



## Voluntary gold certification programs: A viable mechanism for improving artisanal and small-scale mining in Peru?

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### ARTICLE INFO

#### Keywords:

Artisanal and small-scale gold mining (ASGM)

Voluntary gold certifications

Peru

Environment

Rural development

### ABSTRACT

Globally, artisanal and small-scale gold mining (ASGM) provides a livelihood for approximately 20 million people directly and millions more indirectly. Despite its economic contributions and job creation for rural communities, the sector continues to be overlooked in local, regional, and national sustainable development plans. Voluntary gold certification programs, created and administered by international NGOs, have emerged as one response to tackle the social and environmental issues associated with the ASGM sector. Although voluntary gold certifications are gaining more traction, their impacts remain unclear. Focusing on Peru, the country with the greatest number of certified artisanal and small-scale gold mining organizations (ASMOs), this paper examines the practical impacts when certification is achieved and identifies the shortcomings. Based on interviews with gold certification staff members and members of certified ASMOs, as well as site visits to certified mining operations, we demonstrate that gold certification programs are driving ASMOs to implement better environmental management and health and safety practices. Certified ASMOs are also benefitting from the economic incentives of selling gold internationally, and they are investing the premiums they receive from certifications into projects that benefit their workers and the mining town. Still, the reach of certification programs remains limited, with only a fraction of miners working for certified ASMOs. This article concludes that although gold certification programs have the potential to improve environmental protection and contribute to rural development, there are challenges that will have to be overcome for small-scale mining organizations to achieve and maintain certification status.

### 1. Introduction

Artisanal and small-scale gold mining (ASGM), generally characterized by low-tech, labor-intensive mineral extraction and processing, provides rural populations a source of income and significantly contributes to regional and national economic growth. It involves over 20 million people directly and millions more indirectly and takes place in over 70 countries producing almost 600 tonnes/a of gold (Heymann, 2020; Yoshimura et al., 2021). This accounts for approximately 20% of the global annual gold production (World Gold Council, 2022), but in some cases such as in Colombia in South America, the ASGM sector is responsible for more than 80% of the country's annual gold production (Veiga and Marshall, 2019).

Despite the ASGM sector providing a livelihood for millions of people in rural communities, the social and environmental issues associated with the sector overshadow its economic importance. ASGM is the

largest source of global mercury pollution, with an estimated 2000 tonnes of mercury lost to the environment per year (UNEP, 2019). It can also contribute to deforestation (Caballero Espejo et al., 2018) and involve child labor, money laundering, and other illicit activities (Hinton, 2006; Hilson, 2010a). Furthermore, gender inequalities (Arthur-Holmes, 2021), adverse impacts on human health (Tschakert and Singha, 2007), and conflicts with owners of mineral titles (Verbrugge, 2017; Veiga and Fadina, 2020) are also fairly common among the sector. These associated social and environmental problems have raised global concern and called more attention to the need for improved governance and regulation of the sector to improve rural livelihoods and minimize environmental impacts.

Formalizing ASGM is often cited as the first step toward developing the sector (Siegel and Veiga, 2009; Maconachie and Hilson, 2011; Hilson and Maconachie, 2020a), as the largely informal nature of the sector often precludes its inclusion in local, regional, or national sustainable

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development plans (Hilson, 2021; Maconachie and Conteh, 2021). However, most formalization efforts have largely targeted the *legalization* of ASGM activities, by focusing on making ASGM legible so governments can surveil and collect taxes from the sector, rather than building capacity and training miners—necessary components of effective formalization (Veiga and Fadina, 2020; Martinez et al., 2021). Without capacity building and training, governments cannot expect that miners will adopt safe and environmentally responsible practices (Marshall and Veiga, 2017).

Research in sub-Saharan Africa has highlighted that legal frameworks aimed at ASGM have not been aligned with the needs and realities of the sector and have failed to provide adequate support (Hilson et al., 2014; Hilson and Maconachie, 2020b). Therefore, formalization efforts have been inadvertently inhibited, and informality has in fact been perpetuated. Policymakers and donor agencies tend to view the sector as “homogenous” and “static” (Hilson, 2010b: p. 297), leading to oversimplifications and the failure to recognize the ASGM sector as a “platform of wealth creation” (Verbrugge, 2016, p. 109; Hilson and Hu, 2022, p. 94). Additionally, because formalization policies generally overlook the concept of mineral depletion and exhaustion, technical support to determine the extent of mineral reserves has not been provided to miners (Ofosu and Sarpong, 2022), bringing the long-term sustainability of formalization into question. Given mineral reserve depletion, a more comprehensive formalization strategy would include providing miners with opportunities and skills to diversify their livelihoods, which is vital to sustaining rural economies (Maconachie and Hilson, 2018; Chigumira, 2018).

