

**Artisanal and small-scale gold supply chains in Latin America and Africa:
Insights from Peru and Kenya**

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Introduction

Latin America and Africa are the two biggest gold producing regions in the world, and in recent years the rising price and increased demand for gold has brought many new actors into gold supply chains. A significant gold producing sector in these regions is artisanal and small-scale gold mining (ASGM), which produces approximately 12-15% of the world's gold per year. Although for many ASGM operators, mining represents an important source of income in rural areas where there are few other economic options, the ASGM sector is also characterized by informality. As such, the sector is often targeted as a major contributor to the influx of informal gold entering formal gold supply chains.

This paper contributes to a better understanding of gold supply chains emanating from Latin American and Africa through an examination and comparison of gold imports and exports. We do this by drawing on gold import-export records to identify discrepancies in reporting and as a proxy to indicate the extent to which informal gold is entering formal gold supply chains and in what form—as scrap, metal, jewelry, and concentrate. Combining this approach with a systems dynamics modeling exercise grounded in ethnographic fieldwork for two ASGM systems in Peru, we capture the structure of gold supply chains, indicate intersections between formal and informal gold flows, and assess the resiliency of informal gold supply chains in the face of disruptions. We conclude that although informal gold supply chains are quite resilient, they lack transparency. Despite this lack of transparency, our preliminary findings shows that ASGM operators are not necessarily responsible for some of the major exporting activities of informal gold products. This brings into question whether the ASGM sector is the most useful target for government interdictions aimed at greater transparency of gold supply chains.

Methods

In this paper, we draw from the publicly available United Nations' Comtrade dataset, a repository of official international trade statistics. For Peru, we analyzed a 15-year period, from 2005-2020, and for Kenya, we analyzed a 20-year period from 2000-2020. We used the discrepancies as they appeared in reported import and export data as a proxy to begin our investigations of the extent to which informal gold supply chains are entering the formal market. We targeted four different trade codes for gold, including gold metal, gold scrap, jewelry, and gold concentrate to look at the global scale of the gold supply chain. Although we included all countries in South American and selected countries from Africa, which are active in gold production and trade, we focus here on two of those countries, Peru in South America and Kenya in East Africa. This analysis was complemented by a local scale systems dynamics modeling exercise where we drew from ethnographic field work to map the inputs to ASGM systems and the associated flows of materials along gold supply chains originating with ASGM activities.

Results

Our results show that significant trade discrepancies exist in the reported trade data. For Peru, the reporting of gold commodities is more consistent over the 15-year reporting period than Kenya, but there are larger discrepancies between Peru's reporting of exports and the trade countries' reporting of imports. In Kenya, over a 20-year period, the reporting is much less consistent than Peru's reporting, but there are fewer discrepancies between Kenya's reported gold exports than trade partners reported gold imports from Kenya when this information is reported.

Peru

We aggregated the four different forms in which gold is traded (gold metal, gold scrap, jewelry, and gold concentrate) and then mapped the major gold commodity export partners for Peru (Figure 1), a major gold producing country, using the total reported amount (in US dollars) of gold exported by Peru and the total reported amount (in US dollars) of gold imported from Peru by the trade partner countries (figure 1). The United States and Canada are the top two gold commodity destinations for Peru, reporting \$18.5 billion and \$17 billion respectively worth of gold imported from Peru. Peru reported exporting less value in gold (\$15.8) to the United States and

nearly the same value of gold (\$17.6 billion) to Canada. India, Switzerland, Mexico, Italy, and the United Arab Emirates follow a similar pattern as Canada, where the value of gold reported by Peru to these countries is more or less the same value of gold reported to be imported from Peru by these countries. The most significant trade discrepancies in gold commodities leaving Peru and reported as imports from Peru by the trade partner were observed for the United Kingdom and Belgium. Although Peru reported exporting \$356 million in gold to South Africa, South Africa did not report any gold imports from Peru.

