legitimate businesses. While the government is still making adjustments to the actual process to reduce barriers for formalizing, the idea of formalization respects ASGM as a legitimate livelihood and treats miners with dignity. ASGM remains an important development

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<sup>99</sup> Joshua Fisher, Poonam Arora, and Sophia Rhee, "Conserving Tropical Forests: Can Sustainable Livelihoods Outperform Artisanal or Informal Mining?," *Sustainability* 10, no. 8 (July 24, 2018): 2586, <https://doi.org/10.3390/su10082586>.

opportunity since gold mining is an excellent means for rural communities to generate wealth with small-scale miners often receiving 70% or more of the value of international prices,<sup>100</sup> and, therefore, it should still be allowed to operate in limited areas to contribute to poverty reduction in rural regions. Formalization will help facilitate the transition to broad use of sustainable practices in ASGM by requiring operations to meet certain requirements and potentially giving miners access to loans for investing in sustainable production methods.

### **Political Acceptability and Robustness: Governance Issues Creating Conflict**

Addressing illegal gold mining has proven to be a popular platform for presidential candidates during election cycles and to boost popularity once in office. Ollanta Humala, president from 2011 to 2016, implemented the formalization process to deliver on his campaign promise to raise additional tax revenue on formal in support of the fight against rural poverty. The new funds he intended to raise would be funneled to the development of sustainable economic opportunities in regions such as Madre de Dios. Humala failed to achieve widespread formalization of miners, so Pedro Pablo Kuczynski campaigned to provide a new impulse towards formalization, mostly by providing training and creating instructive manuals to educate miners on the established formalization process. Lack of knowledge about bureaucratic procedures for formalization was thought to be the main obstacle for implementation,<sup>101</sup> but as we will discover, new regulatory decrees and weak legal rights due to weak regional institutions are the main obstacles preventing small-scale miner formalization.

To formalize, miners must complete the following requirements:<sup>102</sup>

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<sup>100</sup> “Reducing Mercury in Artisanal Gold Mining.”

<sup>101</sup> Cooperación, “Madre de Dios.”

<sup>102</sup> “Local Perspectives on the Formalization of Artisanal and Small-Scale Mining in the Madre de Dios Gold Fields, Peru | Elsevier Enhanced Reader.”

1. Declare commitment to following the formalization process within the mining corridor.
2. Acquire accreditation of ownership of concession or obtain a contract with a concession owner.
3. Obtain authorization for the use of water.
4. Adopt a plan for environmental impact mitigation and correction.
5. Obtain final authorization to initiate mining operations.

Additionally, mining operators are required to complete a certificate of training, a certificate of the absence of archeological remains, an authorization for the use of explosives, and accreditation as an ASGM enterprise.<sup>103</sup>

While on paper formalization seems like an attractive solution to managing ASGM in Madre de Dios, in practice, efforts to formalize have been largely unsuccessful because these steps have proved to be large barriers for miners who are accustomed to the informality of ASGM. The Formalization and Restructuring Plan for the mining sector in Madre de Dios was approved in 2011. By June 2014, 5,500 miners entered the formalization process, but only 11 operators had completed step (2). By June 2016, five years later, still no SSM operation had completed the formalization process. Step (2) resulted in a significant barrier because approximately 74% of mining concessions were in conflict with other land-use concessions, making it difficult to acquire legal rights to operate as well as obtaining rights to water use.<sup>104</sup>

Because of the complex nature of the legal rights and environmental regulations that underpin the formalization process, the plan, as designed, faces significant challenges for succeeding that undermine the original intent of the process, which is to formalize as many

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<sup>103</sup> “Local Perspectives on the Formalization of Artisanal and Small-Scale Mining in the Madre de Dios Gold Fields, Peru | Elsevier Enhanced Reader.”

<sup>104</sup> “Local Perspectives on the Formalization of Artisanal and Small-Scale Mining in the Madre de Dios Gold Fields, Peru | Elsevier Enhanced Reader.”

small-scale miners as possible. This implies that formalization is not a robust action plan for Madre de Dios. The local government has not been able to solve conflicts in land-use concessions, limiting the ability for miners who have initiated the formalization process to obtain the necessary legal property rights required for step (2), and new regulatory decrees meant to protect the environment have been passed that limit mining near certain bodies of water, imposing further limitations on successfully completing step (3). The stagnant rate of formalization has led to the military intervention strategy of Operation Mercury that has only served to further confuse the process by forcing miners who are facing legal conflicts for concession rights into insurmountable bureaucratic hurdles.

Even if the formalization process did not prove to be significantly burdensome, the institutional strength of the state in Madre de Dios is not strong enough to implement the formalization plan as designed. The Peruvian government essentially pushed formalization efforts as a way to install government authority in the area; however, the single biggest limiting factor in the process of formalization has been precisely the lack of governance in the region. In other words, formalization is meant to support institutional strength in the region, yet it is a process that requires government authority in order to install.

Some argue that the lack of institutional strength can be explained partly by the government's "conquest" approach in installing authority in the region. This argument contends that the state has relied on the formation of private mining companies that are self-governing to implement controls on labor conditions and environmental exploitation in far-reaching areas instead of strengthening local government institutions;<sup>105</sup> However, alluvial gold is not an attractive target for large-scale mining operations because it is spread out through river systems

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<sup>105</sup> Gerardo H. Damonte, "The 'Blind' State: Government Quest for Formalization and Conflict with Small-Scale Miners in the Peruvian Amazon," *Antipode* 48, no. 4 (2016): 956–76, <https://doi.org/10.1111/anti.12230>.

as fine particles and not concentrated in veins as is the case for gold ore of the highland regions, where multinational companies have mining operations. Therefore, no large extractive corporations exist to install some level of control and authority in Madre de Dios. The weakness of the local governments has impeded the formalization process because regional institutions are unable to support necessary steps such as securing property rights for mining concessions. The lack of institutional strength has other consequences such as corruption. Lower levels of government in Peru are more susceptible to corruption as there is less oversight from national governments as well as lucrative opportunities to undermine the law by turning a “blind eye” to illegal mining activities.<sup>106</sup> Additionally, limited financial and technological resources due to lack of tax revenue from formal industries limit the assistance that regional and municipal governments are able to provide to aid ASGM miners in the formalization process.

The challenge of formalization is extending regulation to informal miners who are accustomed to and comfortable with working outside of the formal economy, free from tax obligations and environmental regulations, and eventually introducing mercury-free mining methods or ushering informal miners into other, more sustainable, industries such as agroforestry or ecotourism. However, municipal governments, which are currently not strong enough to support legal proceedings, would have to play a major role in formalization efforts.

### **Replicability**

Formalization can be a strategy that other countries import as a method of regulating and asserting authority in far reaching areas, but regional characteristics need to be paid attention to so as to avoid a disconnect between national policies and their intended effects on a regional

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<sup>106</sup> Anthony J. Bebbington and Jeffrey T. Bury, “Institutional Challenges for Mining and Sustainability in Peru,” *Proceedings of the National Academy of Sciences* 106, no. 41 (October 13, 2009): 17296–301, <https://doi.org/10.1073/pnas.0906057106>.

basis. Involving diverse participants such as regional ASGM practitioners in the policymaking process could close the gap between what different policies offer and the needs of local businesses and communities.<sup>107</sup>

| Report Card             |        |
|-------------------------|--------|
| Efficiency              | Yellow |
| Cost-Effectiveness      | Yellow |
| Potential Impact        | Yellow |
| Fairness                | Green  |
| Political Acceptability | Green  |
| Robustness              | Yellow |
| Replicability           | Green  |

Figure 13. Operation Mercury–formalization strategy evaluation.

**C. OPERATION MERCURY–LONG-TERM STRATEGY: INVESTING IN SUSTAINABLE ECONOMIC ALTERNATIVES**

Encouraging formalization is just one aspect of Operation Mercury’s long-term action plan. The government intends to provide investment to foster sustainable development and alternative economic opportunities for those previously engaged in mining like ecotourism, aquaculture, and sustainable agriculture, among others, but so far, the plan is only in its second phase—the medium-term installment of military bases to establish regional control. Once established, Operation Mercury plans to invest significant capital into the development of sustainable economic opportunities for individual actors to discourage ASGM activities. A total of S/500

<sup>107</sup> “Who Is Afraid of Artisanal and Small-Scale Mining (ASM)? | Elsevier Enhanced Reader,” accessed May 12, 2020, <https://reader.elsevier.com/reader/sd/pii/S2214790X14000185?token=76AC59B92582B4E0E62699ABE196B1C92E67A7A22D776EAE0105E5F24A0AB60740E6B6C3A4BADEFBF2DB4AAB3A7860E7>.



million (\$160 million) has been allocated to this endeavor, but crucial to the success of this plan are the mechanisms through which investment plans are decided and executed so as to maximize economic benefit and identify areas for future sustainable ventures.

**Costs:**

The Peruvian government has promised S/500 million (\$160 million) for sustainable development investment, but so far S/200 million (\$64 million) has been approved. The Ministry of Production's project PRODUCE (*Desarrollo Productivo del Plan integral frente a la minería ilegal La Pampa*) has set aside S/25 million (\$7,550,000) for developing logging, brazil nut, cacao, fishing, and aquaculture projects in Madre de Dios.<sup>108</sup> S/8.8 million has been invested in the Technological Innovation Center (CITE) with an additional S/8 million (\$242,000) for equipment and infrastructure. The leftover funds (from the S/25 million) will go to the National Fisheries Development Fund (FONDEPES), S/233,500 (\$71,000) of which will be used to train and assist 340 aquaculture producers and possibly S/9million (\$2,700,000) of which will be used for the construction of an artisanal pier.