Although Peru boasts the greatest number of formalized artisanal and small-scale gold miners in South America, formalization has failed to resolve many of the social and technical issues associated with the sector (Martinez et al., 2021). Salo et al. (2016) argues that the Peruvian government’s purpose in formalizing the sector has been to gain control of ASGM activities, generate public revenue, and implement and enforce social and environmental norms, while failing to provide clear benefits to ASGM operators. Damonte (2016, 2018) adds that the central state lacks the capacity to “read” and govern local society in Madre de Dios, thus leading to inefficient and inadequate policies which exclude miner’s realities. Another study from the Peruvian Amazon (Álvarez-Berrios et al., 2021), concluded that without adequate enforcement and interagency coordination, formalization does not resolve environmental issues, and in some cases may accelerate ecological destruction. In the Andean highlands, Martinez et al. (2021) concluded that despite formal ASGM operations improving health and safety practices and labor conditions, formal miners felt more pursued and scrutinized than they did when they operated informally, and they continued to face challenges obtaining technical support and accessing capital.

Given the shortcomings of ASGM formalization efforts, voluntary gold certification programs, created and administered by international NGOs, have emerged as one response to tackle the social and environmental issues associated with the ASGM sector. Unlike state-led formalization efforts which rely primarily on the threat of sanctions, voluntary gold certification programs provide market-based incentives for compliance with environmentally and socially responsible mining practices (Glasbergen, 2013; Childs, 2014b; Sippl, 2015). However, for miners to be able to enroll in certification programs, their operations must first be formalized according to national laws. Although voluntary gold certifications are gaining more traction, their contributions toward improving rural livelihoods and minimizing environmental impacts remain unclear (Fisher, 2018; Sippl, 2020). To date, there has been only one study published which evaluates the impact of the Fairmined certification program on the well-being of participating gold miners in Colombia and Peru (N.U. Martinez et al., 2021). This study concluded that participation in the Fairmined certification program improved miner’s well-being and “might” have improved ASGM operations.

Building on N. Martinez et al.’s (2021) work, this study provides a

qualitative analysis of the impact voluntary gold certification programs are having on social development and environmental protection from the perspectives of certified miners and certifying agencies. In this article, we focus on Peru, which has the most certified artisanal and small-scale mining organizations (ASMOs) in the world with three Fairtrade and three Fairmined operations. In particular, we examine the practical effects of the Fairmined gold certification program created and administered by the Alliance for Responsible Mining (ARM) in the Department of Puno. Puno is a suitable setting to examine gold certification programs, as it is home to the very first alluvial ASGM operation in the world to receive the Fairmined certification, and currently all three Fairmined certified ASMOs in Peru are in the region.

This article has multiple objectives centering on the core question of the practical impacts of certification programs. First, we examine to what extent the Fairmined certification program has achieved its objectives of improving rural livelihoods and minimizing environmental impacts (ARM, 2015). Our key contribution is to move the debate beyond questions of how to achieve certification, to understand the outcomes of certification programs as they are experienced by ASGM operators and to identify the potential shortcomings. We argue that although gold certifications have driven some improvements in ASGM environmental and health and safety practices and have resulted in some contributions to local development, there are other environmental and development aspects that have received less attention raising questions about the longer-term viability of certification programs. Our empirical focus is on Fairmined certified operations in the Puno region of Peru; however, our findings are applicable to gold certifications more broadly, as they indicate some of the ways in which certification programs may be improved to more effectively address the challenges experienced by artisanal and small-scale mining operators.

## 2. Gold certification programs and ASGM

Gold certification programs have been proposed as a possible solution to fill the voids of government-led formalization efforts (Veiga and Marshall, 2019) and promote sustainable development in the ASGM sector. Through gold certification programs, miners can participate in NGO-led capacity building projects that promote the use of mercury-free processing technologies, support miners in complying with regulations, and attempt to assemble ethical gold supply chains (Sippl, 2015). To become certified, miners must be part of a formalized ASMO that has legal access to mining rights, and they must adhere to a series of standards pertaining to environmental protection and labor conditions.

Mercury is prioritized in gold certification schemes. Certified ASMOs must not directly emit mercury into the environment, and workers must use personal protective equipment when handling mercury. They are also required to demonstrate that they have in place other health and safety practices and processes and have a workplace that is free from discrimination and child labor. In return, they receive a guaranteed price for their gold, an additional premium, direct access to international markets, and technical support. Certification programs attempt to eliminate middlemen who often provide loans and other supplies (including mercury) to miners in exchange for gold at below market prices, creating a “poverty trap”, as miners become indebted to them (Micheletti, 2003; Hilson, 2008; Spiegel, 2009; Hilson, 2012; ARM, 2014; Wilson et al., 2015).

Although certifications hold some promise for promoting more legitimacy and transparency among the ASGM sector, the implementation and inspection of the certification standards are usually costly and difficult to enforce (Veiga and Marshall, 2019). Furthermore, the requirements to become certified are challenging for many ASGM operators, particularly those who are unable to secure licenses and mineral titles because of costly registration fees, complicated bureaucracies, or few available mineral titles (Hilson, 2008; Sippl, 2015; Hilson et al., 2018). This has led to the question of whether certification programs live up to their “pro-poor” narrative (McQuilken, 2016; Hilson et al.,

2016, p. 236) and only target the “low-hanging fruit” or medium-scale miners who are well-organized and able to meet the stringent certification standards (Hilson, 2014; Hilson and McQuilken, 2016; Hilson et al., 2016, p. 241; Hilson et al., 2018). The transferability of these programs, particularly to countries of Africa, has also been questioned (Childs, 2008, 2014a; Hilson, 2008; Hilson et al., 2016). However, little is known as to how and to what extent voluntary gold certification programs can truly contribute to ensuring social development and environmental protection in the ASGM sector.

