

Analysis of the Improving Dynamic Craft and Small-Scale Deposits

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Abstract: *Artisanal and small-scale mining are activities that have long been established in many developing countries, employing millions of people globally, either directly or in affiliated industries. Also, such activities are deplored for their adverse environmental impacts and their general avoidance of governments, tax collectors and other regulators. Decades of work have gone into addressing these problems, but with limited overall progress in evidence. Going back to some of the key dynamic relationships involved in artisanal mining and small-scale mining, the need for policy reform that gives consistent and effective incentives is argued to be the foundation on which other discussions about environmental protection, sustainability and livelihoods can be built.*

Keywords: Artisanal mining; Regulation; Mineral tenure; Poverty; Dynamics.

1. INTRODUCTION

Small-scale and artisanal mining are endemic features of many poor countries that have geological deposits conducive to such activities. These deposits are at or near the surface, easy to mine with simple tools, and are characterized by the relative simplicity of marketing arrangements. The (unrefined) gold and raw diamonds produced by smallscale and artisanal miners are easily sold, and the same can be said for other commodities such as building materials, industrial minerals and coal. While technology is important, transport is a related issue: gold and diamonds are extremely compact relative to their value and simple to transport over long distances. Less valuable metals typically require more extensive processing. This article presents an analysis of the problems in two key areas that currently seem to obstruct any efforts to make the impacts of artisanal and small-scale mining (ASM) less negative, and, at the same time, to make operations more efficient, to the general advantage of developing countries as well as the miners and their dependants. The first area is the need for investment in operations and the second is the inability of ASM practitioners to gain legal protection for their operations and the land where they work. To place these suggestions in perspective, we must first go back to the broad range of issues that characterize debates about artisanal and small-scale mining. A recent stream of reports and a series of articles in both this journal (February 2002) and in the Journal of Cleaner Production (March 2003) deal with a range of issues related to small-scale mining, although a majority emphasize gold. The exceptions include coal, industrial minerals, and base metals. The theme common to all these contributions is the environmental and social impact generated by this type of mineral extraction. The articles suggest a variety of means to ameliorate these impacts. What most of these contributions indicate is that addressing the impact is a Herculean task, despite occasional rays of hope. However, the majority of these same contributions emphasize specific case histories, national contexts and technical opportunities. In all the articles mentioned above, as well as in a series of reports on small-scale and artisanal mining (Labonne, 2002; Hentschel et al., 2002), a distinct trend has been a strong emphasis on sustainable livelihoods and poverty reduction. These concepts embody notions of transparency, fairness, income distribution, learning, and the integration of social, environmental and economic dimensions, among other things. Before the rise of sustainable livelihoods and poverty reduction as favourite topics in discourses about development, more emphasis was given to issues such as institutions, regulation and frameworks. Over the past decade or so, many conferences, meetings and reports have attempted not only to identify the purely technical problems generated by small-scale mining but also to suggest policy measures that might address them. Many of these were traced back to the problem of much small-scale mining and the attendant problems of health, inefficiency, child labour, environmental degradation, etc. requiring an appropriate legislative framework. A report from the International Labour Organisation (ILO, 1999) lists some of the many calls for legislative frameworks. Such frameworks need to be 'simple, clear, understandable and sensible' (United Nations, 1993); give legal recognition and tenure, and the right to transfer and mortgage of mining titles (World Bank, 1995); include treatment of small-scale mining in the mining codes (National Institute of Small Mines, 1996); and advise that full, transferable mining title to the discoverer of a (gold) deposit should be a simple, quick and transparent process (Dahlberg, 1997). The ILO report draws similar conclusions regarding the needs of small-scale mining from a survey of 32 developing countries, and also identifies the need for legislation to cover health and safety, the desirability of a single agency approach (well-resourced of course) and the need for financial concessions to encourage small-scale mining. The continuous stream of publications about small-scale mining offers few examples of policy interventions that have been successful. And even if some countries have formal legislation on the books that would allow regulation of the sector, all such efforts are likely to remain unsuccessful if there is no implementation. To put these recurring recommendations in perspective, we need to make a series of seemingly banal observations about the nature of

