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Vulnerability of Artisanal and Small Scale Mining to Commodity Price Fluctuation

PAPER 1: The structure of the sector

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Summary

Over 13 million people depend directly on artisanal and small- scale mining activities to survive, and the International Labour Organisation estimates over 100 million are indirectly involved. However, conventional classifications fail to properly address the heterogeneity and complexity of this livelihood. This paper suggests a classification of artisanal and small-scale mining that focuses on the people and their livelihood strategies. In this paper we present a preliminary framework based on our initial observations and research.

This is a first attempt at trying to re-classify the sector in a more holistic way that will be more-people centred and responsive to the livelihood demands of those involved and is based on the literature related to extractive economic industries and petty commodity production. Our suggested classification is termed according to the way in which people use their resources, the models or forms of production, namely: subsistence mining; petty commodity mining and small scale mining. The analysis of these categories suggests that the minimization of risk rather than the maximisation of utility is what determines the livelihood strategies and the mining methods used. All three groups are affected by and respond to risk in different ways depending on their resources, organisational structure and expected livelihood outcomes.

This classification emphasises the people involved, their assets and the strategies they undertake with those assets. It also provides evidence of the importance of the vulnerability context in which they live and work. The policy implication is that we must construct holistic policy interventions in the sector. The diverse nature of the livelihood strategies adopted within each category suggests that miners face different opportunities and challenges. Hence, the study of the ASM sector should shift from one focused on macroeconomic volatility towards one that considers the full range of other risks and uncertainty.

Policies directed to the sector should be oriented towards the development of legal frameworks that properly recognises (but not necessarily condones) the prevailing labour and production arrangements. Certainly, vulnerability to price induced shocks can be expected to be higher in the cases where the entire household is involved and lower when only one of its members is involved. However, covariate shocks would affect households even if their income is diversified.

Although far more research is required in each category to properly identify the sector's main characteristics, it is possible to suggest that policies towards the sector should be oriented towards each one's particular context. Subsistence mining, for instance, may require above all, direct social policies to provide basic goods and services. Once these are satisfied, their ability to accumulate capital (at least at the level of petty commodity) would increase. On the other hand, petty commodity producers could be better assisted through the provision of consumption credit or insurance to avoid redirecting their productive resources and accumulated capital during bad periods.

Finally, identifying the roles that household members play within each sub-category could help design better targeted policies to help, both the individuals and the groups (household, community, association, etc.), achieve more sustainable, and less vulnerable, development.

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1 Introduction

Over 13 million people depend directly on artisanal and small-scale mining activities to survive, and the International Labour Organisation estimated over 100 million are indirectly involved. It is clear then, that the study of this sector must bring about significant and effective policies to improve the livelihoods of many people.

To do so it is important that we aspire to fully understand the sector. Unfortunately, its current classification fails to properly address the heterogeneity and complexity of this livelihood. By focusing on measures of size and technology it makes it difficult to address the livelihoods of miners. If our final aim is to obtain a strong model of the sector with which to analyse and carryout policy regarding economic and livelihood dimensions, then the main difficulty we face is the inexistence of a single definition of ASM that captures both. Each country defines it differently and within each, different definitions apply for artisanal and small scale mining. Similarly, these definitions change according to the type of mineral or the extractive method employed. A model to describe each sub-sector and predict the effects of changes in the external environment would be very inaccurate and could not be used across the border. And more importantly, it would not provide an appropriate tool to analyse the effects of these fluctuations.

In response to the limitations of the traditional definition, we present a framework based on our initial observations and research. This is a first attempt at trying to re-classify the sector in a way that will be more people centred and responsive to the livelihood demands of those involved. We base our proposal on the literature related to extractive economic activities and petty commodity production.

Therefore, we suggest that the ASM sector could be more accurately classified in terms of the way in which people use their resources; the modes or forms of production. In this case these are: subsistence mining, petty commodity mining and small scale mining. This seems to provide us with a better analytical framework with which to carry out our specific research.

This paper is structured in five parts. The next section will present an introduction to the problem of definition of the ASM sector and suggest the new classification. In the following section we begin by discussing subsistence mining. We then describe petty commodity mining and also small-scale capitalist operations. In a final section we put forward some policy implications of this new classification.

2 Market segments

2.1 Not one definition

Before we present a new classification, it is important to determine why it is important to challenge the traditional one. The ASM sector is commonly classified in terms of investment size and the use of technology. Artisanal mining is therefore characterised by small operations and the use of primitive technology, while small-scale mining involves more technological intensive and larger operations – although not as large as medium size mining.

The organisational structure of the sector also changes from artisanal to small scale with the latter being characterised by better organisation and formality.