### 2.1. Brief history of the Fairmined Gold certification

The Alliance for Responsible Mining (ARM) was created in 2004 with the goal of promoting responsible practices within the ASGM sector. Through the Oro Verde (Green Gold) initiative, aimed at biodiversity conservation in the Chocó Department of Colombia, ARM partnered with the artisanal mining cooperative *Oro Verde* to support and promote their mercury-free extracting technologies, their efforts at site restoration, and the economic benefits of selling “green gold” experienced by the Afro-Caribbean population (Sippl, 2015). In 2006, ARM developed its first standard, *Standard Zero*, which created a set of principles of fair-trade practices for small producers and applied them to artisanal and small-scale mining. The targeted areas included health and safety, environmental management, gender, child labor, sustainable livelihoods, governance, formalization, and marketing (Hilson et al., 2018). Through feedback from workshops, and with the input and consultation of miners’ organizations and other stakeholders in Latin America, the standard was updated in 2007. In 2009, ARM entered a three-year partnership with Fairtrade International, and together launched the first gold certification standard in 2011 under the label “Fairtrade and Fairmined Gold” (Childs, 2014b). This standard was modeled after the Fairtrade certification developed for agri-food commodities in the 1970s (e.g., bananas, coffee, tea, and cocoa). In 2013, Fairtrade Gold and Fairmined Gold were publicly released as separate interventions (Hilson and McQuilken, 2016). The stated objective of the Fairmined Gold Standard (2014, p. 4) is to:

... promote the progressive organization and formalization of the ASGM sector, bringing with it improved labor rights, safer working conditions for miners, and strengthened miners’ organizations with the capacity to campaign for legislation and public policies that promote their rights and enable a responsible ASGM sector.

The standard emphasizes ASGM formalization, capacity building, and improved working conditions. In Peru, over the last decade the government has attempted to simplify the formalization process for artisanal and small-scale gold miners, and there are now 10,554 formalized artisanal and small-scale gold miners (*Registro Integral de Formalización Minera*). To become certified, artisanal and small-scale miners must be operating formally and organized into an ASMO.

*“An ASMO is a formal organization established for the purpose of conducting or facilitating responsible artisanal and small-scale mining and constituted according to the legal, social, cultural, and organizational reality of the local context. An ASMO has direct (held by the ASMO) or indirect (held by miners of the ASMO) legal or contractual rights and environmental permits to mine.”* (ARM, 2014, p. 7) [emphasis added]

Without these conditions met, artisanal and small-scale miners are not able to continue the certification process.

Fairmined certification assures that producers receive a guaranteed price, greater than or equal to 95% of the London Bullion Market Association (LBMA) fixing for gold, as well as a premium of US\$ 4000 per kilogram of gold. The fixed premium was originally adopted during the creation of the certification and was 10% of the average LBMA gold fixings in December 2013 (~\$40,000). Per the Fairmined Standard, ASMOS are required to invest this premium in community development projects through their “premium committee”, a group of ASMO representatives that decide where and how to invest these funds (ARM, 2014). Fairmined also offers an additional premium (US\$ 2000 per kilogram) to ASMOS that do not use mercury or cyanide in mineral processing. These ASMOS are certified under the Fairmined Ecological Gold or Eco-Gold standard. For ASMOS to remain certified under either standard, they must undergo annual audits by one of three approved external third-party organizations. Each year, the requirements to renew certification become more stringent to push ASMOS to progressively improve their practices (ARM, 2014).

Currently, there are eight certified ASMOS in the world (five Fairmined and three Fairtrade). However, when examining the uptake over time, Sippl (2020) highlights that from 2013 to 2019, 19 ASMOS gained and maintained certification, and 7 ASMOS gained certification and then decertified. In Peru, there are three Fairmined certified ASMOS and three Fairtrade certified ASMOS. All the Fairmined certified ASGM operations are located in the Andean region of Puno, in southeastern Peru (Table 1), and two of the three certified Fairtrade ASMOS are also located in Puno. The Puno region presents a key region for certification programs, as it leads the entire country in the number of formalized miners (2899 of 10,554). In this paper, we focus on the Fairmined certification because of its sole focus on gold sourced from the ASGM sector and their greater reach among the ASGM sector. Until 2020, 24 ASMOS in Colombia, Peru, Bolivia, and Mongolia worked with ARM, and 13 ASMOS in Peru, Kenya, and Uganda worked with Fairtrade (N.U. Martínez et al., 2021).

According to ARM, between 2011 and 2021, certified ASMOS sold more than 110 tonnes of gold. However, if we consider Heymann’s (2020) estimate that the ASGM sector is producing an estimated 600 tonnes/a of gold, then in the last ten years Fairmined gold represents a very small portion (1.8%). Similarly, 246 miners in Peru are members of Fairmined Certified operations, representing only 0.05–0.25% of the total number of miners in Peru based on De Echave’s (2016) estimates of 100,000–500,000 artisanal miners. These numbers indicate that certification programs have an extremely limited reach. No less, N. Martínez et al.’s (2021) study in Colombia and Peru showed that compared to non-certified miners, miners who participated in the Fairmined certification program reported improvements in their well-being in terms of health, lifestyle, and income satisfaction.