small-scale mining activities. The first observation is that artisanal miners engage in this activity for a reason. Their alternative occupation might be subsistence farming or unemployment and their choice of mining is most naturally explained by their ability to obtain higher earnings in this way. Indeed, a recent article on artisanal mining in Suriname suggests that small-scale mining acts as an alternative economic occupation when the national economy is experiencing stress, for example in the form of hyperinflation (Heemskerk, 2001) or when specific groups are excluded from alternative occupations (Heemskerk, 2001). In reality, the choice facing many miners may not simply be between mining and some other activity (typically farming), since mining may be a secondary occupation used to raise money for investment in farming. However, even in this situation, most of the issues discussed below remain relevant to these miners. The second observation is that small-scale miners almost invariably operate on the fringes of or completely outside the law, ignoring factors such as existing property rights² (that commonly vest all mineral rights in the State), environmental regulations, and taxation systems. Much of the recent research on small-scale mining refers to the environmental issue, but the other two factors are closely related and at least as important, as a result of the rents that do not accrue to the State but to the miners themselves or to criminal networks engaging in more or less open promotion of civil warfare (United Nations, 2002), as in the case of diamonds and other rare, easily portable and highly valuable minerals from certain parts of Africa,³ especially the Democratic Republic of Congo. It is equally important to note that even small-scale mining cannot exist without protection of some sort. Thus it is not unheard of that there may be an alliance between small-scale miners and the national military, as seen in Tanzania (Colin Roberts, personal communication, 2004). However, this dimension is very rarely included in the literature on small-scale and artisanal mining. The third observation is that small-scale miners tend to cause considerable environmental impacts relative to the benefits they produce, sometimes large-scale damage. These damages are a direct consequence of the primitive and inefficient mining and processing methods used, and of the apparent difficulty in making these methods more efficient (Hilson, 2002a; Veiga and Hinton, 2002). The fourth and final observation is that, despite the associated environmental impacts (which can be managed by other means), artisanal and small-scale mining may serve as an important supplement to other rural economic activities, thus mitigating the growth of urban areas and particularly urban slums. The often repeated call for legislative frameworks that can accommodate small-scale mining in individual countries may have been heeded in the developing world, in terms of the enactment of formal legislation. In his 1993 speech to the UN Interregional seminar on Guidelines for the Development of Small/Medium Scale Mining, Jeffrey Davidson listed an impressive series of initiatives, both legislative and technical, aimed at promoting the development potential of this type of economic activity (Davidson, 1993). Unfortunately, the subsequent decade does not appear to have delivered results consistent with the optimism voiced by Davidson. The steady stream of reports in this area in fact suggests that the problems remain more or less the same as they have always been (Hentschel et al., 2002; Labonne, 2002). The problem may be that despite well intentioned efforts to reform institutional frameworks, these efforts have not resulted in resolving the problems created by artisanal mining. A further reason for the lack of progress may be that most suggestions for dealing with problems in the sector seem to take for granted that governments in the affected countries have the capacity and desire to implement the measures suggested (see e.g., Hilson, 2002a, b). Concentrating on the two closely related areas of investment and legal protection involves an explicit emphasis on the efficiency of market processes in areas where smallscale mining takes place. Underlying this is an applied microeconomic approach to the business of small-scale mining, which gives a narrow focus to the discussion and bypasses the broad but unwieldy agenda that follows from the approach centring on sustainable livelihoods and poverty reduction. While this is not to say that sustainable livelihoods or poverty reduction are of lesser importance — the approach is used to focus attention on the broad requirements for investment and secure property rights in artisanal and small-scale mining. This is necessary for two reasons: First, traditional approaches focusing on legal and regulatory arrangements, as well as the more recent emphasis on sustainability and poverty reduction, do not appear to have brought any significant break-through in terms of making small-scale and artisanal mining safer, less polluting or enabling it to generate greater wealth. Second, emphasizing market processes may be considered the foundation upon which the achievement of all the other goals rest. In Section 2 of this article, the ASM sector will be characterized in simple dynamic terms. Section 3 considers the first key issue: investment in artisanal mineral operations. In Section 4, we consider the components of mineral tenure that must be taken into account in any effort to develop a policy for artisanal mining. Section 5 discusses possible avenues for robust reform, and in particular, the need for quite widespread organizational change in mineral agencies, a prerequisite for policy change. Environmental regulation, though touched upon in the next section, is not considered further in this article. In this article, the terms ‘artisanal mining’ and ‘smallscale mining’ are used interchangeably. The important distinction is not one of scale, as is sometimes suggested (Hilson, 2002b), but of ownership and control. The description of employment terms in the Suriname artisanal mining areas illustrates the difference between mine owners, who provide land, equipment, accommodation and food, and workers, who in this case share the risk by taking their payment as a share of the total gold output (Heemskerk, 2003). In many ways this arrangement resembles the employment arrangements described from the early part of the California gold rush of 1849–50 (Umbeck, 1977b).