However, country examples show that there is no clear-cut division between artisanal and small-scale mining. In fact, there is no clear definition of either which is readily accepted worldwide. In the Philippines, the ASM sector is characterised by investment ranging from zero to US$200,000 (Bugnosen 2001). In Tanzania, artisanal mining is defined as informal, disorganised and nomadic (Dreschler 2001). And in Peru, informal artisanal miners in Madre de Dios are medium scale in size (Kuramoto 2003) with US$500,000 operations. This difference is based on the parameters used by each governing authority in each country; the following table shows some of the different characteristics used to define the ASM sector:

Table 1: Definitions of artisanal and small scale mining in selected countries

Country	Main characteristic of definition of small scale mining
Brazil *	Level of mechanisation, mode of occurrence
Burkina Faso	Level of mechanisation
Chile	Legal structure, production levels
Cote d'Ivory	Level of mechanisation
Ethiopia*	Annual production, level of mechanisation
Ghana	Capital investment, number of participants
Guinea	Type of minerals
Mexico	Production levels and value
Philippines	Level of mechanisation, capital investment
Suriname	Mode of occurrence, level of mechanisation
Senegal	Depth of work, crude production levels
South Africa	Capital investment
Tanzania	Capital investment, labour and technology requirements
United Nations	Annual production capacity
Zambia	Size of concession
Zimbabwe	Size of concession, capital investment

** Countries with different definitions of artisanal mining*
ECA "Compendium on Best Practices in Small scale Mining in Africa" December 2002, Addis Ababa, p.6
Mineral Resources Forum, UNCTAD

Besides the heterogeneity in definitions, we can also identify different forms of organisations present in the ASM sector. In Ghana, for example, Hilson (2001) describes a patronage arrangement: Licensed operators employ groups of 'tributers', consisting of five to ten workers each. The tributers keep two thirds of the profits while the operator keeps the rest. The concessionaire, on the other hand, could be an individual, a small firm, a syndicate or a co-operative. In certain cases, when the mine sites are located with in conflict or drug economies or areas, the informal concessionaires would be drug traffickers or warlords. And in some cases, as where the production of tantalum has been used to fund conflict, a slave-trade industry has developed to fulfil labour supply for the mines (D'Souza 2003).

The structure of small-scale mines in Bolivia is significantly different. Other methods and technologies are employed according to the financial situation and the technological knowledge of the miners (Bocangel 2001). In Bolivia, small-scale mining includes small firms, co-operatives and artisanal mining. In fact, co-operatives are often treated differently in view of their different social characteristics. These co-operatives are commonly made up of groups of between fifty and eighty workers that come together to work in a concession awarded by the State (Bocangel 2001) and function almost as a small or medium scale

capitalist operation (Hruschka 2003). Co-operatives in Bolivia, unlike those in neighbouring Peru, have benefited from longer historical public and social support, and so the two are difficult to compare. The following box illustrates the heterogeneity in definitions and perspectives of the ASM sector today.

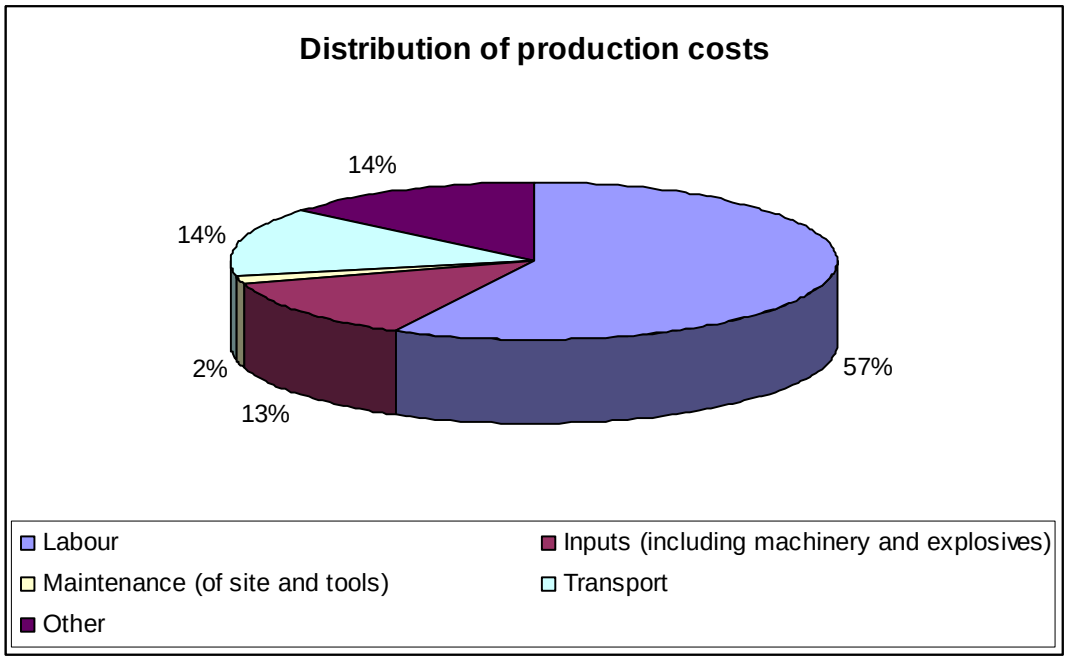
Table 2: ASM Definitions and Perspectives