### 3. Methods and data sources

This study took place in the town of Ananea, located in the Puno region at 4800 m above sea level. It is one of the most important mining districts of Peru and is home to all three Fairmined certified operations. Small-scale miners in Ananea work in large open-pit operations which resemble medium to large-scale operations in which they extract gold from alluvial deposits. The operations consist of dozens of excavators,

**Table 1**  
Certified ASMOS with their certification date, type of certification obtained, location of their operation, and number of members.

Organization	Department	Number of Members	Certification Type	Certification Date
CECOMIP	Puno	~200	- Fairmined - Fairmined Eco Gold	- August 2016 - January 2020
Oro Puno	Puno	~20	Fairmined Eco Gold	January 2018
Cruz Pata Chaqueñas	Puno	~26	Fairmined	March 2020

front-end loaders, and dump trucks used to transport ore to sluice boxes. The ore is then washed down angled surfaces with carpets that capture gold particles. Every four hours, the concentrate is collected from the sluices and mercury is added. A mercury-gold amalgam forms which is generally burned off in an open-flame releasing mercury into the environment.

To understand the impacts of voluntary gold certification programs and their role in ensuring social development and environmental protection, we visited the three Fairmined certified ASGM operations in the Puno region from July 2018 to September 2021. We collected data on the outcomes of certification, the ways in which certified ASMOs were operating, and any changes that ASMOs had made because of certification. These data were collected through over 100 h of on-site observations and twenty semi-structured interviews with employees from three certified ASGM operations. These employees held various ranks at the mines as miners, supervisors, accountants, lawyers, engineers, consultants, and security guards. To examine environmental practices, in particular mercury use patterns and trends, we obtained data on daily mercury use from February–December 2019 from one of the certified ASMOs.

To understand the Fairmined certification process and ARM's perspectives on and experiences with this program, we conducted semi-structured interviews with six ARM employees and compiled information from ARM's website and public documents on the number of certified miners, the certification requirements, and the investments ASMOs have made with the premium received. In addition, we visited the ARM headquarters in Colombia to speak with employees, and we attended various workshops and trainings conducted by ARM to better understand the support being provided to certified miners. To compare the profits that certified ASMOs receive from selling their gold to international markets to those that non-certified ASMOs receive from selling their gold locally, we conducted a cost-assessment using international gold market prices as listed in [kitco.com](http://kitco.com), and we obtained the costs associated with certification (e.g., export costs, audit costs, and income tax) from both ARM and certified ASMOs.

#### 4. Results and discussion

During interviews and field research, several themes emerged in terms of the outcomes of certification programs in relation to social development and environmental protection. Respondents from ARM and ASMOs repeatedly referred to the costs and benefits associated with the Fairmined premium, environmental management practices associated with mercury, and community development initiatives undertaken by the ASMOs. The impacts on social development and environmental protection hinge on the economic incentives (e.g., profitability) offered by the premium which allowed miners to invest into more responsible mining practices. While we acknowledge that there may be other impacts of certification programs, the ones discussed in this paper surfaced as the most relevant to both ARM staff members and artisanal and small-scale miners. Lastly, we examine some of the factors that arose in the field which may impact the long-term sustainability of certification programs.

##### 4.1. Social development

###### 4.1.1. Profitability of certified operations

Certifying agencies promote the economic benefits of certifications to ASMOs, including direct access to international markets, an additional premium, and the elimination of middlemen. While these benefits are enticing for miners, ASMOs must maintain a relatively high and consistent volume of gold production for certification to be economically feasible. Our calculations based on real numbers from one of the certified ASMOs showed that an ASMO must produce a minimum of 1.74 kg per month or 20.93 kg per year to benefit from the premium (BOX 1, Example 1). Although an ASMO producing less than 1.74 kg of

gold per month will receive a fair price based on the LBMA fixing for gold, the money received from the premium will be exhausted covering the annual audit cost, income tax, and export costs (*Total Fixed Associated Costs*), which amount to US\$ 83,700 (see Example 2). This excludes many mining organizations from even entering certification programs.

Furthermore, most of the artisanal and small-scale miners in the world are actually 'micro-miners', processing less than 2 tonnes of ore per day and producing 0.1–0.5 g of gold per day (Veiga et al., 2014). These miners will not benefit from such programs as they generally produce only 3–15 g of gold per month. It appears that gold certification programs continue to favor more *medium*-scale miners that can meet the requirements without much difficulty and will profit with or without the certification.<sup>1</sup>

The average gold production among the ASMOs we worked with, was 3 kg per month (36 kg per year). For this, they would receive an *Annual Total with Premium* of US\$ 2.2 million (BOX 1 Example 2). Formalized miners in the Puno region do not export gold directly, rather they rely on middleman in the local market who purchase their gold at a discounted price, usually 10–15% lower than the international market price. These middlemen then sell to other gold buyers who export the gold once they have obtained a large volume. Along with the premium, according to current gold prices, certified ASMOs selling their gold to international markets can gross 19–26% (US\$ 349,719–452,578) more than they could by selling to the local market. However, when subtracting the *Total Fixed Associated Costs* from the *Total Premium Received*, the *Actual Premium Received* only accounts for 42% of the total premium (BOX 1 Example 2). Factoring this new *Actual Premium Received* into the International Market Price, an ASMO can receive a total of US\$ 2.11 million dollars. Thus, selling gold to international markets with the LBMA gold fixing and the actual premium allows ASMOs to receive 14–21% (US\$ 266,019–368,878) more than selling to the local market. Despite miners losing more than half of the premium (58%) due to *Total Fixed Associated Costs*, ASMOs are still able to make more profits selling to international markets, and at the same time reduce some of the risks associated with selling their gold locally, such as being robbed while transporting gold from the mine to the nearest city. Even though certified ASMOs can benefit from a higher profit margin, there are other economic challenges for ASMOs who wish to become certified.