2. The dynamics of small-scale and artisanal mining

As already indicated, artisanal mining activity involves issues related to poverty, appropriation of natural resources, ownership of the same resources, working practices, health impacts, and environmental impacts. Very few examples of successful

intervention are documented in the research literature on artisanal mining. The processing cooperatives in Zimbabwe (Hinton et al., 2003) and the enactment and implementation of legislative initiatives in Ghana (Ayree, 2003) are among the few success stories. Writings on ASM often get bogged down when trying to cope with this complex set of problems, resulting in detailed and highly informative case histories with a local, regional, or national scope, or in descriptions of policy initiatives, whether identifiable in terms of legal rules or as something to which the euphemism ‘capacity building’ applies. Recent special issues of Journal of Cleaner Production and Natural Resources Forum are, for all their many good qualities, indicative of this. This section is an attempt to develop a conceptual model that transforms some of the complexities into a more organized dynamic model of ASM. This model relies on a technique called causal loop modelling (Sterman, 2000), which allows us to capture, in an informal way, the main interactions between factors or elements that contribute to ASM activities and associated problems. As is customary in such modelling efforts, we begin with a simple model of the individual mine, independent of its operator. We then proceed to enlarge the model with elements that are important for understanding what goes on in the world of ASM, specifically the moderating effects of including consumption decisions of miners, the effects of having a separate submodel for investment in exploration for new reserves and, most importantly we shall try to model the mineral tenure and taxation systems explicitly. A self-perpetuating cycle embodies a notion of balance. A miner may be held in a condition of poverty if the activity only just manages to feed him and his family, but leaves him no chance to break away from this condition. If we try to understand the activity in simple neoclassical economic terms, mineral production generates income. This income may accrue in monetary form (it may also accrue through forms of bartering). With this income in hand, the miner must make a decision about how to spend the income, what sums to allocate for subsistence, for the cost of supplies and how much to investment. It might be argued that miners frequently have nothing left once subsistence needs have been paid for, and therefore have no opportunity to buy supplies or to invest. However, such an argument overlooks the fact that the miner has already made an investment decision by taking up the mining activity in the first place, by purchasing or acquiring the tools for mining, no matter how primitive. Similarly, the miner must maintain his productive equipment and therefore incur some operating costs. Evidence from anthropological research on artisanal miners in Suriname suggests that investment (and credit) decisions play a central role both in operating decisions and in the case of mineral workers deciding to pursue mining as an occupation (Heemskerk, 2002, 2003). The importance of investment will be discussed in detail in the next section. For now it is important to note the effects of investment in terms of the simple model used here. To understand the dynamics, first consider the simple revenue–consumption–production loop. This is a balancing loop in the terminology of system dynamics (Sterman, 2001), where more revenue leads to more consumption, but more consumption does not lead to more production. The same type of argument applies when operating costs replace consumption. More operating costs alone do not increase production. But for the revenue–investment–production loop, the situation is different — more investment leads to more production, more production leads to more revenue etc. In system dynamics this is a reinforcing loop. Small-scale and artisanal miners invariably invest something in their activity. This something may be monetary resources, but may equally well be a mining skill or knowledge about where to look for certain minerals or metals. Artisanal miners could not get started without some form of investment. However, as noted above, if for some reason they decide to prefer consumption over investment, there is indeed the possibility that they will remain in a self-perpetuating cycle of poverty. This suggests that both the importance of investment and the factors influencing the investment decisions of artisanal miners must be examined more closely.