South America: Individual or collective extractive work, using rudimentary tools, manual devices or simple portable machines for immediate exploitation of a mineral which, by its nature, dimension, location and economic use, can be worked, independent of previous exploration work, according to criteria set by the National Department of Mineral Production.
Africa: Small-scale mining refers to operations of individuals or organised groups (four to eight individuals), or co-operatives of ten or more individuals, which are entirely financed by exiting resources at a certain limit, and carried out on a full-time basis using simple traditional techniques and tools or low mechanization levels.
Asia: Small-scale mining is the exploitation of mineral deposits which, due to their mode of occurrence and their size, can be mined economically by simple means and techniques. It has the following characteristics: either open-cast or shallow underground mining using simple equipment and methods; minimal investment on infrastructures and processing plants; heavy reliance on manual labour.
UN: Small-scale mining is any single unit mining operation having an annual production of unprocessed materials of 50,000 tonnes, or less as measured at the entrance of the mine.
ILO: In defining small-scale mining, ILO reports that, small-scale mining means different things to different people. To some it is dirty, dangerous, disruptive and should be discouraged. To others it is profitable, productive, or simply the only way out of poverty. The exact definition varies from one person or group to another in terms of: level of employment or number of workers in a particular mine; annual production statistics; level of mechanization; capital investment; size of claim being worked; limitation to nationals only.
ITDG: Small-scale miners are poor people, individuals or small groups who are dependent upon mining for a living, use rudimentary tools and techniques (e.g. picks, chisels, sluices and pans) to exploit their mineral deposits.
Artisanal mining: Individual work performed using low levels of mechanization, panners with rudimentary forms of mining using manual or portable equipment, and applied only to alluvial, colluvial and eluvial deposits.

From MMSD, No. 84 August 2001; Small-scale Mining and Sustainable Development within the SADC Region, Bernd Dreschler (Santren/ITDG)

Furthermore, the traditional definition emphasises the intensity of capital in mining operations. However, a cost analysis of artisanal mining operations in Peru (Hruschka, 2002) shows that labour costs, including those of the miner himself, account for the majority of the total production costs (see diagram below).

Diagram No. 1: Distribution of production costs for an artisanal mining operation in Peru



Source: Hruschka, 2002

In conclusion, the traditional classification fails in that it is unable to include all the different actors involved in ASM. In doing so, it limits the scope of public policy directed to the sector and excludes the most vulnerable from its benefits. Our argument is that a more people-centred classification should be considered instead. This new classification must provide a strong framework in which to analyse the livelihoods of the people involved in the sector. In the following sections we discuss this alternative classification based on the literature on extractive, peasant and petty commodity economies and apply it to the ASM sector.

2.2 The 'regulatory' view

Before considering our classification, it is worth briefly discussing Eduardo Chaparro's introduction to inter-temporality and its relation with the ASM definitions. Chaparro (2000) puts aside the traditional parameters (size, methods, number of workers, volume of production, etc.) and concentrates in the relationship of miners with the State. Miners are then classified as controlled, uncontrolled or uncontrollable according to the way in which they carry out the five phases of the mining cycle: (i) gestation of the business; (ii) exploration; (iii) development; (iv) production and (v) closure.

Controlled miners are characterised for carrying out all the phases of the cycle and interacting with the State and its institutions and in compliance with norms and regulations. Uncontrolled miners are mainly identified for their conscious resistance to the State, its norms and regulations. Because of their informality and conflict with other groups their mining cycle is shorter and less mechanised or intense. In theory, this group, because of its organisation, could fit the structure of the controlled miners. The uncontrollable, on the other hand, are those that because of their particular socio-economic characteristics participate in the mining cycle in ways that do not fit the structures of the formal sector and are hence unreachable by the State.

This classification, although useful in policy making (particularly in the targeting of formalisation, taxation or private sector development policies), does not address either the economic or the livelihood components of the sector. It does, however, imply that miners are responsible for specific individual or group actions and decisions which help define their relation to the State. And as any human action, these can change over time. The role of the miners over the mineral or the machinery is clearly highlighted.

2.3 An alternative classification

In search for a classification that will centre on people and their actions, we refer to the literature on extractive and peasant economies. Gilsi Palsson (2000) describes three modes of production in Icelandic extractive fishing; subsistence (or primitive), industrialist (or capitalist) and simple (or petty) commodity production. Similarly, David Clearly (1993) describes the integration of the originally unexplored regions of the Brazilian Amazon into the national economy through three stages suggested by Foweraker (1981). In this process he differentiates between subsistence, petty commodity and capitalist production. Can these three categories help describe the ASM sector?

However, these three modes of production position has been contested. Cook and Binford (1990), for instance, argue that the separation of peasant/petty commodity and capitalist production is artificial. Instead, a single economy with different kinds of producers but with the same rationality (only values of the parameters change) exists. This argument may be also valid for the ASM sector where the petty commodity sub-sector is difficult to define.

Nonetheless, the literature on petty-commodity production may still provide a useful initial framework. In summary, it suggests that while the economic activity and the final product remain the same, the resources used, the way they are processed and the markets are different. For example, a fisherman can fish to survive, eating what he fishes and selling or trading his surplus for other basic goods and services; or he can try to sell the majority of his production in a local market to raise an income with which to live and maintain this economic activity, while consuming the surplus within the household; or he could sell his product in the market to make a profit with which to live and make his business grow. The activity and the product are the same, but the markets, inputs, methods and objectives are different; but not exclusive. The subsistence fisherman will probably use very rudimentary methods (fishing from a pier, for instance) while the others will use increasingly specialised and modern tools and strategies. The small-scale businessman might even use formal credit lines and employ other individuals to fish in his boats and with his tool. However, it is also possible for an individual artisanal fisherman working from a pier with very little capital to obtain a large profit and develop a small business. It is also possible for a small-scale capitalist to fish with the aid of rudimentary tools if, for instance, fish are plentiful in a local river or bay. This heterogeneity is true in mining, too.