The Fairmined Standard requires that ASMOs create an improvement plan that outlines how they will meet the standard's terms before their final certification audit. This improvement plan consists of implementing responsible environmental management practices, improving labor conditions, providing basic trainings on health, safety, and mine risks for all employees, purchasing new personal protective equipment and other supplies to enhance mining operations, and fulfilling other requirements such as tracking their purchases and sales. The implementation of the improvement plan can take anywhere from 18 to 36 months, and on average costs ASMOs US\$ 40,000–55,000. After the certification is obtained, there are requirements that ASMOs must meet in subsequent years to remain certified, which cost them on average US\$ 15,000 per year. At this point, formal miners producing less than 1.74 kg per month, those without the financial resources to cover the initial investments to become certified, as well as those that are not able to keep up with the investments for annual improvements may resort to selling their gold in the local informal market.

According to ARM staff members, many miners are not convinced of

<sup>1</sup> In attempt to provide a solution for those excluded operators, in 2020, ARM created the CRAFT Code based on the OECD's Due Diligence Guide to target artisanal miners who were unable to pursue the Fairmined Standard. Unlike the certification program which requires miners to operate formally, obtain legal permits, and participate in annual audits, the CRAFT Code is a self-reporting program rather than a third-party certification program, thus lowering the costs for miners as audits are not necessary. See Sippl (2020) for more information on the CRAFT Code and the differences between certification programs.

**BOX 1**

*Example 1* calculates the minimum gold production necessary for certification to be economically feasible for ASMOs. *Example 2* calculates prices paid to miners based on the international market price<sup>1</sup> and the local market price (10–15% less than the international market price), which includes the premium received by an ASMO producing an average of 3 kg of gold per month. All currency is in USD.

*Example 1.* Minimum gold production required for certification programs to be economically feasible for ASMOs.

Annual Total Premium Received:

$$\text{Total Premium Received} = X \text{ kg} * \$4000/\text{kg}$$

Where  $X$  is the total annual gold produced by the ASMO.

$$\text{Annual gold production (X)} * \text{Total Premium Received} = \text{Total Fixed Costs Associated with Certification} \text{ (see Example 2)}$$

$$X \text{ kg} * \$4000/\text{kg} = \$83,700$$

$$X \text{ kg} = \$83,700/\$4000/\text{kg} = 20.93 \text{ kg gold per year (1.74 kg of gold per month)}$$

An ASMO must produce more than 1.74 kg gold per month to make certification economically feasible.

*Example 2.* An ASMO produces an average of 3 kg gold per month (=36 kg of gold per year).

Annual Total Received with Premium:

$$\text{International Market Price: } 36 \text{ kg} * \$57,144/\text{kg} = \$2,057,184 \text{ 8751.6}$$

$$\text{Premium Received: } 36 \text{ kg} * \$4000/\text{kg} = \$144,000$$

$$\text{Annual Total Received by ASMO with Premium} = \$2,201,184$$

Annual Total Fixed Costs Associated with Certification:

$$\text{Audit cost} = \$4500$$

$$\text{Income tax (approximately 30% of the premium)} = \$43,200$$

$$\text{Export costs} = \$36,000 \text{ for twelve exports (\$3000 per export)}$$

$$\text{Total Costs} = \$83,700$$

Annual Actual Premium Received:

$$\text{Total Premium Received} - \text{Total Costs} = \$144,000 - \$83,700 = \$60,300 \text{ (42% of the total premium is actually received)}$$

Actual Total Received with Premium:

$$\text{International Market Price: } 36 \text{ kg} * \$57,144/\text{kg} = \$2,057,184$$

$$\text{Annual Actual Premium Received: } \$60,300$$

$$\text{Actual Total Received with Premium} = \$2,117,484 \text{ (14–21% more than selling to the local market)}$$

Local Market Price Received without Certification (10–15% less):

$$10\% \text{ Less than International Market Price: } 36 \text{ kg} * \$51,430 = \$1,851,465$$

$$15\% \text{ Less than International Market Price: } 36 \text{ kg} * \$48,572 = \$1,748,606$$

<sup>1</sup>International market price was obtained from <https://www.kitco.com/charts/livegold.html> on August 13, 2021.

the economic benefits of becoming formalized and view paying taxes as an extra burden. In addition, miners have never had to report and show proof of their costs or production numbers. Certification requires full transparency which is a challenge for miners in rural areas where it is common for suppliers to not provide receipts for goods and services. Although ARM shared that many ASMOs reach out to their organization to pursue gold certification, they stated that many are only able to meet one or a few of the criteria, making it difficult for certifications to have broad-reaching impacts.