3. Investment and finance in artisanal mining

Even very primitive artisanal mining involves investment, as noted above. Investment related to artisanal mining is usually discussed in traditional mining terms. The comprehensive review by Noetstaller (1981), for example, refers to the lower level of investment needed for artisanal mining, as measured in terms of investment per ton of output or capacity. Noetstaller then moves on to discuss the financing of these investment needs. Unfortunately, in the process, an important distinction is overlooked. The traditional mining investment analysis distinguishes between exploration costs, mine development (i.e., getting to the ore, by tunnelling or stripping) and equipment costs. In addition, there are the investments needed for infrastructure and processing facilities. Although important, these items do not tell the whole story about the difficulties of artisanal mining, quite apart from the need to finance the investments. The traditional mine investment analysis (Gentry and O’Neil, 1984; Runge, 1998) implicitly assumes that each and every one of the investment items are approached in an optimal way, consistent with the rationally behaving unit that is a mining firm. Mining companies are assumed to be specialized in all of the tasks involved. When they are not, the literature on the structure of the mining industry describes how some activities are left for even more specialized firms to carry out — from stream sediment sampling and ground geophysics in the early phases, all the way through to site rehabilitation after cessation of mining activity (Eggert, 1992). The essential point is that traditional business models for mining activity rely on the pursuit of task specialization, sometimes inside an integrated mining corporation, sometimes through a more atomised approach, but still governed by the mining firm at the centre. Artisanal miners, by contrast, tend to pursue the integrated model. Not because they possess all the necessary skills, but mostly because very few subcontractors are available. Even if specialists existed, artisanal miners would still need the financial resources to acquire their services — and payment would have to be prompt. Some artisanal miners may well be free-riding on those who first discover a new mining area. However, this does not change the fact that artisanal miners are ill placed to develop their own specialization, compared to established and more or less creditworthy firms. Thus, the

greater need to be a generalist sets the artisanal miner aside⁵ and influences his or her investment needs profoundly. Given the millions of people involved in small-scale mining, the difficulty of pursuing specialization clearly does not deter entry into the business. Since specialization is not an option (when compared to more professional mining firms) and investment capital is scarce, a central issue is how artisanal miners can break out of the trap in which they are often caught and where they can barely survive on their mining income. One possible avenue out of the trap is knowledge about more efficient (and in the process possibly also less environmentally harmful) mining. The idea that investment in knowledge is an important determinant in creating growth has been extremely popular in economics research in the past decade and a half (see e.g., Romer, 1994). In the context of development in a single sector through investment in knowledge — followed by the subsequent leakage of some of that knowledge, Easterly (2001) vividly describes the potential of knowledge investment in the context of the growth of garment manufacturing in Bangladesh. Despite the success of what happened in the example used, Easterly cautions that investment in knowledge is no panacea, being dependent on both the existing stock of knowledge and the returns to investing in knowledge (Easterly, 2001). In the context of small-scale and artisanal mining, this knowledge gap is a more nuanced explanation of the lack of progress in the sector than the argument that miners exist at a subsistence level from which they cannot escape. Thus, an important challenge in overcoming the problems facing artisanal miners is one of breaking the vicious circle that prevents investment in knowledge. Doing so requires attention to the incentives for such investment and these in turn are related to the security of the property rights to mineral land and other assets enjoyed by artisanal miners. If miners are squatters on other people's land or on land belonging to the State and if they are harassed by authorities as a result, then incentives to invest in knowledge, let alone physical capital — such as e.g., equipment — are likely to be limited.