Two conclusions can be extracted from this: it is impossible to generalise and whether they are different parameters or different values, different forms of production exist within extractive sectors. And these forms of production could be described as livelihood strategies.

Using the sustainable livelihoods approach, we can classify artisanal and small-scale miners according to four key components: their assets; their vulnerability context; their policies, institutions; and process; and their livelihood outcomes. Subsistence, petty commodity and

small-scale capitalist mining can be then defined according to the characteristics of each of the components.

From our initial analysis, we can expect to find that subsistence miners live in extreme poverty and/or deprivation owning little assets and relying mostly on human capital and their access to very limited natural resources. We could also expect to find that they are extremely vulnerable to external shocks and risks with significant effects on their consumption capacity. Hence, they must mine whatever they have access to as a means of quickly satisfying their most basic human needs. Furthermore, subsistence miners are mostly informal or illegal, unrecognised and often victims of institutional violence from formal structures and processes. As a result, they have no access to final markets, business and public goods and services, rights or social or political power.

Vulnerability is an important factor for subsistence miners. Subsistence households are consumption/production units that allocate resources within the household with the objective of smoothing consumption. Because they lack institutional protection against risks (e.g. no access to credit or insurance) they must employ a significant amount of their resources towards protection strategies. In the case of subsistence farmers, one can expect that whatever is produced will be consumed within the household. However, since miners produce non-consumable commodities (mineral) they must sell it before it can become a food entitlement. Unable to access markets and business services, and particularly to enforce their economic and social rights, their exchange entitlements are low; often too low for a sustainable livelihood. And this is further challenged by the negative effects of mining on human capital.

Small-scale capitalists, on the other hand, have access to more resources, particularly financial and physical capital, and are able to secure legal rights to natural resources (e.g. water and mineral sites). With better access to markets, services, rights and power, small-scale capitalists can better protect themselves from negative shocks and risk (via credit and insurance, for instance) and therefore do not need to allocate significant levels of resources to that end. Another important characteristic is that labour and capital are fully separated and the capitalist is only a productive unit. Its livelihood outcome is to make a profit.

In the middle, access to policies, institutions and processes is unstable and unreliable (often expensive) and resources are only slightly more readily available. The vulnerability context is still significant but the existence of a few institutional mitigation and preventive tools as well as more assets may provide protective strategies for the miner. It is difficult to determine the desired livelihood outcomes of this group of miners, but we might close in by suggesting that, since they have not yet separated capital from labour and the consumption/production unit is still pretty much in place they aim to simultaneously maximise profit and smooth household consumption. This would lead them to sometimes allocate resources and profits of the business within the household, thus making accumulation of capital difficult and unreliable. This group could be described as petty commodity miners.

In the following section we will provide a brief qualitative analysis of each. The study focuses on developing countries and has, in some cases a bias towards Latin America due to the use of the petty commodity and peasant economy literature. However, as we refine the framework, our focus will shift towards Africa; both in qualitative and quantitative terms.

3 From subsistence production to mining

This section is particularly important for the goal of poverty reduction since it describes those in the most vulnerable situation. It also focuses on the population farthest away from international markets and the macro-economy. This is particularly relevant because it deals with the miners who would be less susceptible to international commodity prices, interest rate or exchange rate fluctuations.

The concept of subsistence production has undergone considerable development. The peasant, on whose behaviour it is based, was initially perceived to be a backward and irrational agent who was not ready to adopt new technologies or methods. The policy implication for this was that these primitive farmers had to give way to a new breed of industrial farmers. Chayanov, working in Russia during the Soviet Revolution (Chayanov 1925), saw that peasants showed different rationality than that expected of rural capitalism. It was his view that peasants responded to economic and social demands through logic which was fundamentally different to that of capitalist farmers. For instance, they would increase production when prices dropped (to maintain their income constant).

In 1964, Schulz argued that peasants in developing countries were profit maximisers and efficient resource allocators. Their unwillingness to innovate (which accounted for the apparent backwardness), he argued, was due to inappropriate and hostile government policies. The policy implication of this view was that governments needed only to remove their hostility and increase the amount of technology infrastructure available in the rural areas.

Lipton, although agreeing with Schulz on certain issues, suggested that small farmers were, in fact, utility maximisers and unable to allocate resources efficiently. He recognised risk aversion as the main cause for this inefficiency, as did Schulz. More recently, rural participatory approaches have showed that allocation inefficiencies are due to risk and other factors such as no access to rights, services and markets (Dorward, Poole et al. 2003). As rational decision-makers, farmers seek to maximise their utility but are not able to optimise their resource allocation due to the precautions they must take against risk (high yield volatility, income uncertainty, climate change, etc.) and other factors, including culture, family composition, economic an social constraints, etc.

