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The public good dilemma of a non-renewable common resource: A look at the facts of artisanal gold mining

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ABSTRACT

Millions of people worldwide are involved in artisanal and small-scale gold mining. Many of them live in conditions of poverty and insalubrities due to the mercury amalgamation of gold and the application of other rudimentary techniques. In spite of this, the sector has been nearly overlooked by resource economists. In this paper we analyze the sector based on a survey of the existing literature. We find some commonalities of artisanal and small-scale gold mining in different countries of the developing world as follows: low levels of mechanization and technology, labor intensiveness, low awareness of environmental degradation, poor training, high transience among some miners, and lack of financial savings. Moreover, with these commonalities in mind, we present some topics and challenges for a research agenda in the field of environmental, ecological, and development economics.

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Introduction

The extraction of minerals has been the material basis of many economies (Tilton, 1992). The extraction of hydrocarbons or non-fossil minerals and their industrial uses have expanded the wealth of many nations in recent centuries. However, non-renewable resources continue to represent the most elemental mean of livelihood for some of the poorest populations in the world (Swain et al., 2007). The extraction of minerals all over the world has been studied by both natural and social scientists. Economists are not the exception and over the years have developed theoretical and empirical models studying the optimal rate of extraction of non-renewables (see for instance Hotelling, 1931; Pyndick, 1981; Managi et al., 2004).

Yet, there are other dimensions of the non-renewable extraction that deserve some attention: the externalities generated from it, and also the dependence of such extractions of millions of people in the world using artisanal techniques. A clear example of it is the artisanal and small-scale gold mining (ASGM) in which miners who want to maximize private profits employ the cheapest technological alternative for the recovery process: mercury amalgamation. This technique leads to environmental and health problems in the long run due to the mercury pollution it generates.[1] With the end of solving the pollution problem generated by the recovery process better production technologies, which are generally more expensive for acquiring and harder to operate, must be employed. Therefore, miners face the dilemma related to the pollution resulting from the gold recovery process; i.e., a public-good dilemma in which private benefits are apparently higher when using mercury amalgamation and social welfare is improved by using a cleaner technology.

In addition to environmental pollution, ASGM faces several social, political and economic difficulties that deserve some attention. With these facts in mind, many scholars have stressed the importance of a good understanding of the dynamics of ASGM communities before designing and implementing any policy (Hentschel et al., 2002; Hilson, 2005, 2006; Hilson et al., 2007; Spiegel, 2009; Dondeyne et al., 2009). Nonetheless, in spite of the known conditions of ASGM, this subject has been overlooked in the environmental, ecological, and development economics literatures.

This paper does not present the results of any empirical research conducted by the authors. Instead, we survey the literature related to ASGM with the objective of gaining a broad

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[1] There are certainly other concerns such as occupational hazards relating to land sliding or lack of adequate oxygen. Nonetheless, regarding ASGM, mercury pollution is by far the most discussed affair in the literature review done in this paper.

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picture of ASGM that would foster the understanding of the main conditions characterizing this activity in the developing world.[2] Such an understanding is the first necessary step for the design of policies to overcome the social dilemma; i.e., to regulate both extraction and pollution from the resource exploitation. With this description in mind, we aim to discuss a research agenda for this fairly unexplored topic in the resource, environmental, ecological and development economics literatures. Specifically, we discuss feasible theoretical approaches and methods to analyze behavioral patterns and for policy assessment in ASGM. Within this discussion, our main focus is the social dilemma associated with the use of mercury amalgamation in the recovery process and the social factors that impede the resolution of such dilemma.

In the next section, we provide a general overview of the common features characterizing ASGM worldwide. Furthermore, we identify the major challenges for the sector, and for scholars and policy makers working with these communities. Then, in Section 3 we present a brief discussion of the reviewed works and a possible future research agenda for social scientists, particularly for natural resource, environmental, ecological and development economists. In Section 4 we conclude.

Commonalities of artisanal gold mining worldwide[3]

Since the pre-colonial period, ASGM has contributed to the economic development of many countries (CDS – Centre for Development Studies, 2004). Currently, approximately 25% of the world's gold production is generated by ASGM (Chouinard and Veiga, 2008). For several millions of people involved in this economic sector, gold extraction is the most attractive activity in terms of income generation. However, the application of conventional practices, mercury amalgamation being the most representative, makes ASGM an activity with a high negative environmental impact, primarily due to mercury pollution (Hilson and Pardie, 2006; Swain et al., 2007; Tomicic et al., 2011). This environmental impact returns to the community itself, neglecting the possibility of developing other economic activities, as well as posing a health risk.