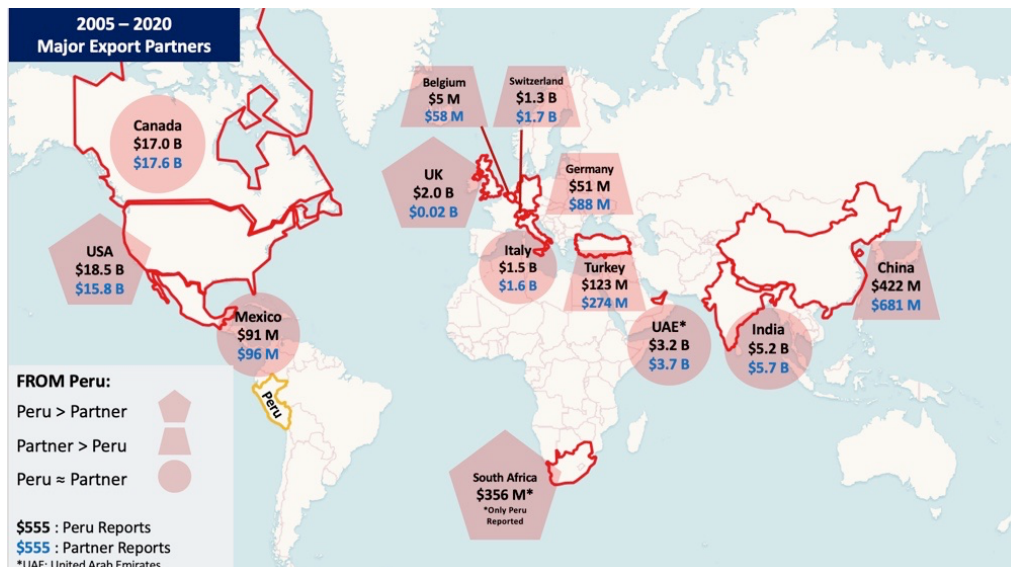


Figure 1: Visualization of Peru's exports in aggregated gold commodities (gold metal, gold scrap, jewelry, and gold concentrate) from 2005-2020, showing the value of gold reported as exported by Peru and the value of gold reported by trade partner countries as imported from Peru. The circles represent more or less the same reporting between countries; the pentagons represent cases where Peru reported a higher value of gold exports than the partner country reported as imported from Peru; and the trapezoids represent cases where the trade partner reported a higher value of gold imported from Peru than Peru reported as exporting to that country.

Given the role of Peru as a major global gold producer, we did not expect a significant amount of gold imports to Peru. According to the dataset, however, several countries reported exporting gold to Peru, and Peru reported importing gold from all these countries except for Saudi Arabia (figure 2). There are much higher discrepancies in the reported value of gold exported to Peru than the reported value of gold exported from Peru, and for most cases, Peru reported much lower values of gold imported than their partners reported as exports to Peru. Only Chile, China, Thailand, and Colombia reported lower values in gold exported to Peru than Peru reported as imports from these countries, but their share in the imports are much lower than the rest. Saudi Arabia reported the highest value of gold commodities exported to Peru (\$110 million), but Peru did not report any gold imports from Saudi Arabia.