In Madre de Dios there are currently an estimated 150 formal fish farms. In May 2019, FONDEPES invested S/3.5 million in aquaculture in Madre de Dios to strengthen aquaculture and help make it a profitable venture and sustainable alternative to gold mining. Small business owners that take on loans to start aquaculture operations and participate in fairs about technical

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<sup>108</sup> "PRODUCE invertirá más de S/25 millones en Madre de Dios para los sectores de pesca, acuicultura y producción," accessed May 11, 2020, <https://www.gob.pe/institucion/produce/noticias/26595-produce-invertira-mas-de-s-25-millones-en-madre-de-dios-para-los-sectores-de-pesca-acuicultura-y-produccion>.

assistance and capacitation are eligible for a one-year grace period on loan repayment and can cancel the debt 4 months after.<sup>109</sup>

Investing in sustainable enterprises is important not only for health and environmental conditions but also for regional infrastructure construction, institutional development, and poverty alleviation. An on-the-ground UN policy worker described ASGM as a “poverty trap.”<sup>110</sup> While miners are able to obtain high profits, most of it must be spent on high fixed and variable costs to keep the mining operation running. SSM requires expensive equipment that is often illegally smuggled in from Bolivia. Additionally, the fuel required to run the heavy machinery is strictly regulated and mostly comes at a premium via black markets. The government does not receive tax revenue from gold that is illegally smuggled out of the country, meaning that the government loses out on significant tax revenue that it could use for developing infrastructure, schools, hospitals, etc. Because potential tax revenue is lost, the government has limited funds for repairing the environmental wastelands left behind by illegal mining activity. This limits the options for future land use and damages the biological capital of Madre de Dios.

It is difficult to get people to switch their livelihoods, and it is also hard to displace the widespread belief that gold mining is highly profitable when that is not necessarily the case. We discussed the poverty trap, wherein mining operations require expensive illegally imported equipment and fuel while not contributing to the local economy. One study shows that fish farming and Brazil nut harvesting incomes are comparable and, under the right conditions, more

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<sup>109</sup> “EL MINISTERIO DE LA PRODUCCIÓN ENTREGARÁ S/. 3.5 MM EN CREDITOS PARA EL DESARROLLO DE LA ACUICULTURA EN LA REGION MADRE DE DIOS,” FONDEPES, accessed May 12, 2020, <http://www.fondepes.gob.pe/Portal2018/index.php/blog/noticias-5/291-el-ministerio-de-la-produccion-entregara-s-3-5-mm-en-creditos-para-el-desarrollo-de-la-acuicultura-en-la-region-madre-de-dios>.

<sup>110</sup> “Local Perspectives on the Formalization of Artisanal and Small-Scale Mining in the Madre de Dios Gold Fields, Peru | Elsevier Enhanced Reader.”

profitable than ASGM. Figure 14 compares the income ranges from these three activities to the average annual wage in Madre de Dios. While aquaculture brings in a slightly

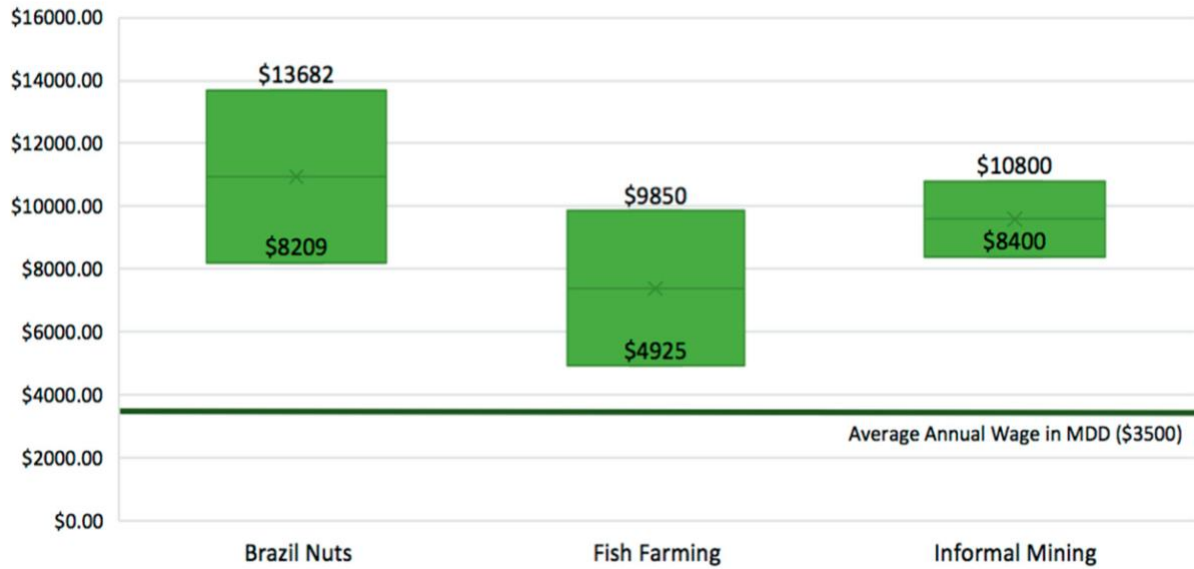


Figure 14. Annual income ranges in Madre de Dios from Brazil nut harvesting, aquaculture, and small-scale gold mining.<sup>111</sup>

lower annual income, Brazil nut harvesting is actually slightly more profitable from these estimates. Right now, the aquaculture industry in Madre de Dios is relatively small with 150 formal fish farmers in the region, but as the industry grows, it can be made more profitable with increasing economies of scale. More ponds created with the aid of collective digging would help fish farmers recoup their investments more quickly, and the increased volume of fish would lower transportation costs for the fish harvest to reach regional markets in Cusco, where fish can be sold at a higher price.<sup>112</sup> Brazil nut harvesters can also boost their incomes through organic certification programs that would allow their products to command a higher market price, by collaborating on joint shelling facilities, and/or using unsold nuts as fish feed.<sup>113</sup> Figure 15

<sup>111</sup> Fisher, Arora, and Rhee, “Conserving Tropical Forests.”

<sup>112</sup> Fisher, Arora, and Rhee.

<sup>113</sup> Fisher, Arora, and Rhee.

compares annual incomes between Brazil nut harvesting, fish farming, and informal gold mining after profit-increasing measures have been taken. Government agencies and NGOs could provide assistance to help boost profits for sustainable enterprises, significantly increasing their annual incomes and making sustainable alternatives more attractive than ASGM.

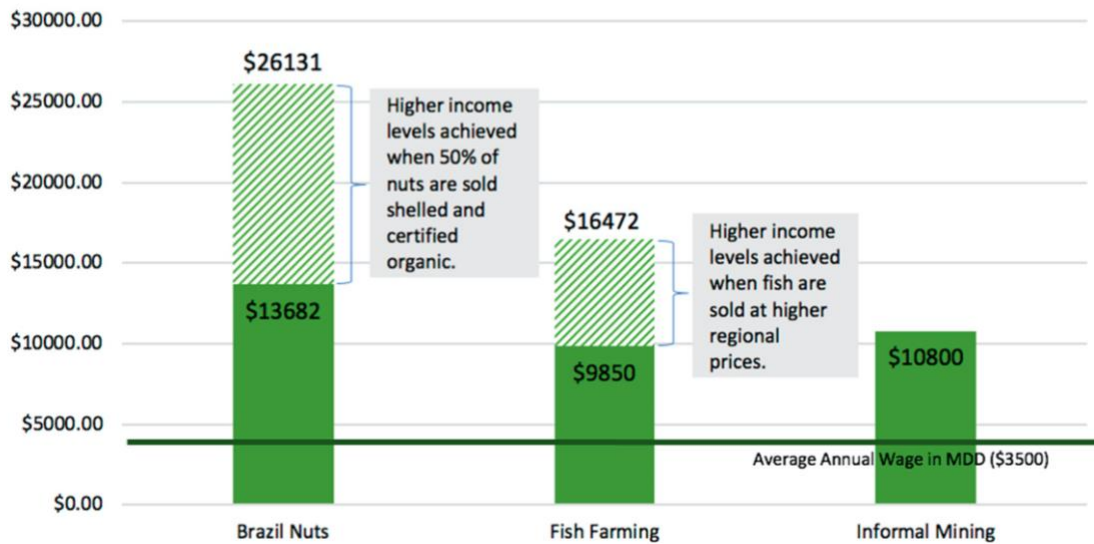


Figure 15. Income from sustainable alternatives to informal gold mining have the potential to far surpass the average annual income generated in Madre de Dios with appropriate measures taken to achieve competitive prices.<sup>114</sup>

**Cost:**

The government has pledged S/500 million (\$160 million) to sustainable development in Madre de Dios to support economic alternatives to ASGM, which creates significant health and environmental risks while not contributing to the local economy. With an estimated population of 140,000 people where 70% of the economy is tied to gold mining,<sup>115</sup> the funds would have to be efficiently used to transition 98,000 people (70% of 140,000 people) away from mining or

<sup>114</sup> Fisher, Arora, and Rhee.

<sup>115</sup> Falen, “Madre de Dios.”

mining-related occupations to sustainable economic alternatives. This would mean that the government could spend approximately S/5,100 (~\$1500) per person (S/500 million divided by 98,000 people in mining-related occupations). The actual amount of potential investment per person would be a lot less in reality because of overhead expenses needed to operate government agencies that would fund and oversee loans, infrastructure investments, and technical assistance programs. We also have to account for misallocation of funds and corruption that can take place at national and regional levels, as has happened in the past.