Previous studies have identified what has been named a "poverty trap" for some communities involved in labor-intensive extractive jobs such as artisanal gold-miners (Spiegel, 2009; Hilson and Ack-Baidoo, 2011). According to Azariadis and Stachurski (2005) p. 326, a poverty trap is "any self-reinforcing mechanism which causes poverty to persist." These mechanisms may be determined by cultural, institutional or structural conditions that put these communities into vicious cycles from which it is difficult to escape and that may influence the rate of depletion of the resource (Hilson and Pardie, 2006). In the following, we describe the conditions that may drive these mechanisms in ASGM.

Legal and institutional aspects

Gold mining using either artisanal methods or methods with a low degree of mechanization and low productivity is practiced by over 10 million people in the developing world (Spiegel and Veiga, 2005). In countries such as Tanzania, Zimbabwe and other territories of sub-Saharan Africa as well as some Latin American countries, such as Colombia and Peru, ASGM is essential for many communities that find in the extraction of gold a complementary source of income (Kitula, 2006; Maponga and Ngorima, 2003; Spiegel, 2009; GEMMA, 2007). In other cases, in countries such as Colombia or Ghana, geographical or climate (drought) conditions or the low productivity of soil make ASGM almost the only possible source of livelihood for many villagers (Hilson and Potter, 2005; Hilson and Pardie, 2006; PEA – Programa Expedición Antioquia, 2010).[4]

These circumstances, however, are not the only factors encouraging the practice of ASGM. In addition, some specific economic reforms promoted by the World Bank or the IMF in developing countries may have created another set of conditions for the emergence and rise of poverty. The implementation of these reforms may cause public sector employees to lose their jobs due to the privatization of selected stated-owned enterprises and then to move to other economic sectors with job opportunities such as ASGM (Hilson and Potter, 2005; Banchirigah, 2006). Likewise, reforms to the mining sector in some African and Latin American countries, intended to promote foreign investment in large-scale projects, have caused the displacement of rural communities that have no option other than moving on to ASGM (Banchirigah, 2008; Molano, 2011).

Legalization, formalization and enforcement are regarded as another challenge to ASGM in some countries analyzed in the literature. There is consensus that governments should legalize small-scale mining and implement sector-specific legislation before considering any effort to address any problems related to ASGM (Veiga, 1997; Hilson, 2002a; Chaparro, 2004; Ali, 2009; Giraldo and Muñoz, 2012). With regard to legislation, it is clear that an illegal mining activity is referred to that undertaken without a mining license (Fisher, 2008; Hilson and Maponga, 2004; Enriquez, nd). In many countries, however, legalization of the mining sector has left out ASGM. Sector-specific reforms designed to stimulate foreign investments in large-scale projects (Banchirigah, 2008; Molano, 2011), bureaucratic licensing schemes (Hilson and Potter, 2005; Fisher, 2007; Elejalde, 2012), and lack of enforcement (Teschner, 2012) have excluded small-miners from access to and rights over mineral resources.

Nevertheless, in their struggle for survival, many miners continue to extract the mineral either from areas without any assigned entitlement or from properties of large-scale mines (Ali, 2009). In the latter case, unauthorized miners may operate for several days inside mines owned by large-scale companies, under serious hazardous conditions. The regulation of these miners, who are referred to as *ninjas* in Mongolia (Ali, 2009), and *machuqueros* in Colombia (Navia, 2005), may be a tough problem to solve. On one side, large-scale companies are interested in wiping out transgressors, and on the other side, regulators should consider fostering conditions for alternative livelihood programs targeting these groups of miners. Finally, another ingredient of illegality in ASGM is the participation of illegal armed groups that have turned to gold mining to finance their activities or for money laundering (Vergara, 2005; Grätz, 2009; Maconachie, 2009; Romero, 2011).

Some other features can also help to understand that in addition to being poverty-driven, ASGM involves self-reinforcing mechanisms that trap artisanal miners in a cycle of poverty. It is observed that these mechanisms embrace not only the legal and economic context surrounding the activity but also socio-economic and cultural aspects that shape miners' behavior in issues such as the management of natural resources as well as the miners' own economic decisions. These mechanisms are explained below.

[2] There are some differences in the nature of ASGM between developed and developing countries. A critical difference is the greater technological level of small mines found in developed countries (Lahiri-Dutt, 2004).

[3] In this paper, the terms "artisanal mining" and "small-scale mining" are used interchangeably.

[4] For instance, Tschakert (2009) notes that among *galamsey* miners in Ghana, mining is regarded as the income-generating activity that best meets their need for cash.

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