Lastly, it is important to highlight that for certification programs to function as theorized, there must be enough jewelers willing to pay the premium price for certified gold. ARM staff said that they have faced periods when certified ASMOs were producing more gold than jewelers were willing to purchase. Without a guaranteed buyer of certified gold, ASMOs may revert to selling their gold back to informal markets. Another situation which was observed during the onset of the COVID-19 pandemic was that certified ASMOs were unable to export due to very high export costs (reaching up to US\$ 10,000 per export). Despite being certified, ASMOs may not fully realize the economic benefits and can lose out on the higher profits from the international price, as well as the premium.

#### 4.1.2. Reinvesting into rural livelihoods

A key component of the Fairmined certification program is that certified ASMOs must contribute to social and economic development in the area. In Puno, certified ASMOs are comprised of cooperatives with shareholders and workers who are natives to the community or neighboring towns, thus the people benefiting from certification programs are direct members of the community. One miner shared, “For every kilo we

export, we receive a premium of US\$ 4000; this fund is allocated for the needs of the workers, the community, and our organization. We assumed the challenge of social responsibility and sustainability over time with the development of our communities because we want to give our collaborators the level of life they deserve.” This miner highlights how important the community is for the miners, and he also emphasizes how the premium has allowed them to give back to their workers and community.

Certified ASMOs in this region have invested the premium in projects to improve their operations. One upgraded their dining facilities and installed a solar water heater so workers would have hot showers. Others invested in cleaner technologies (e.g., gravity concentrators) and personal protective equipment for miners. Certified ASMOs have also invested in projects for the community. For example, one ASMO purchased and installed a mesh screen above the elementary school playground to protect the children from the sun and another provided office furniture to the local community. Every Christmas, certified organizations donate books and gifts to local students.

Despite these efforts, the overall development in the local town of Ananea (population estimate: 32,285) remains minimal (INEI, 2015). There is no hospital and there are no doctors, the town lacks a water treatment plant, and there are teacher shortages. The town has several hotels, restaurants, hardware stores, machinery repair shops, and mechanics that serve the mining industry and its workers. Many of the miners who work at Fairmined certified operations grew-up in Ananea or neighboring communities but have purchased homes in larger cities far from there in Juliaca (150 km) and Arequipa (256 km), citing better educational and economic opportunities for their families as the reasons why. It appears that miners themselves are investing outside of the local

and in many cases, their native community. One miner stated, "I don't want my kid to be a miner, I want my kid to be a mining engineer." Although some miners are investing in their children's education which can signal a positive step toward sustainable development, the lack of miners' local investments indicate that development in the mining town of Ananea is limited.

Adding to this situation is that cooperatives in Puno are no longer accepting new shareholders. Thus, there are a few people who are directly benefitting from the Fairmined certification. In Puno, there are only a total of 246 workers from three different organizations directly benefitting from the improvements at mine sites. Targeting specific groups to obtain certification and excluding impoverished, unlicensed miners carries the risk of elite capture (Hilson, 2008; Haan and Geenen, 2016). If certification programs truly aim to improving the livelihoods of miners by impacting economic growth and reducing poverty and inequality, then they will need to be more effective at capturing the majority of workers who truly need the support.

#### 4.2. Environmental protection

Both ARM and ASMOs highlighted that the most significant changes driven by certification programs were improved environmental management practices. A past president of a certified ASMO stated,

The Fairmined certification allowed us to become aware of caring for the environment and carry out mining tasks with a responsible approach. To keep our certification and premium, each year we must comply with new environmental management requirements. This allowed us to optimize our resources, become more conscious of environmental protection, and in turn eliminate the use of mercury completely in the [recovery] process.

Throughout the certification process, miners are taught about the importance of environmental protection and are incentivized for implementing better environmental management practices. Because the certification is aligned with the Minamata Convention on Mercury, it specifically targets mercury and puts in place a process to support ASMOs to progressively minimize its use.

The Environmental Protection section of the standard, Section 2.1 (Management of Toxic Substances) is solely dedicated to progressively reducing mercury use and eliminating cyanide leaching of amalgamated tailings with new requirements at years 0, 3, 6 and 9. However, other topics such as tailings management and water quality management are very briefly mentioned, and air quality is completely omitted. ARM staff

members agreed that this was a shortcoming of the certification program and stated that their goal was to expand the focus to encompass other environmental issues. They expressed concern, however, that if the environmental standards were too stringent then this could decrease the number of miners able to pursue certification.

##### 4.2.1. Minimizing and eliminating mercury use

ASMOs certified under Fairmined are allowed to use mercury as their preferred gold recovery method, but they must demonstrate that they are capturing the vapors using retorts. Eco-gold certified ASMOs do not use any chemicals (mercury and/or cyanide) in mineral processing. During site visits in 2018, there was only one operation in Puno that was Eco-Gold certified and one that was Fairmined certified and was using a retort to capture mercury during their amalgamation burning process. Even so, from February–October (2019), this Fairmined certified ASMO used a total of 34,178 g of mercury, recovered 24,359 g (71%), and released over a quarter (29%; 9819 g) of it into the environment (e.g., tailings, atmosphere), amounting to an average of 608 g of mercury lost during recovery per month (Fig. 1).