For aquaculture, the cost of building a new pond is \$1850, and it usually takes two years to recoup the investment.<sup>116</sup> Government-sponsored small business loans could significantly help with the startup costs. Another avenue for high-impact investing, the regional government could consider buying refrigerated trucks (~\$10,000 new), which would provide fish farmers with better access to regional markets and higher prices. One pond can produce up to 550kg of fish year, so a fish farmer who has access to regional markets where prices are higher (\$5.15/kg at regional markets instead of \$3.50/kg at local markets) can earn  $(\$5.15/\text{kg} - \$3.5/\text{kg}) * 550 \text{ kg} = \$907.50$  in additional profit per pond per year. Fish farmers with more ponds can benefit from higher output volume that boosts revenue and profit by further reducing average costs associated with transport.

**Impact:**

As shown in the previous section, the profit per fish farmer means that aquaculture is a viable alternative to gold mining. The problem is getting people to make the switch. There are roughly 40,000 illegal and informal ASGM miners in Madre de Dios and only 140 formalized fish farmers. An additional 58,000 are employed in mining-related occupations. If even a portion

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<sup>116</sup> Fisher, Arora, and Rhee, “Conserving Tropical Forests.”

of these people switched to fish farming, not only would the environmental and health costs of ASGM be reduced but a significant amount of tax revenue could be generated for the government to inject into sustainable development projects and regional infrastructure.

Aquaculture would also increase food security in the region. The figure below estimates the potential tax base and income tax revenue (at a 5% tax rate) that Madre de Dios could generate from providing capital and technical assistance for aquaculture operations.

| # of Fish Farmers<br>(1 Pond/Farmer)                     | Total Income per Year<br>(W/ Access to Regional<br>Prices) | 5% Income Tax Revenue<br>per Year |
|--|--|-----------------------------------|
| 140 (current level)                                      | $140 * 550\text{kg} * \$ (5.15 - 2.26) =$<br>\$222,530     | \$11,126.50                       |
| 2000   | $2000 * 550\text{kg} * \$2.89 =$<br>\$3,179,000            | \$158,950                         |
| 5000   | $5000 * 550\text{kg} * \$2.89 =$<br>\$7,947,500            | \$397,375                         |
| 29,140 (50% of 58,000 mining-<br>related workers switch) | $29,140 * 550\text{kg} * \$2.89 =$<br>\$46,318,030         | \$2,315,901.50                    |

Per pond, if the fish farmer can generate an additional \$907.50 in income with access to regional markets, then by taxing profits at a 5% rate, the government can generate \$45.35 per additional aquaculture pond. Currently, ASGM generates S/42,000 (\$12,181) per year in total government revenue for Madre de Dios while forcing expensive mitigation efforts for the health and environmental damage caused.<sup>117</sup> Currently, gold mining in Madre de Dios is estimated to produce S/1.6 billion per year.<sup>118</sup> This means that the regional government could receive an

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<sup>117</sup> Álvarez et al., “INFORME PREPARADO POR EL INSTITUTO DE LA AMA ZONÍA PERUANA - IIAP Y EL MINISTERIO DEL AMBIENTE.”

<sup>118</sup> Álvarez et al.

estimated S/50 to 200 million per year from gold mining tax revenue.<sup>119</sup> S/200 million generated from S/1.6 billion in gold production revenue would imply a 12.5% tax rate. Our calculations only assume a 5% tax on aquaculture profits, the higher tax rate on revenue from gold mining would make sense. Aquaculture does not create the environmental destruction that gold mining does, so lower taxes could be an additional positive incentive to pursue alternative to ASGM.

### **Efficiency: (Potentially) Highly Efficient**

The government can fully recoup the costs of sustainable development through taxes, bringing the net cost to a far lower level than the value of damage by gold mining, and sustainable economic activities have few to none of the negative health and environmental effects that gold mining has while increasing food security in the region. Assuming that all \$160 million were invested in fish ponds ( $x$ ) and refrigerated trucks ( $y$ ) to bring the fish production to regional markets, excluding overhead costs, the regional government could recoup its initial investment at a 5% tax rate in approximately 7 years while providing an income of \$15,875 per year for 28,856 fish farmers in Madre de Dios.

We can demonstrate this result using a simple system of equations:

1.  $\$160,000,000 = \$1,850x + \$10,000y$ , where  $x = \#$  of fishponds and  $y = \#$  of trucks.

The first equation sets our total investment fund of \$160 million equal to a combination of  $x$  fishponds and  $y$  trucks, which represents the number of fishponds and trucks we can potentially invest in at their relative prices of \$1,850 and \$10,000.

2.  $(365 \text{ truck trips per year}) * (1000\text{kg full capacity}) * y = (550\text{kg of fish per year}) * x$

Since trucks have a maximum load capacity of 1000kg per truck, we must calculate the optimal ratio of trucks to ponds to invest in. If we have too many trucks, the average transportation cost

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<sup>119</sup> Álvarez et al.

increases, eroding overall profits for the fish farmers. If we have too few trucks, then only some of the fish production will be able to reach the regional markets with higher prices. Each truck can make the return trip from Puerto Maldonado to the regional market in Cusco once a day, or 365 days per year, carrying a maximum of 1000kg of fish per trip. Each pond produces 550kg of fish per year. Solving for the ratio of ponds to trucks yields:

3.  $x/y = \sim 664$  ponds serviced per truck

We can isolate  $x$  or  $y$ , and plug it back into equation (1), yielding:

4. Plug back into (1):  $x = 288,563$  ponds,  $y = \sim 129$  trucks

Our solution indicates that we should invest in 288,563 fishponds at \$1,850 each and 129 trucks at \$10,000 each to achieve an optimal ratio of fish ponds to refrigerated trucks.

If each fish farmer owns 10 ponds, which is the maximum possible number of ponds per concession, the government can fund 28,856 fish farmers (288,563 ponds/ 10 ponds per concession). With 10 ponds, a fish farmer can earn an annual income of **\$15,875** per year:

1.  $550\text{kg of fish per pond} * \$2.89 \text{ profit/kg} * 10 \text{ ponds} = \$15,875 \text{ annual income}$

At a 5% tax rate and if trucks make the trip every day for  $\sim 1.64$  years (We are assuming that the trucks have 500,000 lifetime miles and the return trip between Puerto Maldonado and Cusco is 833 miles. Each truck can then make about 600 lifetime trips.  $\sim 600$  lifetime trips/365 trips per year  $\approx 1.64$  years), the government can breakeven on its investment in approximately 7.23 years

We find this breakeven point using the following equations:

1. Profit = Tax Revenue - Variable Costs (Replacing Truck Fleet) - Fixed Costs

We adapt the typical profit equation (profit = revenue – costs) to fit our theoretical government’s model. The regional government generates revenue by taxing the fish farmers. Its variable costs



would be replacing the trucks every 1.64 years, and its fixed costs would be the initial \$160 million cost of the fishponds and refrigerated trucks.

$$2. \text{ Tax Revenue} = (\$15,875) * (28,856 \text{ Farm Fisheries}) * 0.05 \text{ Tax Rate} = \$22,904,450/\text{year}$$

To calculate tax revenue, we multiple a fish farmer's expected annual income times the total number of fish farming operations times our assumed tax rate of 5%. Our expected annual tax revenue would thus be \$22,904,450.

$$3. \text{ Variable Costs} = 129 \text{ Trucks} * \$10,000 / 1.64 \text{ Lifetime Years} \approx \$786,500 \text{ per year}$$

To calculate total variable costs per year, we multiply our initial 129 trucks by their \$10,000 price tag and divide the total by 1.64 years, which is the average number of years that each truck runs before needing to be replaced. To maintain the transportation operations, we must spend \$786,500 on truck replacements.

$$4. \text{ Fixed Cost} = \$160,000,000 \text{ initial investment}$$

Our fixed cost is the \$160 million initial investment made to startup the fishponds and the initial fleet of trucks.

$$5. \text{ Revenue} = \text{Variable Costs} + \text{Fixed Costs}$$

To find the number of years it would take for the fishpond scheme to turn a profit, we must find the year where total revenue equals total costs. We can rearrange the profit formula to Fixed

Costs = Revenue – Variable Costs, and plugging in our previous calculations yields:

$$6. \$160,000,000 = \$22,904,450y - \$786,500y$$

$$7. \$160,000,000 = (\$22,117,950) * y$$

$$8. y = \$160,000,000 / \$22,117,950 = 7.23 \text{ years}$$

This model is an oversimplification, as likely the variable costs would be much higher when taking fuel and drivers' wages into account, and we are assuming that all \$160 million were

invested directly into ponds and refrigerated trucks when there would likely be significant overhead costs. Additionally, the calculations only consider trucks carrying one load from Puerto Maldonado to Cusco with an empty return trip, so the government could further increase revenue by transporting other goods on the trip back. We would also have to set some money aside to provide informational workshops and technical assistance for new fish farmers. Distribution and allocation of funds for development projects could negatively impact efficiency if the process is weighed down by bureaucratic proceedings, so the national and regional governments should consider this when deciding on an implementation strategy.

The difference in tax revenue from aquaculture and gold mining raises an important point: gold mining should be allowed on a limited basis in designated areas because of the wealth it could potentially bring to the region that it currently does not, as demonstrated by a simple optimization problem. We established that a fish farmer with 10 ponds has the potential to earn \$15,875 per year. At a 5% tax rate, each fish farmer would generate \$793.75 tax dollars without any negative environmental impacts that the tax dollars would have to mitigate. Madre de Dios generates an estimated S/1.6 billion of gold per year and the estimated lost tax revenue is S/200 million, which would imply an 12.5% tax rate. With 40,000 miners operating in Madre de Dios, each miner could generate S/5000 per year in taxes:

1.  $S/1.6 \text{ billion in total gold revenue divided by } 40,000 \text{ miners} = S/40,000 \text{ revenue per miner.}$
2.  $S/40,000 * 0.125 = S/5000 \text{ in taxes per miner } (\$1,460).$

This is about 84% more tax revenue per person than what aquaculture produces, but along with the extra tax dollars, miners create significant environmental damage. Striking the right balance

between lower-tax yield but environmentally friendly sustainable industries and high-yield but exploitative gold mining is the key to bringing responsible prosperity to Madre de Dios.