Hence, the farmer is now perceived to be a producer/consumer utility maximiser with inefficient resource allocations. Utility, in this case, is measured in terms of consumption levels. The literature on poverty and vulnerability argues that the poor aim to smooth consumption over time and engage in activities and protective measures to achieve it. Could the subsistence miner be described in the same way?

3.1 The subsistence mining sub-sector

It is difficult to describe any one ASM sub-sector (subsistence, petty commodity and small-scale capitalist) without referring to characteristics shared by the others. In this section we will focus on the more vulnerable, and larger, subsistence mining sub-sector but will unavoidably make reference to activities that can be classified as petty commodity or small-scale capitalist mining.

Some classifications differentiate between subsistence mining and artisanal mining and place it at the lower end of the ASM traditional spectrum. In this case, we consider subsistence

mining as a category on its own. We begin by defining the subsistence sector as one in which miners carry out activities to satisfy their households' immediate basic needs.

Empirical studies suggest that this category of mining is mainly carried out by individual or independent families, depending on the mineral, its occurrence and the cultural and social norms and practices governing the miner's society. For instance, in Guyana, gold sites are located in the Amazon rainforest, in the rivers near the border with Venezuela and Brazil (D'Souza 2003). Men leave their farms and families to mine for gold during the dry season; this is more a solitary activity. The same is true for gold mining in Suriname (Heemskerk 2001; 2003). In Africa and Asia, on the other hand, it is more commonly a family activity. Children and women participate in the mining, carrying, processing, and selling of minerals as documented by Bugnosen (2001) for Philippines, Dreschler (2001) for Southern Africa and Hilson (2001) for Ghana. In Tanzania, for example, men mine while women and children carry the mineral out of the mine and process it. It is also common for women to sell the processed mineral in local markets. In the case of tantalum, women, and particularly children, are sent into the tunnels due to their physical 'advantage' (D'Souza 2003).

These mining units are organised in various ways. In Peru, mining communities develop near or around a mining site. The livelihoods of their members often rely solely on their mining capability and, in some cases, all members of the household participate in it. In other communities or households, women participate in supporting economic activities and in the care of the home and children; it is usual for children to labour in the mines (Martinez 1999; Kuramoto 2001). Women, generally, never enter mines due to a strong cultural belief that this brings bad luck (Seeling 2002).

These examples also show that households have different livelihood strategies and livelihood diversification patterns, which are conditioned by the context in which they live; as has been documented by Seeling (2002) for Peru. It also shows that subsistence mining can be supported or complemented by other subsistence activities such as subsistence farming or petty commodity production and trade.

In conclusion, subsistence mining is primarily a livelihood strategy for very vulnerable households. They are organised in family and extended family units and may be self employed or employed by a license holder or contractor. This first glance suggests a very diverse composition of the sub-sector.

3.1.1 Many organisational structures

Evidence from Malawi, Mozambique, Tanzania, South Africa, Zambia and Zimbabwe (Dreschler 2001) suggests that the organisational structure of subsistence mining is also varied. Although it is commonly an activity of individuals or households (which could be part of a community) this must not lead to the assumption that these are always independent workers (or entirely self employed). A large and unaccounted proportion of subsistence miners are employed by petty commodity or small-scale capitalist miners or mining organisations (formal and informal). The literature recognises an even more diverse set of employment relations (often, subordination) in this case.

In Peru alone, Kuramoto (2001) identified four forms of mining subordination. In the mid-southern region, subsistence miners work mostly independently, but must pay the concession titleholder and the mill owners in cash and in kind to process their ore. In the *altiplano*, a system is in place whereby the contractor pays the miner by allowing him to extract ore for himself for 2 or 3 days every month – this leads to human resource exploitation, particularly of the children in the household. In the rainforest, where gold is

found in the rivers, miners are hired by means of a verbal contract in their place of origin and transported to the mine site. Once they are there they are given three-month contracts with payment only at the end, to prevent them from returning home or mine for other concessionaires or for themselves. Finally, in the northern coast, miners are linked to large mines that offer them meagre prices abusing the weak negotiating position of the subsistence miners. Although some changes have occurred in Peru as a result of a legal reform in 2002, some of these labour relations linger.

In Tanzania and the Democratic Republic of Congo, the combination of demand for tantalum and gemstones and civil war has fuelled the development of a slave market in mining (Stuijt 2003). Ninety-five percent of the US$300 million a year tanzanite imports by American jewellers originate from these 'slave' mines, where children work for US$2 a month or less (LoBaido 2001). In Ghana, Hilson (2001) describes a system of *tributers* that must pay the concessionaire of the land a portion (a third) of their profits. All these examples suggest that subsistence miners enter into very different types of labour arrangements to mine. In some cases they are forced (some more violently than others) by the conditions of their employment to overexertion and are made vulnerable to abuse.

In conclusion, organisational structures in the subsistence sector transfer vulnerability on to the miner.