4. Mineral tenure in small-scale and artisanal mining

Countries with many small-scale and artisanal miners have been exhorted to implement good mineral tenure systems on many occasions. The estimates of the total number of artisanal miners may not be very accurate, but they suggest that the activity remains as widespread as it has ever been, although some allowance must be made for the effects of cyclical changes in commodity prices, general economic conditions and availability of technology and skills. Moreover, in view of the identification in the preceding section of current disincentives to invest, three questions arise: • Are tenure systems generally appropriate for small-scale mining? • Would small-scale and artisanal miners use tenure systems if they were appropriate? and • What are the barriers to designing and implementing mineral tenure systems that can accommodate both small- and large-scale mining?

4.1. Mineral tenure arrangements in the absence of regulation

Before addressing questions about the appropriate mineral tenure for small-scale mining, we must look at what happens in the absence of any form of formal tenure. Two well described — but very different — events are helpful in this respect. One is the California gold rush that took place in the years 1848 to 1850, and the other is the Amazon gold rush of the 1980s. One important study of the California gold rush concentrates on contractual arrangements in the absence of formal regulation (Umbeck, 1977a, b) as seen from the point of view of institutional or contracting economics. In contrast, the Amazon gold rush was studied from an anthropologists perspective at the time it was taking place (Cleary, 1990). In the case of the California gold rush, there was no mining law and no government structure that could come up with one. The state was a new addition to the United States, following a war with Mexico, and any authority the local government representative might have had soon evaporated as the soldiers rushed to the gold fields. The central point in Umbeck's research is that the choice of contract, in this case between a sharing contract in which miners pool labour and share gold equally, and a land allotment contract in which each miner has his own area, will depend on two constraints: minimization of the variance of individual income and contracting cost. Individuals will be more interested in an even stream of income than in one that is highly variable. At the same time, miners will choose the contractual arrangement with the lowest transaction cost — for example, an informal agreement among eight miners — to pool labour and share gold findings, as well as making sure that all members adhere to the agreement. With high profitability variance, which is common in mineral activities, there is an incentive to share work and output. Competing against this is the cost of entering into, and subsequently enforcing compliance with such an agreement. As population in the area increases — assuming that the size of the mining area remains constant — there is enormous pressure to increase the membership in existing shared contracts, making their enforcement very costly. Increasing the number of people in each contract makes it more difficult to reach agreement, makes sharing more complicated, and especially enforcement more expensive to carry out. All these aspects shift the balance towards making land allotment contracts more attractive. Such contracts are a private form of tenure but are dependent on private enforcement, either by the miner or someone the miner employs. The data from California uncovered by Umbeck broadly confirm this prediction (Umbeck, 1977a, b). During the early part of the rush, when population pressure was relatively low, sharing contracts were the norm, with no known exceptions from 1848. The arrival, in 1849, of tens of thousands of new gold-seekers, lured by dramatic accounts of the 1848 season, led to sharing contracts being abandoned in favour of land allotment contracts. In the Amazonian gold rush of the 1980s, vividly described by Cleary (1990), the contracting form is very much like the latter stage of the California gold rush, with exclusive reliance on land allotment. A unit area, barranco, is allocated to a newcomer by the