### **Fairness**

The government's investment in sustainable development is very fair as they are providing positive economic incentives for switching to alternative occupations instead of enforcing punitive measures for engaging in illegal mining activity as the military incursions into La Pampa have done.

### **Political Acceptability and Robustness**

Sustainability is a big buzz word in politics, especially in global climate change politics and in reference to developing countries where poverty poses major threats to the environment in a country such as Peru with vast natural resources that are ripe for exploitation. However, securing funding for these initiatives can be difficult when many infrastructure projects and social programs are competing for the same funds. Peru has the potential to gain access to development funding from the UN or other international organizations that support sustainability initiatives, which could be used to sponsor aquaculture and other responsible industries in Madre de Dios.

The implementation plan for Operación Mercurio's sustainable development initiative largely leaves financing decisions to the local agencies such as CITE and FONDEPES. While S/500 million have been promised, only S/200 million have been approved and transferred to regional government agencies in Madre de Dios, indicating that transferring funds from the national to the local level may face obstacles. The funding that does reach the hands of local agencies could be misallocated, used inefficiently or stolen by corrupt officials.

## Replicability

The plan essentially transfers funds from national to local government agencies to be used for the promotion of sustainable job opportunities. There is a lot of flexibility as to how that would be achieved on a local level, so other countries can take local factors into consideration when planning on how to invest the funding.

| Report Card             |        |
|-------------------------|--------|
| Efficiency              | Green  |
| Cost-Effectiveness      | Green  |
| Potential Impact        | Green  |
| Fairness                | Green  |
| Political Acceptability | Green  |
| Robustness              | Yellow |
| Replicability           | Green  |

Figure 16. Operation Mercury—sustainable investment evaluation.

### D. MERCURY SUPPLY CHAIN CONTROLS UNDER THE MINAMATA CONVENTION AND PLANETGOLD

On October 10th, 2013, Peru ratified the Minamata Convention, an international treaty between 128 countries to address and coordinate international controls on the primary production and trade of mercury. In Japan, industrial mercury waste caused the highly toxic metal to bioaccumulate in the marine food chain of Minamata Bay, creating a widespread outbreak of mercury poisoning and shedding light on the global issue of mercury pollution. In an attempt to prevent the tragic long-term consequences of the Japanese incident from occurring again in other places, 128 countries signed an agreement to develop domestic policies and cross-border trade agreements that would eventually limit or completely halt the production of mercury, and strictly

control mercury supplies that are produced and used. The largest global anthropogenic contributor to atmospheric mercury is ASGM, comprising an estimated 37% of total atmospheric mercury output due to the rudimentary mercury amalgamation process that miners use to extract and refine gold ore.<sup>120</sup> Countries such as Peru that signed the agreement and are significant producers of mercury pollution ASGM are required to submit a National Action Plan to the Minamata Convention Secretariat, detailing their plans for mitigating domestic mercury pollution from ASGM activities. However, questions arise about whether the pledges made under the Minamata Convention on mercury will effectively help to control mercury waste in Peru by limiting access to mercury for illegal miners who use it as a cheap ore processing method gold.

The articles of the Minamata Convention aim to eliminate anthropogenic mercury pollution through several means. Countries that ratify the convention treaty agree to prohibit all primary extraction of mercury within 15 years of ratification, disclose any stores of mercury greater than 50 tonnes and identify sources that generate 10 or more tonnes of mercury per year, install measures to dispose of excess mercury from industrial waste, and create an authorization procedure for cross border mercury movements, among many other requirements.<sup>121</sup> Additionally, Peru, as a significant generator of ASGM-related mercury pollution, is required to submit a National Action Plan (NAP) before proceeding with its own domestic implementation measures.

After ratifying the Minamata Convention in 2013, Peru set out with the assistance of the Artisanal Gold Council (AGC) and further support from the Global Affairs Canada and Red Social to develop a National Action Plan (NAP), as required by the treaty, with the aim of

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<sup>120</sup> “Reducing Mercury in Artisanal Gold Mining.”

<sup>121</sup> Lucía Delfina Ruíz Ostoic, “MARTÍN ALBERTO VIZCARRA CORNEJO,” 2019, 7.

reducing mercury emissions from ASGM in Peru. This project, called MEJORO (*Mejorando la Pequeña Minería Artesanal de Oro en el Perú*), aims to tackle the problem of mercury pollution through three main mechanisms: (1) helping miners to implement gravimetric ore processing systems and other practices that protect environmental, health, and safety conditions, (2) providing support for national, regional, and local governments to aid their formalization processes for ASGM and environmental impact standards, and (3) helping to create a transparent supply chain for artisanal gold that allows “its tracking from the mines to the international markets,” giving miners access to premium prices for their gold.<sup>122</sup> While the pilot project is currently underway, Peru approved its National Action Plan on April 18, 2019, and currently, the Peruvian Ministry of Energy and Mining (MINEM) and the Ministry of the Environment (MINAM) are collaborating to formulate and implement the tasks set out in the NAP in accordance with the agreements of the articles of the Minamata Convention. To involve local actors in the creation of the plan and approach the implementation in a decentralized way, MINEM and MINAM recently held participatory workshops where regional leaders could provide feedback for parts of the national proposal for reducing mercury in Peruvian ASGM.<sup>123</sup>

Through the whole ore amalgamation process described in Chapter 2, an estimated 44 to 50 tonnes of mercury are released into the environment in Madre de Dios per year.<sup>124</sup> From its elemental form used in mining, mercury does not break down but is transformed into methylmercury by bacteria that then accumulates in riverbanks, plants, fish, and, farther up the

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<sup>122</sup> “South America,” *Artisanal Gold Council* (blog), accessed April 22, 2018, <http://www.artisanalgold.org/our-projects/southamerica/>.

<sup>123</sup> “Minem realiza talleres de socialización del Plan de Acción Nacional para la Minería de Oro Artesanal y a Pequeña Escala en el Perú,” accessed May 11, 2020, <https://www.gob.pe/institucion/minem/noticias/82236-minem-realiza-talleres-de-socializacion-del-plan-de-accion-nacional-para-la-mineria-de-oro-artesanal-y-a-pequena-escala-en-el-peru>.

<sup>124</sup> David J.X. Gonzalez, “Treaty Does Not Stop Illicit Mercury Trade in South America | YaleGlobal Online.”

food chain, in people, so people living in or near SSM operations are not only exposed to mercury contamination from mercury vapor but also from consuming fish or drinking water contaminated with bio-accumulated methylmercury. The devastating health effects of mercury are well documented (See Chapter 2.). Both forms of mercury, elemental (used in ore processing) and methylmercury (bioaccumulated form), cause significant long-term harm to miners. Despite the health risks, miners continue to use mercury in the gold amalgamation process because it is quick and easy to use as well as cheap. Gravimetric ore processing methods that are promoted by the Minamata Convention and other international actors as a sustainable small-scale mining method involve expensive technological investments that many miners are unable or unwilling to afford.

While the Minamata Convention and Peru's National Action Plan represent the first instance of international collaboration on controlling and regulating the global supply chain of mercury, some experts have cast doubt on the effectiveness of these measures. One Yale researcher claims that global efforts to control mercury have merely changed the nature of mercury production and trade in Latin America.<sup>125</sup> While the U.N. (Spain) and the U.S., the world's two leading mercury producers, banned mercury exports altogether in 2010, Mexico and Indonesia increased production, becoming the leading exporters in 2016. Domestic production of mercury in Peru was banned from use in mining, but imported mercury was allowed to be used for ASGM until 2015 when Peru stopped mercury imports altogether. While mercury imports have halted, ASGM miners are still using mercury in their ore processing, indicating the emergence of a black-market supply from Bolivia, which closely borders Madre de Dios. Between 2014 and 2015, mercury exports from Mexico to Peru dropped from 94 to 9 tonnes,

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<sup>125</sup> David J.X. Gonzalez.

while exports to Bolivia increased from 24 to 138 tonnes.<sup>126</sup> Additionally, Peruvian officials have seized illegal shipments of mercury near the border with Bolivia. The emergence of a mercury black market is a challenge for Peruvian enforcement of the Minamata Convention.

Another researcher claims that measures enacted through the Minamata Convention can only be successful in eliminating harmful mercury use through one of the following ways: (1) limiting or eradicating mercury supply, (2) regulating the market by discouraging the purchase of mercury through the introduction of mercury-free mining methods or eliminating ASGM activity completely, and (3) regulating mercury use.<sup>127</sup> The researcher claims that (1) is not possible in a timely manner because the limits on primary mercury production agreed to through the treaty do not kick in for fifteen years after a country has ratified the Minamata Convention, and damage in Madre de Dios may be irreparable by that point as ratification itself could take years to pass through a country's legislature. Unfortunately, (2) is also unlikely because there are few options for gold ore processing, none of which are as cheap or easy-to-use as mercury and shutting down all illegal gold mining activity in Madre de Dios would take extensive military action and enforcement of the law in difficult terrain. If gold prices remain high, rent seekers will continue to flock to the Amazon to mine for gold. Lastly, (3) would approach the reduction of harmful mercury pollution by regulating its use, which is difficult considering all of uses to which mercury is put outside of gold mining—technology, medical devices, industrial processes, even dentistry. Following the mercury regulations outlined by Peru's National Action Plan could vastly improve public health, the environment, and the economy. Limiting the burning of amalgam could significantly decrease mercury vapor inhaled by miners and released into the

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<sup>126</sup> David J.X. Gonzalez.