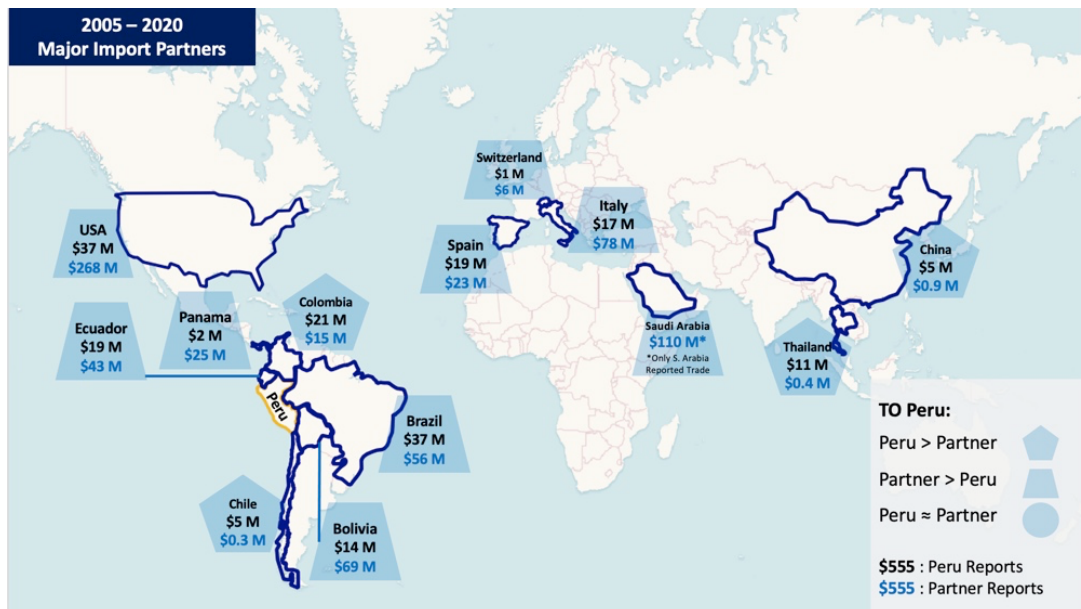


Figure 2: Visualization of Peru's imports in aggregated gold commodities (gold metal, gold scrap, jewelry, and gold concentrate) from 2005-2020, showing the value of gold reported as imported by Peru and the value of gold reported by trade partner countries as exported to Peru. The circles represent more or less the same reporting between countries; the pentagons represent cases where Peru reported a higher value of gold exports than the trade partner country reported as exporting to Peru; and the trapezoids represent cases where the trade partner country reported a higher value of gold exported to Peru than Peru reported as importing from that country.

When taking a closer look at the forms in which gold is exported from and imported to Peru, the highest discrepancies in reporting were for gold concentrate (figure 3).

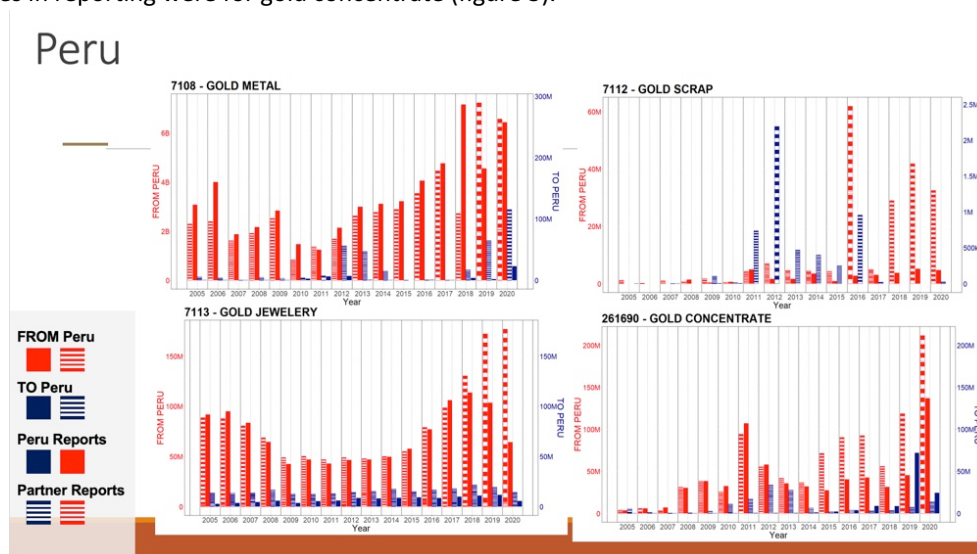


Figure 3: Reported gold exports from Peru in the form of metal, scrap, jewelry, and concentrate from 2005-2015.