3.1.2 Seasonality

Another characteristic of subsistence mining and of most of those in the ASM sector is that this is often a seasonal activity. As a consequence, at the subsistence level, the household will seek to diversify its portfolio as much as possible to guarantee a minimum livelihood (Ellis 2000) thus engaging in both on farm and off farm activities (Escobal 2001; Reardon, Berdegue et al. 2001). With time, however, due to agricultural land degradations (e.g. in and around Peruvian mining camps and communities Martinez 1999), persistent droughts (e.g. in Zimbabwe as an effect of El Nino in 1992 and 1994, Dreschler 2001) and low agricultural yields and prices in the developing world (Dreschler 2001; Reardon, Berdegue et al. 2001), miners tend to specialise in the activity that yields the highest comparative profits; with emphasis on fast cash. This means that the household sells off assets that cannot be used in that productive activity. In this case, mining requires very different assets than agriculture and as this process advances it would become increasingly difficult to continue to change back and forth from mining to other activities in a seasonal basis.

This form of income-based protective strategy has its own costs and risks. As demonstrated by Dercon (2002) diversification strategies are often expensive for the poor because they require larger and more diversified asset stocks. In their absence they are forced to enter into low return activities that use assets which are common to a number of different activities (i.e. mining and agriculture). This means that the risks affecting these diversified activities could be common to all, thus increasing their overall vulnerability. Subsistence miners hence are forced to specialise and loose an important protective livelihood strategy.

3.1.3 Limited capital and services

Human capital among subsistence miners is highly at risk (Seeling 2002). Access to health and nutrition services is limited. The poor health provisions in subsistence mining can have an effect on the productivity of human capital that can only add to this trend of specialisation and, hence, increased vulnerability.

Subsistence miners mostly lack access to land rights. Hence they must work for others to have access to 'good' sites or face larger risks if they work alone. To reduce these risks, miners search for sites with high mineral concentration and often move from find to find in order to maximise their short term yield and profitability.

They have no access to mining market services such as ore body and purity evaluation, product marketing and quality control. Similarly they have no access to formal funding and depend on informal lenders and intermediaries. Even among formal subsistence miners, there is an absence of market and financial services. And when they are present, distrust (Kuramoto 2001) and lack of proper information (Mendizabal 2003) act as barriers of access. Their access to funding often rests on the supply chain: they obtain small working capital advances from input suppliers or accept discounted prices from mill owners or buyers in return for immediate cash payments (Hruschka 2003). This is further explored in the next section as we analyse a cost benefit analysis of artisanal and small scale mining in Peru.

3.1.4 Some constraints

Peake, Johnson and Svotwa (1998) suggest that the main technical problems that affect the subsistence sector are the environment and access to funding. From their study, however, it could be possible to consider that one of the main constraints faced by them is their informality. However, some chose to remain informal, as in the case of some mining communities in Peru (Martinez 1999), as a means for protection from harassment by the authorities. Evidence from the recent Peruvian artisanal sector reform, however, shows that artisanal miners have been able to increase their capacity when entering the formal sector (Hruschka 2003). Unfortunately, due to lack of proper information dissemination, the reform has not been complete (Kuramoto 2003).

Water is one of their main inputs; both for mining and for physical survival. Both mining and processing require large amounts of water, as described in the literature (Hilson 2001; Kuramoto 2001; Hentschel, Hruschka et al. 2002 and others). However, cases from southern Africa show that mining is carried out during the dry season, since most miners work in the agricultural sector during the wet season (Dreschler 2001). The price of water during drought and in dry areas would be an important factor to consider in the subsistence of the sector.

In general, this sector is threatened by various forms of risk. In another paper in this series we discuss some of these risks in more depth. They include yield risk, health risk, weather shocks, legal and policy uncertainty, risks from other sectors, economic risks and paranormal risks.

3.1.5 Drivers of subsistence mining

From the brief review above and the literature on ASM it is possible to suggest a set of drivers for subsistence mining. These drivers could be classified in terms of push and pull factors (it should be noted that these would probably be similar to those for the petty commodity) as in the rural non farm literature (Escobal 2001; Reardon, Berdegue et al. 2001):

Pull factors:

- High and fast returns
- Cash supplement
- Easy entry
- Employment opportunity
- Favourable terms of trade
- Networks (kinship or other social)
- Find

Push factors:

- Poverty
- Low return from agriculture, grazing or other rural activities
- Unsatisfied short term needs
- High unemployment, low income
- Unfavourable present and expected terms of trade (in what they do)
- Loss of social networks (to migration, death, sickness, etc.)
- Absence of land
- Crisis

These show the significant role that household welfare plays in the decision-making process of miners. Subsistence miner's rationality, as that of farmers, focuses on maximising their household utility by reducing their consumption volatility. This is subject to exogenous factors such as the weather, economic, social and political shocks or trends. Their objective and their inability to control the vulnerability context prevent them from efficiently allocating their resources among alternative livelihood strategies.

At the First World Mines Ministries Forum in Toronto (2000) the following drivers where highlighted:

1) Cash supplement: Being a subsistence activity, it is possible to infer that individuals and households engaged in artisanal mining are prepared to carryout any activity that will help them subsist. Hence mining is often one of many livelihood strategies undertaken by households during the dry season when labour in the agricultural sector is not needed.
2) Poverty: The most vulnerable and poor have fewer alternatives to earn an income or access basic goods and services.
3) Crisis: Natural disasters, economic crisis, famine processes, etc. can drive people and households into subsistence mining workforce.
4) Community: Many miners belong to communities with long standing mining traditions. Hence they enjoy 'economies of scale', particularly of information about methods and new finds.