<sup>127</sup> Buccella, "Can the Minamata Convention on Mercury Solve Peru's Illegal Artisanal Gold Mining Problem?"



surrounding environment, reducing bioaccumulation.<sup>128</sup> This could drastically improve public health statistics that show worrisome levels of mercury in hair tests of miners and in studies of Amazonian fish that are commonly consumed. However, we would expect miners' compliance with mercury burn bans to be low in the absence of a viable technological alternative for processing gold ore. Also, illegal miners already break the law by using illegal dredging equipment or operating in protected areas—why would they suddenly comply with a new law? Additionally, regulating the illegal mining industry could bring in an estimated \$305 million in taxes each year, if done properly, but raising taxes on formal mining activity has failed in the past and as we discussed, previously discussed, formalization efforts have proven challenging.

In addition to enacting legislation to regulate mercury supplies, MINAM and MINEM have partnered with the UN Development Programme (UNDP) and the Global Environment Facility (GEF) on a program called planetGOLD that aims to help Peru and 8 other countries comply with Article 7 of the Minamata Convention, which requires countries to develop a National Action Plan to reduce mercury-use in ASGM mining. In Peru, the project aims to reduce mercury emissions by 15 tonnes in 5 years.<sup>129</sup> planetGOLD approaches the issue through 4 strategies: (1) strengthening institutions, evaluating formalization policies, and creating educational materials to help facilitate formalization, (2) providing loans for mercury-free small-scale mining technology and facilitating direct market access for better prices, (3) providing technical assistance for mercury-free technology and practices, (4) developing outreach and communication materials to educate miners and stakeholders about the dangerous effects of mercury and its role in the gold supply chain. The project launched in January 2020 in Arequipa, Piura, and Puno, three other areas with informal mining activity in Peru, with a budget of ~\$4.35

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<sup>128</sup> Buccella, 179.

<sup>129</sup> “Peru,” planetGOLD, accessed May 13, 2020, <https://www.planetgold.org/peru>.

million. Components 1, 2, 3, and 4, will each receive \$650,000, \$1,525,000, \$1,175,000, and \$250,000, respectively.<sup>130</sup> ~\$360,000 will go toward the agency fee for GEF partners. The program is still in its infancy, so there is no data available about its current impact.

### **Cost:**

planetGOLD received \$4.35 million in funding.<sup>131</sup> Ratification and early implementation of the Minamata Convention on Mercury generated \$65,000 in expenses.<sup>132</sup> The National Action Plan on Mercury in the Artisanal and Small-Scale Gold Mining Sector in Peru costs \$500,000, which was paid for with financial support from GEF.<sup>133</sup>

### **Impact**

The Minamata Convention aims to restrict and control the international mercury supply, which would place upward price pressure on illegally smuggled mercury in Peru, and in theory, discourage illegal mining activity by eroding profitability. However, as one researcher pointed out, the strict controls on the mercury supply likely led to the emergence of a black market in Madre de Dios. Peru has stopped importing mercury, yet the ASGM miners all are able to acquire it for their operations, and evidence from international mercury exports and imports show a sharp uptick in mercury exports from Mexico to Bolivia and exports to Peru decreased.

Additionally, the ultimate beneficiaries of the illegally mined gold would likely be criminal organizations, so the demand-side of the equation is unaffected. Criminal organizations still want to use gold for money laundering. Gold miners could charge higher prices for their

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<sup>130</sup> “GEF-6 Program Framework Document (PFD),” accessed May 13, 2020, [https://www.thegef.org/sites/default/files/project\\_documents/GOLD\\_PFD-Signed-CI-UNDP-UNEP\\_0.pdf](https://www.thegef.org/sites/default/files/project_documents/GOLD_PFD-Signed-CI-UNDP-UNEP_0.pdf).

<sup>131</sup> “GEF-6 Program Framework Document (PFD).”

<sup>132</sup> “Project Detail,” accessed May 13, 2020, <http://www.mercuryconvention.org/Projectdetailview/tabid/5403/language/en-US/Default.aspx?Id=%202118>.

<sup>133</sup> “Project Detail,” accessed May 13, 2020, <http://www.mercuryconvention.org/Projectdetailview/tabid/5403/language/en-US/Default.aspx?Id=%202092>.

production, passing the added cost of mercury to the buyer, but small gold miners are unlikely to have much pricing power. Since gold is a commodity, markets like the London Bullion Market set global prices, leaving little room for negotiation between primary producers and middlemen. Some organizations could resort to using forced labor tactics to extract gold at a cheaper cost, as some reports have shown evidence of labor abuse in the area already.<sup>134</sup>

If planetGOLD succeeds in its initial projects and is successful in widely introducing mercury-free processes to ASGM in Peru, then a similar program could be applied in Madre de Dios. 50 tonnes of mercury are at stake in Madre de Dios and 145 tonnes across Peru. planetGOLD has a rather conservative goal of reducing mercury waste by 15 tonnes over the course of the five-year project. At a price tag of \$4.35 million, planetGOLD spends \$290,000 to reduce one tonne of mercury, not including startup costs. On the open market, mercury is sold in flasks, and each flask weighs approximately 36kg. At \$2000 per flask of mercury (2018 price), one tonne of mercury would cost \$58,823.53 on the market. planetGOLD should therefore aim to reduce mercury pollution in Peru by at least 73.9 tonnes of Hg ( $\$4.35 \text{ million} / \$58,823.53$ ) to reach the break-even point. If not, GEF is better off buying up flasks of mercury on the open market to restrict supply than invest in the planetGOLD project. However, the \$4.35 million price tag of the five-year pilot project in Peru includes startup costs, so each additional tonne of mercury reduced would actually be less expensive than \$290,000 to eliminate from environmental waste. If startup costs represented 25% of the \$4.35 million, then the marginal cost of each tonne of mercury reduced is \$217,500, which is still substantially higher than the market price of \$58,823.53 per tonne of mercury. To be efficient, planetGOLD should, therefore, further reduce the marginal cost per tonne of mercury reduced to at least ~\$44,000 per tonne of

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<sup>134</sup> “Indicators of Forced Labor in Gold Mining in Peru.”

Hg so that the project achieves the same level of mercury waste reduction as simply buying flasks of mercury on the market.

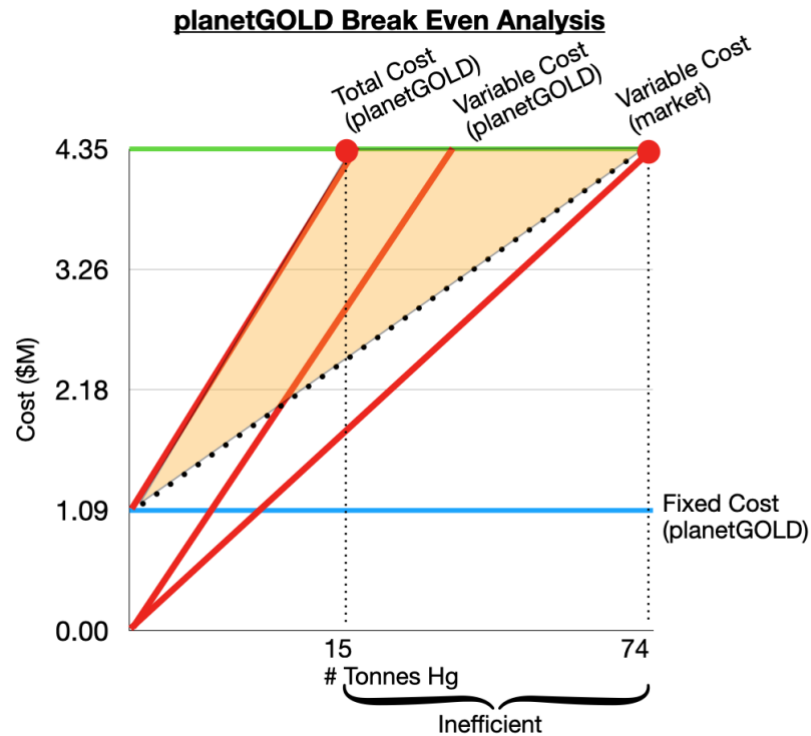


Figure 17. planetGOLD break even analysis.

**Efficiency:**

Overall, the mechanisms enacted by the ratification of the Minamata Convention in Peru alone will not solve the problem of mercury pollution in Madre de Dios, but the convention is a good launch point to encourage international collaboration to regulate mercury and prevent its use for illicit purposes like illegal gold mining. The controlling the burgeoning mercury black market and enforcing ASGM compliance with mercury regulations need to be achieved in Peru before the country sees improvement in environmental and health-related consequences of heavy mercury use. Luckily, the current administration under Vizcarra is attentive to the issues caused

by mercury use, so hopefully, further controls on cross border smuggling can be enacted in a timely manner to prevent further damage in Madre de Dios.

planetGOLD is meant to support Peru in reducing the amount of mercury used in ASGM; however, the project should seek to reduce the marginal cost of mercury per tonne eliminated from ASGM use to equal the number of tonnes that the \$4.35 million project budget could buy on the open market, or 74 tonnes. As planetGOLD is only a pilot project, cost per tonne eliminated will naturally be higher at the start due to fixed overhead costs but targeting the cost per tonne of mercury eliminated to the market price of mercury should be a goal for future phases to achieve efficiency.

**Fairness:**

The investment opportunities created by planetGOLD for implementing mercury-free practices are a positive consequence for gold miners that does not jeopardize their livelihoods and improves their health and safety conditions while also eliminating mercury emission. With formalization, however, the loss of jobs for intermediaries in the illegal gold supply chain poses substantial risk for threats to planetGOLD and similar initiatives and increased criminal activities.<sup>135</sup> The emergence of a mercury black market is one example of new criminal activity sparked by mercury-free initiatives; however, providing more job opportunities in alternative sustainable industries or in the formalized gold supply chain could be one way of mitigating this risk.<sup>136</sup>

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<sup>135</sup> “GEF-6 Program Framework Document (PFD).”