Kenya

The data presented from Kenya demonstrates the four types of gold commodities reported in the Comtrade data (figure 3). There are noticeable gaps in reporting. For example, there is no reporting of gold metal exports by

Kenya from 2010 to 2015, even though the trade partners report receiving gold metal exports from Kenya; the reporting of gold scrap exports from Kenya stops after 2007, with trade partner countries continuing to report gold scrap imports from Kenya; from 2010-2015 Kenya did not report any gold jewelry exports, and trade partner countries continued to report jewelry imports from Kenya; and gold concentrate reporting is sporadic by both Kenya and the importing countries over the observed reporting period.

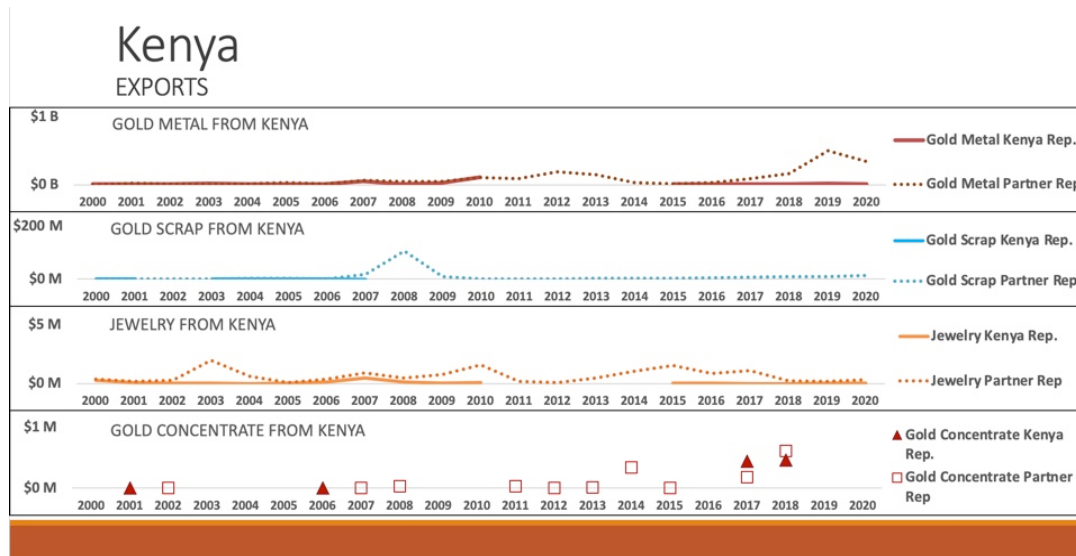


Figure 3: Gold commodity exports reported by Kenya and trade country reported imports from 2000-2020.

Systems Dynamics Modeling

As a complement to the Comtrade data analysis, we mapped the components of local gold supply chains in two ASGM sites in Peru using systems dynamics modeling. This model included the necessary inputs to ASGM operations and associated material flows along ASGM gold supply chains. Running the model with disruption scenarios, in particular a flooding scenario, demonstrated that informal gold supply chains are quite resilient to disruptions. However, when coupling this with our trade data analysis, we conclude that although resilient, these supply chains are not necessarily transparent, as evidenced by the large amount of reporting discrepancies.

Conclusions

The least discrepancies in the reported gold trade between Peru and Kenya and their trade partners can be seen in the trade of gold metal, with larger discrepancies appearing in the trade of gold concentrate. At the local level, artisanal and small-scale gold miners generally do not participate in the global trade of concentrate. Instead, many process their concentrate first using mercury to obtain gold (metal) to sell and then sell their tailings from this process locally to larger cyanidation plants. Therefore, on a global scale, ASGM's contribution to gold supply chains is mainly in the form of metal, raising the question of where the concentrates are coming from, where are they going, and who is transporting them and how. With increased gold prices, there is also a question of whether ASGM operators are going to start selling concentrates on the global market. Moreover, our results indicate that potentially the most useful efforts to disrupt informal gold supply chains may be better placed in building capacity among the ASGM sector so that they may operate in more formal channels and addressing the global movement of gold concentrates.