D'Souza, argues that the most significant pull and push factors are an attractive find and the weather, respectively. Rushes are often the consequence of finds and the subsequent appearance of an income generating opportunity. Populations with few resources and no legal land titles would be the first to migrate to the area to exploit the newly found mineral. The gold rush of Serra Pelada in Brazil in the late 1980s attracted about 80,000 migrants. Ravelo (1996) describes how hundreds of men still arrive every day looking for riches. The success stories from the past have fuelled a gold rush that has lasted over a decade. This shows that in some cases, the effects of fluctuations in demand or supply can be felt at various moments in the future.

A summary of some of the main characteristics of the subsistence sub-sector is presented below. More still needs to be done regarding statistical information regarding this group. In general, it is possible to conclude that subsistence miners are the most vulnerable.

Table 3: Characteristics of Subsistence Mining

Factors/Issue	Characteristic/Status
Labour capital division	No
Agent	Consumer/Producer
Capital accumulation	No
Resource allocation	Inefficient
Objective 1	Maximise Utility
Objective 2	Minimise risk and variability of income
Legal status	Mostly informal or illegal
Organisation	Individual or family
Mining sector environment	Unstable
Relation with large scale mining	Conflictive and irrational
Access to working capital	Own resources; from providers and buyers; employers
Inputs	Mostly local but depending on scale and mineral they should be internationally traded
Number of intermediaries	Many
Negotiation/bargaining power	Low
Ability to stock or hold production while waiting for changes in market conditions	No

4 Small scale capitalist production

At the other end of the sector are small-scale mining operations. In theory, small-scale miners should behave as firms. There is a complete separation between capital and labour and capitalist miners, as any other capitalist producer, have as their objective to maximise profit subject to production costs. They operate in the formal market and make use of financial and marketing services.

Small scale mines are often classified differently according to the mineral, its occurrence and the country's mining strategies (Kuramoto 2001). In general, small-scale mines are larger and more mechanised (Bugnosen 2001) than artisanal (under the traditional classification), but this separation can be easily contested. Economies of scale, which can explain large small-scale mechanised mines can also explain medium-scale artisanal mines, as is the case of alluvial deposits that require artisanal methods but also provide the perfect conditions for taking advantage of economies of scale.

The difference must, therefore, be not the method or the scale of the operation, but rather the mode of production, or the objective of the agents involved. Unlike subsistence miners and petty commodity miners, small-scale capitalists are producers only.

Small-scale capitalist mining describes the activities of, mostly, syndicates and small companies; including those providing goods and services to the industry and concessionaires holding the legal rights over plots mined by petty commodity miners and subsistence miners. Unlike them they have achieved a higher level of separation of capital and labour and small-scale capitalist miners allocate their resources more efficiently to obtain higher yields and profits. With access to financial and business services, they are able to accumulate capital.

Their production is more mechanised and labour requirements are more specialised. Although in some areas, production remains artisanal, regardless of the size of the site or production levels. As the small-scale enterprise increases in size, the requirements of reserves, time, capital, skills, infrastructure and labour also increase. These requirements are needed to match the higher operational constraints which the small-scale capitalists have to face. Therefore, it can be assumed that their mining decisions will not be motivated by subsistence or maintenance needs, but rather by the goal of capital accumulation. It is also true, then that the presence or lack of these elements would have a strong effect on their decision making process and enterprise.

Where the subsistence farmer was willing to mine anything that would give him enough to satisfy his household's most basic needs, the small-scale capitalist will have to consider a broad set of costs and constraints. Peake, Johnson and Svotwa (1998), in a study of the sector in Southern Africa, identify the following technical issues affecting the small-scale capitalist (although they do not use this term, they do refer to syndicates and small companies):

- Capital investment;
- Safety and health;
- Qualified staff;
- Product marketing and quality; and
- More sophisticated technology.

Table 4: Characteristics of Small Scale Capitalist Production

Factors/issue	**Characteristic/status**
Labour capital division	Yes
Capital accumulation	Yes
Resource allocation	Efficient
Objective 1	Maximise Benefits
Objective 2	Minimise production costs
Legal status	Formal
Organisation	Small scale business or syndicates
Mining sector environment	Stable
Relation with large scale mining	Good or neutral
Agent	Producer
Access to working capital	Venture capital funds
Inputs	Mostly local but depending on scale and mineral they should be internationally traded
Number of intermediaries	Few
Negotiation/bargaining power	High/medium
Ability to stock or hold production while waiting for changes in market conditions	Yes

5 The fuzzy middle-ground: petty commodity mining

Between subsistence production and small-scale capitalist production there exists an area where producers' behaviour is difficult to classify. Petty commodity production might provide a framework with which to work and to better understand the ASM sector. Moreover it is a group of some interest to policy-makers, since they have demonstrated an ability, albeit limited, to accumulate assets and some potential to lift themselves out of poverty.