local dono, typically the discoverer of a new mining area. Details of the social structure of these garimpero camps are very complex, but the essential point made here that, given the Brazilian context, property rights to a barranco, which typically measures 10 by 10 metres, is virtually secure once it has been allocated. Working another man's barranco is seen as 'the most heinous sin, short of outright murder' (Cleary, 1990). In this sense, the contracting format in Amazonia does not diverge greatly from the 'finders right' approach that much of national mining tenure legislation is based on, most notably in countries with an Anglo-Saxon common law tradition, even to this day. It should be noted, however, that within a barranco, an element of the sharing contract also exists, in the form of a porcentista, a person who works the barranco for a percentage share of the resulting income (Cleary, 1990). The implications of these observations are not that artisanal miners should be left to their own devices, but only that they seem able to come up with working property rights arrangements, be they ever so crude, in the absence of formal property rights systems. These emerge as the result of (implicit) economic reasoning, but are also, as shown by Cleary, older traditions that have evolved over many years. The very provocative question this raises is whether governments should refrain completely from developing regulations in this area, or perhaps define a minimum level of activity that has to be reached before national regulators get involved. It also raises the question of the character of any tenure provisions adopted, and if such a system should mimic the primitive, yet working solutions that miners have discovered on their own.

4.2. Appropriate mineral tenure for small-scale and artisanal mining

When considering appropriate mineral tenure for artisanal and small-scale mining, it is helpful to review some of the accumulated knowledge concerning the way others have addressed similar problems. In a conference presentation in 1993, Edward Nyamekye of the Ghana Minerals Commission described the Ghanaian approach to small-scale mining, which involves simple licensing systems, liberalized marketing arrangements and the creation of district offices to facilitate use of the system (Nyamekye, 1993). A closer examination of the Ghanaian approach⁶ (Ghana, 1989), however, reveals that the Ghana Minerals Commission has wide powers to terminate small-scale mining licences; environmental provisions are very brief, and licenses cannot be transferred. The example from Ghana illustrates a range of issues surrounding special regulations for small-scale mining, including a definition of small-scale mining, the level of protection afforded licence holders, means for addressing unitization problems, and taxation systems. The example from Ghana, as well as much of the information contained in reports on small-scale mining from CASM⁷ and MMSD,⁸ continually highlight both the needs for designing and implementing effective regulation of small-scale mining operations.

4.2.1. Definition

The need for definition refers to the distinction between artisanal and small-scale miners and large-scale miners. Artisanal mining may be a one-man affair, or it may involve several people, organized in different ways, for example under the sharing contract mentioned before, or as salaried workers. The typical way to distinguish small from large scale is by mining area size. Despite the possibility to use employment or output as an alternative measure, mining area size or permit area is simpler to use. The question of definition is important only if regulation differs between one size of operation and another, as in the case of Ghana noted above. If, as will be suggested below, regulators choose not to regulate the very smallest of artisanal operations, distinguishing those operations that are to be subject to the regulation from those that are not becomes crucially important.

4.2.2. Simplicity

Simplicity is needed in view of the character of the artisanal miners that the tenure system is to serve. Reading skills and insight into legal technicalities are not likely to be their strong point. Similarly, simplicity is less costly, all else being equal. If a tenure system is to be used, it must be accessible and present in those areas where mining takes place. The need to recruit local officials further dictates simplicity. Finally, simple rules may be somewhat inflexible but they are easier to communicate to artisanal miners. While simplicity is clearly desirable, it may not be easy to achieve. If current mineral tenure systems are very different from what is proposed, the staff of the existing system will have significant vested interests in maintaining the status quo. How such resistance may be overcome is discussed below.