<sup>136</sup> “GEF-6 Program Framework Document (PFD).”

### Political Acceptability and Robustness

The Minamata Convention and planetGOLD are global initiatives spurred from the “top” of the political ladder and not always in collaboration with on-the-ground stakeholders—miners or unions like FEDEMIN that ultimately determine the how effective the program will be through their active participation in adopting mercury-free methods and formalizing. Involving diverse interest groups in policy making will improve the design and implementation of future projects, improving robustness.

### Replicability

128 countries have signed the Minamata Convention, and 119 countries have ratified the treaty within their legislatures. Now countries are developing their national action plans and working towards the requirements set out in the articles on the agreement. planetGOLD is currently helping 8 countries, including Peru, to be compliant with Article 7 of the convention that requires signatory countries to take steps to reduce mercury emission in ASGM.

| Report Card             |        |
|-------------------------|--------|
| Efficiency              | Yellow |
| Cost-Effectiveness      | Yellow |
| Potential Impact        | Yellow |
| Fairness                | Green  |
| Political Acceptability | Yellow |
| Robustness              | Yellow |
| Replicability           | Green  |

Figure 18. Mercury supply controls evaluation.

## **Chapter 6: Prospective Solutions to Control the Gold Supply Chain**

The actions taken by the Peruvian government so far have aimed to increase governance through military action, facilitate the formalization process to provide a platform for enacting environmental and labor standards, and usher small-scale miners towards more sustainable economic opportunities through direct investment and Minamata mercury restrictions. There still remains opportunity to strengthen these efforts through smart investment and effective gold supply chain management that creates end-to-end accountability for produced gold. The formation of a traceable gold supply chain would help hold companies responsible for their gold sourcing practices, and it would make money laundering more difficult for criminal organizations. And the question remains, could the over \$700 million used to fund Operation Mercury and Minamata projects have been used to reduce the damage caused in Madre de Dios more efficiently with the support of other strategies?

From Chapter 2 we learned that criminal organizations use gold as a means to launder money and finance their operations, fueling demand for illegally mined gold. The lack of transparency in the gold supply chain provides a perfect cover for actors using gold for illicit means while also hiding the origins of newly mined gold and the conditions under which it was produced. As we have learned, ~20% of the gold in a wedding band or in the bullion pieces in our bank vaults was likely produced through ASGM with mercury-enabled processes that damage human health and the environment. As end consumers in developed countries have become more aware of the conditions under which one-fifth of the world's gold is produced, demand has started to shift towards responsibly produced gold.<sup>137</sup> Meeting this consumer demand will not only help to improve conditions on the supply-side of the equation but will also

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<sup>137</sup> "Attitudes Toward Brand Ethics - US - January 2020: What to Watch," accessed April 19, 2020, <https://reports-mintel-com.ezproxy.lib.utexas.edu/display/1001644/?fromSearch=%3Ffreetext%3Dgold%2520mining>.

create traceability and accountability throughout the gold supply chain, making it more difficult for cartels and terrorist organizations to infiltrate gold markets as a financing mechanism. The diamond industry has seen marked improvement in its traceability through the Kimberley Certification Process to meet customer demand for conflict-free diamonds, and the gold mining industry should take note. Groundwork has already been laid out through the Fairtrade Gold Certification program that pays miners a premium for their production for using responsible, mercury-free processing methods. Blockchain-based supply management platforms could support weaknesses from gold certification programs. Chile's ENAMI is a government-sponsored entity that buys and processes copper ore from small-scale miners while also providing them with technical and financial support. These cases provide intriguing solutions for enacting controls on the gold supply to meet buyer-side demands.

#### **A. RESPONSIBLE GOLD CERTIFICATION PROGRAMS: EXAMPLES FROM FAIRTRADE AND THE KIMBERLEY PROCESS**

The Kimberley Process Certification Scheme (KPCS) was established in 2000 to prevent the trade in conflict diamonds ("blood diamonds") with promising results: 99.8% of the world diamond production is accounted for through this certification process.<sup>138</sup> The international certification scheme was created by the United Nations General Assembly and currently has 54 participants, representing 81 countries. Like the Minamata Convention, participation in KPCS is voluntary, but member countries must meet certain requirements to participate in the conflict-free diamond trade and to prevent non-certified diamonds from infiltrating the market. These requirements include ratifying legislation to require that all diamond imports or exports be certified through KPCS and to impose diamond trade prohibitions with non-KPCS member

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<sup>138</sup> "About | KimberleyProcess," accessed April 22, 2018, <https://www.kimberleyprocess.com/en/about>.



countries. But the enforcement of these laws is largely up to the participating country itself. All shipments of diamonds leaving for or entering a country must have a Kimberley Process Certificate with information like country of origin, carat weight, value of shipment in USD, number of parcels in the shipment, and a certificate validation by the exporting authority among other things. KPCS handles diamonds purchased before 2003 (the year KPCS was implemented) in the following way: they recommend that diamond owners seeking to sell these diamonds indicate a supposed place of origin to the best of their knowledge with a statement from the original seller confirming this information to provide evidence that the diamonds were produced in conflict-free areas.<sup>139</sup> This methodology is vague and allows room for falsifying documentation.

While, the main intention of KPCS was to “stop the trade in conflict diamond and ensure that diamond purchasers were not financing violence by rebel movements seeking to undermine legitimate governments,”<sup>140</sup> this goal has been largely achieved on paper with the high percentage of world diamond trade certified through KPCS; however, a loophole exists in KPCS’s definition of “conflict diamond” as it does not account for potential human rights abuses in mining operations because diamond sales can still support government regimes, corrupt or not. This has been a major problem in Zimbabwe upon discovery of alluvial diamond deposits in the Marange fields. The discovery led to an influx of illegal miners before the army seized control of the diamond fields in 2008. Under the control of a corrupt military force, blatant human rights abuses occurred in these mining fields. Over 200 miners were massacred. In response to these reports, KPCS banned diamond imports from and exports to Zimbabwe in 2009. In 2011 they

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<sup>139</sup> “KPCS Core Document.Pdf,” accessed April 22, 2018, <https://www.kimberleyprocess.com/en/system/files/documents/KPCS%20Core%20Document.pdf>.

<sup>140</sup> Audrie Howard, “Blood Diamonds: The Successes and Failures of the Kimberley Process Certification Scheme in Angola, Sierra Leone and Zimbabwe,” n.d., 24.

lifted the ban, but this same year, BBC discovered mining camps where corrupt officials recruited illegal workers for diamond mining. The failure to set standards for preserving the basic human rights for diamond miners leaves them vulnerable to poor labor conditions and abuses by corrupt officials in government-owned mines.<sup>141</sup> KPCS does not set any environmental standards for countries to abide by either.

The Kimberley Process still needs work.<sup>142</sup> It could benefit from a uniform enforcement policy as well as uniform punishments across countries for breaching laws to ensure participant compliance. While a country's respective government can control its certified diamond import or export, it has little control over the conditions of the mines themselves. Placing more security forces near mines would reduce the number of unlicensed or illegal miners, but guards can be corrupt or serve a corrupt regime as in Zimbabwe. A government under a corrupt regime could also forge certificates, undermining the whole purpose of the certification process. The Kimberley Process has "observers" who help monitor the effectiveness of the KPCS, but an independent monitoring system to track mining conditions does not exist. Only recently have other groups begun to step in. The Responsible Jewelry Council, an KP "observer," set a Code of Practices for member countries to follow in areas related to human rights, working conditions, health and safety, and transparency.<sup>143</sup>

The measures by which the Kimberley Process has managed to curb the sale of blood diamonds to fund civil wars to the extent it has should be built and improved upon to extend similar certification processes to other valuable and exploitable minerals like gold. The Fairtrade Certification has made significant leaps in this effort to improve transparency or origin in the

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<sup>141</sup> Howard, 151.

<sup>142</sup> Howard, 155–58.

<sup>143</sup> Howard, "Blood Diamonds: The Successes and Failures of the Kimberley Process Certification Scheme in Angola, Sierra Leone and Zimbabwe."

gold supply chain. Currently, it is impossible for consumers to know where and under what conditions the gold in end-products was mined. Fairtrade is a “closed-pipe” system that establishes the traceability of gold using the classic license model, similar to the KPCS. However, the Fairtrade Organization has strict international standards for miners and traders to comply with at all levels of the supply chain for certification.<sup>144</sup> These standards include measures for environmental, health, and safety regulations in mining communities as well as processing and handling gold at the trader level. Fairtrade can provide physical traceability of gold from the miners to the refiners for mass balanced gold and can provide documentary traceability all the way to the end Fairtrade-certified product. In exchange for complying with these exhaustive standards, Fairtrade offers miners fair prices in addition to the Fairtrade Premium. The Fairtrade Ecological Premium is granted on top of other payments for mining operations that have eliminated the use of mercury and cyanide.

A shift in public opinion spurred the creation of Fairtrade gold standards after several incidents drew consumer attention to the impacts of gold mining in the developing world, driving demand for ethically sourced gold. Large-scale mining drew negative attention from its environmental disruption and hazardous pollution. NGOs then launched campaigns exposing social and environmental problems associated with small-scale mining, and the public became aware of gold mining used to fund conflict in the Congo.<sup>145</sup> It also became “trendy” to consume fairly traded or ethically sourced products.<sup>146</sup> Several initiatives targeted the large-scale mining industry, but few addressed the needs of small-scale mining communities. With over 16 million

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<sup>144</sup> “Fairtrade Standard for Gold and Associated Precious Metals for Artisanal and Small-Scale Mining,” accessed November 4, 2019, [https://files.fairtrade.net/standards/2015-04-15\\_EN\\_Gold-and-Precious\\_Metals.pdf](https://files.fairtrade.net/standards/2015-04-15_EN_Gold-and-Precious_Metals.pdf).