By the end of 2019, this operation eliminated mercury from their gold recovery process. They implemented a shaking table to further concentrate their pre-concentrate obtained from the sluices and then directly smelted with borax to extract the gold from the concentrate (Fig. 2). In 2020, four years after becoming certified, the ASMO passed the Eco-Gold audits and became the second ASMO in the Puno region and all of Peru to obtain the Eco-Gold certification. Miners from this ASMO highlighted that the two most important reasons why they chose to become Eco-Gold certified were to receive a higher premium and to eliminate negative impacts to human health and the environment. Given that this ASMO is the second largest in the Ananea mining district in Puno, this elimination of mercury is significant. But it is important to note that these methods are not universal. The shaking tables worked efficiently at this site because most of the gold was liberated (Veiga and Gunson, 2020), and the borax was effective because of the high grade of gold in the concentrate. The same would not necessarily be true for a primary rock or other type of ore, such as a colluvial ore.

ASMO representatives agreed that better environmental management and chemical control and handling were positive aspects of becoming certified, but they advocated for equal emphasis to be placed on providing them with support on how to improve their gold recovery. They were aware that gravity recovery methods were not the most efficient because they were able to recover more gold when they reprocessed their tailings. There was a consensus that they needed more

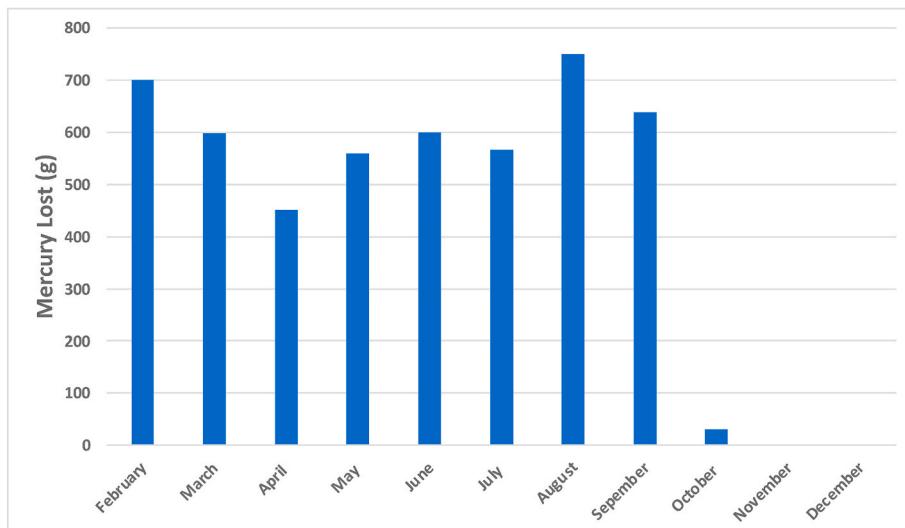


Fig. 1. Total mercury lost in grams per month from February–December 2019 by a certified ASMO. In October 2019, gravity methods were introduced to replace mercury amalgamation.



**Fig. 2.** In September 2019, one Fairmined cooperative implemented a shaking table to further concentrate their pre-concentrates obtained from the sluices and remove the use of mercury. After a small high-grade gold concentrate is obtained, the cooperative uses borax to recover gold. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

technical support to avoid having to reprocess their tailings multiple times and advocated for information and training on improved recovery methods to be included as part of certification programs. The miners' sentiments also raised the question of whether the complete elimination of chemicals (e.g., mercury and cyanide) is truly a viable option for all types of artisanal and small-scale miners (e.g., alluvial versus hard rock).

#### 4.3. Looking to the future

Despite some of the positive contributions that certification programs are having on improving miner's livelihoods and minimizing environmental impacts, there is future uncertainty. Of the three certified ASMOs included in this study, one of them is currently the longest certified organization globally, in year six of Fairmined's ten-year plan. The other two certified ASMOs are in years two and four. Currently, the Fairmined Standard does not have any additional requirements past year nine for certified ASMOs. However, ARM staff members shared that the goal is for these certified ASMOs to grow as organizations and perhaps pursue a different certification for medium to large-scale operations (e.g., Responsible Jewelry Council). To date, only one ASMO (Minera SOTRAMI S.A.) was able to move from the Fairmined certification to the more stringent Responsible Jewelry Council certification.

One challenge that remains for ASMOs is the lack of geological data on the viability of the ore deposits. Miners echoed this uncertainty by estimating that the life of mine would last anywhere from 5 to 30 years, but in general they were optimistic. One miner stated, "Ooooo this mine is going to outlive me. I'm going to be gone and my kid's kids will still be working here. This mine isn't going anywhere." The priority for miners and certifying agencies is to maintain or increase annual gold production and continue operating, exporting their gold, and receiving a premium. Yet, as reserves are depleted, annual gold production will inevitably decrease, raising questions of whether the costs of maintaining certification outweigh the benefits. Certifying organizations, as well as government could play a role in eliminating some of this uncertainty by supporting miners in obtaining geological data.

A further challenge is that there must be consumer and market demand for "responsible" gold and a relatively stable or increasing international price of gold. If demand and the price of gold decrease, ASMOs may abandon their operations with even greater environmental and human health impacts. In the Puno region, as miners operate in large open-pit mines, abandoning mine sites has major implications for future livelihoods as this ecologically degraded land will take decades to

regenerate. In addition, heavy metals present in abandoned tailings also present long-term ecological and human health risks for downstream communities and future generations.