4.2.3. Accessibility

The initial example from Ghana, which involves accessibility of mineral tenure authorities, perfectly illustrates this point. An artisanal miner will try to estimate his benefit from obtaining formal rights to the land he intends to mine, and then compare this to the cost of obtaining such rights. Many factors enter into this implicit calculation, including distance and the cost of travelling to the nearest mineral tenure official, bureaucratic delays and the cost of lost production. The perceived probability of actually being assigned the property right must also be taken into account. In addition to being accessible in fact, the mineral tenure system must also be seen to be accessible, in the sense that artisanal miners must believe that they can get to the local or regional office that awards mineral tenure, and that their claim to a particular small piece of land will be swiftly granted and

recorded. In this sense, accessibility is a question not only of how many branch offices there are, but also of the ability of each branch office to process applications quickly, and at a reasonable cost in terms of the official fee. Artisanal miners are prepared to move their operations to any new location that offers the opportunity for mining gold or other minerals of value. In view of this, accessibility of mineral tenure authorities must also include their flexibility. If miners move to an area not previously mined, the tenure granting authority should ideally come along and provide access to mining areas, and have the administrative means to do so in the form of maps etc. on which to mark new claims.

4.2.4. Transferable mining rights

Many contributions to the field of mineral policy reform have stressed the need for making mineral property rights transferable.¹⁰ In Ghana for example, such transfers are not possible and that appears to be the case in a number of other countries as well. Explanations of why governments feel the need to restrict the transfer of mineral tenure are difficult to come by. One possibility is that such restrictions reflect a legacy from mineral policies that had a strong national emphasis, sometimes referred to as 'resource nationalism'. The arguments in favour of transferability are strong and closely related to information accumulated about a certain unit of land. If mineral tenure is made fully transferable, the information about mineral occurrences becomes more valuable and incentives to conduct exploration and develop viable deposits increase significantly. Furthermore, if the presence of minerals is documented, transferability makes it easier to use the mineral tenure as collateral for raising financing for development.

4.2.5. Unitization

In rare instances, major social efficiency gains can be obtained by forcing or encouraging individual artisanal mine operators to cooperate in extracting a mineral resource. Some but not all petroleum regulation systems deal with this issue. Providing a legal tool of this kind is far from easy, even if the benefits to society in the case of oil may be very substantial (Wiggins and Liebcap, 1985). Put differently, sometimes artisanal miners may stumble upon a deposit that is larger, more valuable and extends further than they can develop on their own, but that could produce efficiencies of scale given the appropriate technology. Several smallscale operations may exploit such a large deposit alongside each other or they may form cooperatives, but realization of the value of the deposit sometimes depends on applying large-scale methods and benefiting from economies of scale in both mining and processing. In the latter case, governments will tend to be less concerned that they will be unable to benefit sufficiently if a large valuable deposit is blanketed by many small artisanal tenures. The need for a unitization provision may be overstated here. Very little is known about the extent to which much more profitable mines could have been operated in those areas where artisanal miners have congregated through history. In the case of the Amazon gold rush of the 1980s, David Cleary makes reference to several geologists from large companies who are not only very impressed with the exploration skills of some artisanal miners but also fairly confident that few, if any, opportunities for large-scale mining were missed due to artisanal activity (Cleary, 1990).

4.2.6. Enforcement

Any regulatory system needs enforcement. In the case of mineral tenure, enforcement refers to protection of the rights of individual miners, whichever way they are organized in terms of production. Social norms are highly important, and may in some instances suffice to regulate behaviour. The example from the Amazon suggests that long-established norms can play a very important role in enforcement. In general, apart from social norms, enforcement depends on the resources provided for this purpose, and on the skills and determination available. The relationship between regulatory objectives and the vigour with which they are pursued is a central issue. Given the probability that developing countries have a limited supply of enforcement resources, it is important that rules are simple, unequivocal and broadly accepted by miners as something that helps them resolve conflicts between themselves.