<sup>145</sup> “Gold Policy Report - Final 13 01 15.Pdf,” accessed April 22, 2018, <https://www.fairtrade.org.uk/~/-/media/fairtradeuk/media%20centre/documents/gold%20policy%20report%20-%20final%2013%2001%2015.ashx>.

<sup>146</sup> “Attitudes Toward Brand Ethics - US - January 2020: What to Watch.”

small miners globally and an estimated 500,000 in Peru, the Fairtrade Organization has begun to make steps to ensure minimal environmental impacts while generating maximum social and economic benefits to miners and their communities.

To achieve Fairtrade Certification miners must comply with strict standards to ensure human and environmental protection.<sup>147</sup> These include general requirements like paying taxes, fees, and royalties to relevant authorities, securing accreditation from necessary government agencies or NGOs of the “artisanal and small-scale nature” of mining enterprises, and adopting anti-corruption policies forbidding bribery, money laundering, illegal taxation, and extortion. Fairtrade also sets trade, production, and business development requirements. The trade standards outline rules that companies and/or organizations need to comply with to sell Fairtrade-certified gold or other precious metals. Traceability is one of the key aims of these standards to ensure that the ethical mining of metals can be verified. The production standards require that mining operations define their System of Production to register all participating miners, areas of operation, processing units, external service providers, and a mining plan with concession numbers. Both miners and traders are expected to have Internal Control Systems (ICS). On the miner side, the ICS is supposed to cover all volume and sales into the Fairtrade supply chain to ensure the exclusion of precious metals or tailings from non-registered miners, areas, or other processing units. Small-scale mines are also supposed to have regular monitoring of operating areas by authorized persons like a shift manager. Processing facilities are supposed to comply with ICS by listing all miners and processing units that deliver gold, minerals, and tailings to them with a signature and ID number of the responsible person. These facilities should record delivery dates, amounts, areas of origin, gold content, and payment of Fairtrade Minimum

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<sup>147</sup> “Fairtrade Standard for Gold and Associated Precious Metals for Artisanal and Small-Scale Mining.”

Price and Premium to miners. The production standards also have measures for environmental and ecosystem protection to support practices that minimize environmental contamination, restore ecosystems fully, and avoid invasion of protected areas. Fairtrade does not expect small-scale miners to immediately eliminate gold production using toxic substances for certification. Mercury is cheap, easy to use, and accessible for miners, while rolling out new production technologies is financially burdensome and requires special technical knowledge. Therefore, Fairtrade will still pay miners their premium while they are in the process of converting to more sustainable mining methods.

The financial burdens on miners to meet Fairtrade requirements are significant, so to compensate miners for their efforts to abide by ethical operating procedures, Fairtrade offers miners a Fairtrade Minimum Price for their gold as well as a Fairtrade Premium. The Fairtrade Minimum Price is set at 95% of the market price of gold. This market price is set twice a day by the London Bullion Market Association (LBMA). Miners also receive a Fairtrade Premium of \$2000 per kilogram of high-quality gold. Miners can also earn a Fairtrade Ecological Premium, an extra 15% on top of the guaranteed minimum price, if gold is produced without the use of chemicals like mercury or cyanide.<sup>148</sup>

The weak governance and well-known corruption in remote areas of Madre de Dios make certification schemes difficult to effectively implement and verify to avoid unethical or illegal gold from infiltrating the supply chain. However, once mining rights are secured and operating processes meet certain legal, ethical, and sustainability standards, new blockchain-based technology can be used as a tool to register and record the transfer of ethical gold from the source to the end-product (See B.).

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<sup>148</sup> “Gold Policy Report - Final 13 01 15.Pdf.”

| Report Card             |        |
|-------------------------|--------|
| Efficiency              | Green  |
| Cost-Effectiveness      | Green  |
| Potential Impact        | Green  |
| Fairness                | Green  |
| Political Acceptability | Green  |
| Robustness              | Yellow |
| Replicability           | Green  |

Figure 19. Gold certification program evaluation.

### **B. PRIVATE SECTOR SOLUTIONS: BLOCKCHAIN-ENABLED SUPPLY MANAGEMENT**

Blockchain is the technology behind Bitcoin and other cryptocurrencies, and it functions as a shared set of information across a decentralized global network of computers that is continuously updated as new transactions occur. The database is not stored at a central location but simultaneously across millions of computers with internet access, making transactions transparent, easily verifiable, and also nearly impossible to corrupt. Using this technology, a publicly distributed ledger could be created to secure the world’s ethical gold supply. It could support certification schemes like Fairtrade Gold to thwart illegally mined gold from entering the ethical gold supply chain at any stage. This is precisely what one corporate partnership aims to do.

In April 2018, Cobalt Blockchain (COBC) and DLT Labs announced a partnership to “provide secure, traceable and transparent methods for tracking and certifying the provenance of

metals and minerals through the entire supply chain from source to end-user.”<sup>149</sup> DLT, which stands for Distributed Ledger Technology, has developed a supply chain and logistics product called DL Asset Track to help complex supply chain networks maintain end-to-end visibility between producers, distributors, and final consumers.<sup>150</sup> The partnership is seeking to adapt this tool to create a distributed ledger platform specifically for entities involved in metals and minerals trading. With the increased global awareness of deplorable working conditions for miners, the global consumer demand for ethical and conflict-free mining products has soared, and with it, the need for transparent and reliable methods of tracking origins. COBC recently acquired cobalt mining concessions in the Democratic Republic of Congo in an area with active small-scale miners. The platform will be piloted there before being offered commercially.

This distributed ledger platform works in the following way. The platform is created with regards to the industry and supply chain needs. Transactions are made user-to-user and verified through shared, secure records of the distributed ledger platform. When the asset finally reaches the end consumer, there exists a traceable, auditable, and incorruptible record of information for that asset. All transactions made throughout the network are updated constantly and are visible to authorized participants. Companies can track and record relevant information, especially origin and certification standards, without being able to alter them. Once a transaction is recorded, for example a newly mined oz of gold is bought from a certified miner, information about that transaction could not be altered for corrupt purposes down the line. Ease of tracing origins of mining products will help keep downstream buyers accountable for responsible gold sourcing. Higher demand incentivizes miners to achieve legal standards and certification requirements so

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<sup>149</sup> “Mineral Supply Chain to Be Transformed by Cobalt Blockchain And DLT Labs,” *DLTlabs* (blog), April 3, 2018, <https://dltlabs.com/mineral-supply-chain-transformed-cobalt-blockchain-dlt-labs/>.

<sup>150</sup> “DL Asset Track,” accessed April 23, 2018, [https://dltlabs.com/wp-content/uploads/2018/03/DL\\_Asset-Track\\_new.pdf](https://dltlabs.com/wp-content/uploads/2018/03/DL_Asset-Track_new.pdf).

that their output can earn higher market prices. It remains unclear how COBC/DLT plans to certify mined cobalt. They will likely have to partner with local governments or international certification processes to integrate them into their platform. In the case of the gold supply chain, it is also unclear as to how a blockchain-based supply management platform would account for recycled or grandfathered gold sources, if at all. A problem also arises when one entity buys a physical asset but sells it in a conventional way (i.e. a cash transaction) because the ownership verification would occur on two different databases that do not communicate.<sup>151</sup>

In Peru, the government can support blockchain-based transactions by clarifying the legal framework in which small-scale gold miners operate. This would include improving formalization procedures and monitoring and regulating mining concessions so that miners are able to operate within the formal economy and therefore eligible for certification. They would also need to expand basic infrastructure requirements like reliable energy sources and internet connection to remote areas where mining occurs.<sup>152</sup> Formal and certified miners would then be able to sell and their production directly into the verified supply chain instead of having to go through intermediaries.

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<sup>151</sup> Mohit Mamoria, "Let's Think about Putting Physical Assets on Blockchain," Tech Wire Asia, December 22, 2017, <http://techwireasia.com/2017/12/physical-assets-blockchain/>.

<sup>152</sup> Philipp Sandner, "Solving Challenges in Developing Countries with Blockchain Technology," *Medium* (blog), July 9, 2017, <https://medium.com/@philippsandner/solving-challenges-in-developing-countries-with-blockchain-technology-78ec9b01bae3>.



| Report Card             |   |
|-------------------------|---|
| Efficiency              | ■ |
| Cost-Effectiveness      | ■ |
| Potential Impact        | ■ |
| Fairness                | ■ |
| Political Acceptability | ■ |
| Robustness              | ■ |
| Replicability           | ■ |

Figure 20. Evaluation of Fairtrade certification aided by a blockchain-based gold supply management platform.

### C. CENTRALIZED GOLD BUYING PROGRAMS: LEARNING FROM CHILE’S ENAMI

In the 1940s, the Peruvian government created the Banco Minero (Mining Bank) to provide financing and loans to small-scale miners, but the government suspended its operations on December 18, 1990 after the bank had over \$70 million in outstanding “bad” loans and an additional \$4 million debt for operating expenses.<sup>153</sup> The bank was unsustainable because of mismanagement and the failure of many small mines at the time. From 1980 to the bank’s closure, the number of employees grew from less than 200 to around 1,600, while only 5 of the 1,000 loans had been made to small-scale mines still in operation.<sup>154</sup> In the late 1960s there were around 450 small-scale miners in Peru, but in 1990 when the Banco Minero closed, only 10 small-scale mines remained in operation after either being nationalized or going bankrupt. The government considered reopening the Banco Minero, but ultimately president Alberto Fujimori decided not to because of the losses it had amassed.

<sup>153</sup> Barry Lynn, “BANCO MINERO LOSSES SPUR TAKEOVER BY PERU.,” *American Metal Market*, December 27, 1990.

<sup>154</sup> Lynn.