The abandonment of mines is another pressing long-term issue, along with mine closure and remediation. As mentioned, all the certified ASMOs in operation have been certified for under six years, but there are several ASMOs who have lost their certification (Sippl, 2020). Therefore, the question of whether and how certified ASMO will successfully close their mine operations and remediate environmental issues remains unanswered. The Fairmined Standard does not include any specific guidance or detailed information on mine closure or remediation, rather the only requirements are that impacted areas must be rehabilitated through topographic restoration (year 3) and must be revegetated as appropriate for the ecosystem or intended uses (ARM, 2014). To our knowledge there does not exist an ASGM operation that has successfully undergone mine closure and remediation. If certification programs are truly targeting long-term social development and environmental protection, there must be a stronger emphasis on mine closure for the future generations.

Some of the recommendations to improve miner's practices as well as the sustainability of gold certification programs, require more government support and greater NGO capacity. ARM staff members reflected on this and described how issues such as mine closure and remediation have often been sidelined by governments and funding agencies who have primarily focused their attention on mercury. They discussed how they have tried to increase their capacity by intentionally focusing their work in two regions (Arequipa and Puno) that together, account for almost half of the formalized artisanal miners in Peru (44%) (Registro Integral de Formalización Minera,). They stated that they prefer to work in regions where they can provide capacity-building workshops and technical assistance to multiple ASMOs at once and refer to these locations with multiple certified ASMOs as "clusters". They also highlighted that non-certified ASMOs are more likely to trust their organization if they have a positive track-record of working in the area, and they are also more likely to pursue certification if they see certified ASMOs benefitting.

#### 5. Conclusion

The complexity and variety of challenges associated with ASGM preclude simple solutions. Formalization alone does not resolve all the social and environmental issues associated with the ASGM sector, and

NGOs and certification programs are providing miners with incentives and capacity-building opportunities to implement responsible mining practices. In some ways, certifications are proving profitable to ASMOs, driving safer and more responsible environmental practices, safeguarding human health and safety, and making contributions to local communities. Certifications also legitimize artisanal and small-scale mining activities to international stakeholders.

Gold certification programs have the potential to positively enhance ASGM formalization efforts by contributing to social development and minimizing environmental impacts. For ASMOs that have become certified, retained their certification, and continued to produce a constant volume of gold, the economic incentives have proven to be greater than selling to middlemen in the local market for suboptimal prices. These economic returns have allowed ASMOs to invest in improving their mining operations and provide their workers with decent jobs and consistent pay. However, as we demonstrate, miners must have constant, reliable gold production for the price of gold and the premium to outweigh the export and audit costs and taxes. Because of this, the uptake of gold certification programs is quite low and continues to exclude the majority of miners who are unable to meet the entry requirements. Ultimately, if the requirements were less strict and a greater percentage of miners were able to become certified, the success of certification programs is still not guaranteed because there must be consumer and market demand for “responsible” gold. If too many organizations become certified and there are not enough consumers and market demand, it could lead certified miners to rely more on informal markets.

Although gold certification programs are driving ASMOs to implement better environmental management practices, such as the reduction and elimination of mercury, this does not necessarily increase gold production. All conventional mining companies in the world use cyanide because the gold recovery is far higher than the use of gravity and direct smelting. Future research must determine whether eliminating chemicals entirely is the best course of action for artisanal and small-scale gold miners.

Certified ASMOs have invested the premium into development projects that benefit their workers and the local mining town of Ananea. Perhaps the most valuable investments include improving working conditions at the mine site and investing in cleaner technologies, but it appears that ASMOs’ investments in community development resemble philanthropic donations that rarely lead to longer term social development. As miners’ profits are generally invested elsewhere and cooperatives in Puno are closed to new shareholders, the risk of elite capture may undermine sustainable development efforts in Ananea.

Ultimately, certified ASMOs are benefitting from certification program’s capacity building initiatives and the economic incentives that allow miners to improve their practices and livelihoods. However, the reach of certification programs remains limited. This year, ARM plans to publish the third version of the Fairmined Standard, with new updates for certified and non-certified ASMOs. Future research should examine how these new updates will impact all ASMOs. Lastly, governments and civil society organizations should strongly consider providing artisanal and small-scale miners with permanent technical and economic assistance for the entire mine life cycle to improve rural livelihoods and environmental protection, specifically mine closure and remediation to prevent miners from abandoning mine sites and leaving environmental and human health liabilities for future generations.

## Funding

Funding for this research was provided by the National Science Foundation [grant numbers 1743749 and 1935630]. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

## Author statement

**G. Martinez:** Conceptualization, Methodology, Formal analysis, Investigation, Data Curation, Writing-Original and Draft. **N. Smith:** Conceptualization, Methodology, Writing-Review and Editing, Supervision, Project Administration, Funding Acquisition. **M. Veiga:** Writing-Review and Editing.

## Acknowledgements

We would like to thank all the interviewees for taking time out of their busy schedules to participate in the research, and the members of the ASGM cooperatives for allowing us to visit their operations. We’d also like to acknowledge the comments from two anonymous reviewers that improved this final manuscript.

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