4.2.7. Taxation

Any mining activity will at some point raise the question of taxation. Minerals are usually defined constitutionally as the property of the nation and their extraction, regardless of who is the operator, brings demands for a government share. In artisanal mining, defining a taxable entity is very difficult, as is monitoring of profits. Consequently, such systems are susceptible to smuggling and general evasion of regulation in other respects, as any contact with regulators could disclose that a mining operation exists. In dealing with the taxation issue two fundamental problems must be addressed: Does artisanal mining produce, on average, a volume of profit that merits the construction of a dedicated taxation system? And if this is the case, how should such a system be designed? Even if we don't know much about the economic performance of different types of operation (measured in terms of size), the case for linking taxation to the quality of tenure can be made. Firstly, since an artisanal or small-scale miner would rather not pay tax at all, the tax payment must be seen to give the miner a direct and immediate advantage. Such an advantage would be generated by a form of tenure that miners sense as protection and 'value for money'. Secondly, in addition to providing security in

a broader sense, tenure may bring efficiency gains in a number of ways. The individual miner no longer needs to spend part of his income on protecting his assets, and he will have a very different incentive to make his operation more efficient. Prospects for regulatory change in the administration of small-scale mining Mineral policy reform cannot be isolated from other sectors. Such reform will be of little use if the rest of society remains deeply corrupt or if the rule of law does not function. Thus, the general assumption in the previous sections has been that the rule of law exists, even if it may not be perfect. The prospect for successful change, along the lines indicated above, depends in a general way on these conditions. More specifically, change depends on two levels of actors accepting the need for change. Under normal circumstances, change would be expected to come from the political level, stimulated, for example by the prospect for expanded economic opportunities and for tax revenue. The ability to take the first initiative towards a mineral policy change may, however, also come from the institutions in charge of operating the existing mineral policy or from external actors, such as the World Bank or other donors. Regardless of where the process originates, any outcome of a policy review that recommends change carries with it the risk that it may alienate members of the institutions that are needed to carry out the change. Furthermore, there is the risk that proposals for change will be seen as outright or implicit criticism of existing organizations and their members; this risk increases with the radicalism of proposals, notwithstanding the fact that change may be much needed. This article began by drawing attention to some of these complex relationships. Several points are worth reiterating. The first point is that small-scale mining may be a subsistence activity that traps the artisanal miner if he or she is unable to reinvest some of the revenue in the operation and at the same time has no alternative employment to take up. Escape from this trap, it was argued, required miners to invest, both in knowledge and in physical capital such as equipment and land. From this followed the second important point, that to escape the trap, miners must have incentives to do so. These incentives were summarized under the heading 'secure tenure' that is simple, accessible, transferable, enforced and taxed at a level that does not give negative incentives to obtain tenure. The third point is that creating positive incentives will be a difficult process. Government revenue may be limited or even reduced, providing incentives may go against cherished conceptions about national sovereignty over mineral resources and existing organizations (mineral administrations, ministries etc.) may be strongly opposed to losing prestige, influence, and sources of bribes. These discussions formed the basis for the subsequent examination of what exactly could go into a policy reform aimed at small-scale mining. All of the seven points deserve mention here but particularly important are the suggestions that the very smallest of operators might be made exempt from regulation and that an appropriate form of taxation goes hand in hand with a form of tenure that works as a real protection for those who have it. The remaining points, simplicity, accessibility, transferability, enforcement and unitization, are not unimportant but they are perhaps less controversial. All of this deliberately ignores environmental impacts of artisanal and small-scale mining. These are by no means trivial but the underlying argument for not including them is that regulating this type of activity is very difficult as long as it remains completely outside the law. A system that gives significant incentives to obtain tenure, even after taxation, would bring larger operations within the law. Whether the application of tough environmental regulation would not drive them away again is debatable, but the risk is present. However, once known, such operations may also be targeted with other (i.e. more voluntary) forms of environmental management. The message for future reform efforts in this area is quite clear. While there are many potential benefits to be had from an expansion of artisanal and particularly smallscale mining, securing these for the nation may require political, administrative and organizational changes, all of which are likely to be difficult and painful.

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