Not only did the Banco Minero provide financing for small-scale miners, which in today's context would be useful in efforts to aid the transition to safer, mercury-free technology in small-scale mining, but it also ran a centralized gold-buying program that would purchase the entire production of small-scale gold miners in Peru, cutting out the middlemen. While in the late 20<sup>th</sup> century, a mining development bank proved unsustainable, today with over 500,000 small-scale miners in Peru, forming a development bank for miners would not only be feasible but would also provide an avenue to foster a close government-SSM community relationship that could be leveraged to encourage formalization and the adoption of clean technologies while also providing miners with direct market prices for their gold production.

Peru's mining bank could mirror Chile's ENAMI. As the world's largest copper producer, Chile has turned to a centralized organizational body to exert some level of regulation over its small- to medium-scale copper mining industry for the miners' benefit, and a similar concept could greatly benefit ASGM in Peru. Founded in 2000, the *Empresa Nacional de Minería* (ENAMI) was created with the purpose of promoting the development of small- and medium-scale mining firms in Chile.

ENAMI is a government-owned entity, but it is structured like a business. Its large scale buying and selling operations generate enough revenue for financial self-sufficiency and provide general support and oversight to this industry sector. ENAMI's manages public policies for the promotion and development of small- and medium-scale mining, introducing an ethical code as well as policies for sustainability, environmental protection, occupational health and safety, energy efficiency, process quality, and mining support help to achieve its mission. An auditory committee acts as an internal control mechanism to ensure policy compliance in various processes and efficient resource consumption. The quantity of copper ore that ENAMI is able to

buy, process, and sell gives it leverage to negotiate higher prices on the international market. In turn, miners receive competitive prices for their ore rather than selling their output to swindling middlemen.<sup>155</sup>

ENAMI's sustainability and environmental policies help protect workers by enacting risk management strategies and supporting a culture of prevention at their processing units. They ensure that ENAMI processing plants efficiently consume water and energy resources while also minimizing environmental contamination from air pollution or toxic residues. Miners can also receive technical and financial assistance to help improve their mining processes and increase production outputs. Access to new, more sustainable mining technology is crucial for supporting best practices in the sector.

In the context of small-scale mining in Peru, formalized miners would benefit from a similar organizational structure to that of ENAMI. A central buying and selling scheme for gold produced would reduce the vulnerability of small miners in remote areas to corrupt or criminal gold buyers who are obstacles for fair compensation. Centralizing the transactions between miners and gold buyers would undercut abusive middlemen and would have the added benefits of collective price negotiation on the international market as well as the possibility of administering technical and financial assistance to miners.<sup>156</sup> Access to these resources would also make ethical gold certification schemes more accessible to miners (See Prospective Solutions A).

Former Peruvian president Pedro Pablo Kuczynski recently proposed creating a development bank entity to connect miners with financial assistance, but his ultimate removal

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<sup>155</sup> "Reporte de Sustentabilidad 2017," accessed April 22, 2018, <https://www.enami.cl/api/descarga?f=/Reporte%20Sustentabilidad/ReporteSust2017-ENAMI-bfinal.pdf&f=/Reporte%20Sustentabilidad/ReporteSust2017-ENAMI-bfinal.pdf>.

<sup>156</sup> Korinek, "Managing the Minerals Sector."

from the presidency prevented this idea from gaining any traction;<sup>157</sup> However, the solution is still promising because of the technical and financial support it can provide miners. A development bank for small-scale miners with a centralized gold buying program would face political resistance despite the potential benefits it could bring. By starting a mining bank, some would perceive the government as encouraging illegal gold mining activity and condoning all of the negative public health and environmental costs associated with ASGM. A development bank specifically for miners could prop up government institutions in the region and encourage formalization, as some sort of registration would be required to access loans and another bank resources. It could also support alternative economic development by reinvesting revenue from gold buying into sustainable small-scale enterprises in Madre de Dios. A new Banco Minero is an interesting proposition, but it would require a lot of collaboration and coordination between different levels of government and political interests.

| Report Card             |        |
|-------------------------|--------|
| Efficiency              | Green  |
| Cost-Effectiveness      | Green  |
| Potential Impact        | Green  |
| Fairness                | Green  |
| Political Acceptability | Yellow |
| Robustness              | Green  |
| Replicability           | Green  |

Figure 21. Mining development bank with a centralized gold buying program.

<sup>157</sup> Redacción EC, “Kuczynski propone creación de banco de fomento minero,” El Comercio, May 8, 2016, <https://elcomercio.pe/politica/elecciones/kuczynski-propone-creacion-banco-fomento-minero-395719>.

## V. CLOSING THOUGHTS

| Final Report Card                          |                    |                  |                    |          |                         |            |               |
|--|--------------------|------------------|--------------------|----------|-------------------------|------------|---------------|
| Current Solutions                          | Cost-Effectiveness | Potential Impact | Overall Efficiency | Fairness | Political Acceptability | Robustness | Replicability |
| OM- Military Raids                         | Red                | Yellow           | Red                | Red      | Yellow                  | Green      | Green         |
| OM- Formalization                          | Yellow             | Yellow           | Yellow             | Green    | Green                   | Yellow     | Green         |
| OM- Alt. Development                       | Green              | Green            | Green              | Green    | Green                   | Yellow     | Green         |
| Minamata Convention & planetGOLD           | Yellow             | Yellow           | Yellow             | Green    | Yellow                  | Yellow     | Green         |
| Prospective Solutions                      |                    |                  |                    |          |                         |            |               |
| Gold Certification                         | Green              | Green            | Green              | Green    | Green                   | Yellow     | Green         |
| Blockchain-Enabled Supply Chain Management | Green              | Green            | Green              | Green    | Green                   | Green      | Green         |
| Centralized Gold Buying Program            | Green              | Green            | Green              | Green    | Yellow                  | Green      | Green         |

Figure 20. Final report card.

Our analysis applies a management consulting problem-solving approach combined with policy analysis to evaluate current and prospective strategies and how efficiently they address the root causes of illegal gold mining in Peru. Supply-side and demand-side factors as well as institutional weaknesses all contribute to the proliferation of illegal mining in Madre de Dios.

From a supply standpoint, miners want to engage in ASGM because of the promise of lucrative profits and the lack of alternative economic opportunities. From the demand-side, high demand for gold exists from consumers and criminal organizations that create conflicting interests in mining practices. Consumers want sustainably sourced gold while criminal organizations have no interest in where their gold comes from, just that it can be successfully used to launder profits from drug sales in the U.S. and elsewhere. Institutional weaknesses in Madre de Dios impedes the government's ability to support formalization efforts and makes enforcement of labor and environmental standards more difficult.

Through our problem-solving process, we discovered that the current strategies used by the government could be strengthened with a blockchain-aided gold certification scheme and the founding of a development bank for mining.

Operation Mercury 2019 is the main avenue through which the Peruvian government aims to address the issues caused by illegal mining in Madre de Dios. Its three-pronged strategy approaches gold mining from multiple dimensions through military raids, investment in formalization, and developing sustainable alternative economic opportunities in the region. While the military raids were overall costly and only provided a short-term reduction in illegal mining activity, the planned military bases could be an effective avenue for establishing government authority in the region. Formalization rates continue to lag, but the potential tax revenue from newly formalized miners could provide significant capital for infrastructure and sustainable development projects. Long-term sustainable development initiatives through Operation Mercury are in their early stages, but if the government efficiently invests available funds, they could generate a significant number of jobs in sustainable industries like aquaculture that earn comparable annual incomes to small-scale gold mining.

In addition to investment in these areas, the government is trying to reduce mercury use in ASGM through education programs like planetGOLD that teach about the health risks of mercury. By discouraging its use and providing technical and capital assistance to miners, the hope is that miners will choose to invest in safer, mercury-free technology. The project set a conservative goal of reducing 15 tonnes of mercury from use across Peru when the country as a whole emits 145 tonnes of mercury per year.

Each “prong” of Operation Mercury and efforts to curb mercury use can be improved upon through complementary solutions that we explored in Chapter 5. The Peruvian government can address gold demand-side factors by supporting Fairtrade gold initiatives. The demand for eco-conscious gold is growing among consumers and adopting ethical and responsible mining practices would allow ASGM to earn higher revenues for their gold. A blockchain-based management platform would add additional traceability and security in an ethical gold supply chain, preventing illegally mined gold from infiltrating it. Finally, the installation of a new Banco Minero could assist the government with effective investment planning for sustainable development projects, and any additional revenue from a centralized gold-buying program could be reinvested in these sustainable initiatives. A mining bank could also strengthen formalization efforts by helping to foster formal business relationships with miners.

As the buying and selling of illegally mined gold become more difficult and the buying and selling of ethically produced gold become more lucrative, gold miners will slowly transition to responsible production processes. In the meantime, the Peruvian government faces a valuable opportunity to facilitate a quicker transition to sustainable mining practices through its current efforts aided by new complementary strategies.

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## **BIOGRAPHY**

Arabella Benavides was born in Houston, Texas on January 3, 1998. Her parents moved to Texas from Peru in 1996. She enrolled in the Plan II Honors program at the University of Texas at Austin in 2016 where she also majored in economics and Latin American studies. In her junior year, Ms. Benavides studied economics and management at St Edmund Hall, Oxford University, which she also represented on the lacrosse field in the 2019 Varsity Match against Cambridge. At UT, she was a member of the Kappa Kappa Gamma sorority, Phi Gamma Nu business fraternity, and was in the first cohort of fellows in the Social Entrepreneurship Learning Lab. Ms. Benavides graduated in May 2020 and plans to start working at a consulting firm in Austin in the fall. Her thesis was inspired by many road trips with her grandparents through Piura in northern Peru, where informal gold mining operations take place alongside the Pan-American highway, pictured below.