The literature on petty commodity is rich but focuses mainly on urban areas (Hart 1973; Moser 1978; Bromley and Gerry 1979) although most of what is true in the urban domain can be applied in the rural space. Petty commodity is seen as a form (not a mode) of production between feudalism and capitalism, in which capital and labour are not yet divided, and where feudal resource ownership structures linger. According to Eversole (2003) petty commodity producers produce marketable commodities but at a scale and quality which yield very low profits and make it almost impossible for them to grow. They behave as small entrepreneurs but with lingering peasant or family farm behaviours, forcing them, for instance, to allocate resources and profits of the business within the household.

Capital accumulation, although a very slow and indirect process, is possible. Buecheler and Buechler (1992) and MacGaffey (1987) were among the first to point out that urban petty commodity businesses accumulate capital and act in an enterprising fashion; Hill (1963), Attwood (1992, 1997) reached the same conclusion for rural petty commodity production.

5.1 Two positions

The debate surrounding petty commodity production stems from the study of the informal sector in developing countries. Two opposing views can be identified (Kennedy 1981). First, a view commonly shared by officials from the ILO, the World Bank and other international organisations, who consider this sector to be a consequence of a sluggish rate of economic change and the persistence of traditional life-styles. This view can be closely associated with that of the peasant and small farmer/producer as backward, but it is mostly related to the policies of de-regulation and market and financial environment promotion. The assumption is that this sector is only transitional and that, as formal restrictions and market imperfections are removed, it should disappear (De Soto, 1989). In other words, it is created by the government's inability to adjust its fiscal policy in the formal sector according to each producer's endowment (Azuma and Grossman 2002).

They consider that the informal sector contributes to the economy as a whole providing employment opportunities and the provision of low cost training for a young or inexperienced workforce. In conclusion, they argue that despite shortages of capital, proper tools, secure environments, etc., they enjoy growth opportunities and autonomy and should be able to grow without massive intervention from the state.

The second position argues that informal producers belong to a different, yet interlinked (in this case, subordinated), mode of production. The importance of this distinction is more evident in the more holistic policies necessary to develop this sector that this view calls for.

This group considers that petty commodity producers' function is to serve the interests of capitalism by increasing the profitability of foreign-owned corporations and interests; which facilitates the drain of resources from the developing world. Petty producers are a source of cheap labour to large firms; provide cheap goods and services to labour employed in those firms, in effect subsidising their low wages; and are the source of unearned surplus squeezed out of them through various forms of unequal exchange. This happens because, as Bromley and Gerry (1979) point out, only a minority of petty commodity producers are self employed. Instead they are tied and subordinated to more powerful enterprises as disguised waged workers supplying goods and services but not enjoying any of the benefits of legal employment, and of dependant workers. They survive in a state of financial supply and market dependence on larger firms.

5.2 Main characteristics of the sector

The heterogeneity of this sector makes it difficult to resolve this debate. It is possible to conceive it as both part of the traditional economy and as different form of production altogether; depending on the context and sector analysed. In that sense, Robin Eversole (2003), questions whether the economic activities of the poor constitute petty commodity production or perhaps the efforts of microentrepreneurs to accumulate capital. Based on empirical study in Bolivia, Guatemala and Peru, he suggests that the key difference between petty commodity and capitalist producers' is not in their potential goals (subsistence, as opposed to capital accumulation), but in their resources and obstacles, that keep the micro-entrepreneurs in low-yield activities. His findings also show that micro-entrepreneurs are both labourers and entrepreneurs which suggest not only a different parameter value (if compared to capitalist production) but a different parameter altogether. Eversole´s study recognises some of the characteristics of petty commodity production; petty commodity as being that producers:

- Have an eye for profit;
- Want to grow;
- Know marketing in their market;
- Use informal capital markets;
- Grow at slow rates and little by little (margins are low);
- Are involved in joint ventures;
- Are engaged in high competition and obtain low earnings/profits;
- Diversify to spread risk making use of large human capital resources;
- Often diversify because they have SEEN a market opportunity or SEE limits to their own local markets; and
- Are very flexible

Foweraker (1981) views petty commodity production in terms of a process. He sees the Brazilian Amazon as the integration of unexplored regions into the national economy, and suggests it takes place in 3 stages. First, a non capitalist stage of subsistence economy, described above, complimented by some petty commodity production. A second pre-capitalist stage characterised by the in-migration and an increase in extractive activities and the appearance of a land market. Petty commodity still exists but embryonic capitalist labour relations appear. And finally, a capitalist stage (described below) in which capitalist agriculture replaces extractivism and there is a concentration of land ownership. Petty commodity may still exist but it is subordinated to capitalism. This framework leads to some empirical predictions:

- Increased migration
- Dominance of capitalist agriculture in the countryside
- Decline of extractivism
- Expansion of capitalist social relations
- Subordination of petty commodity production
- Concentration in land ownership

Another consequence is the expansion of the urban space and the subordination of the peasantry and country side to it; becoming feeders of the city industrialists –and even then, they are subordinated to the country side capitalists.

5.3 Petty commodity miners

Petty commodity mining refers to the mining activities of better capitalised and organised miners. This form of production may be made up of micro-entrepreneurs and co-operatives or syndicates. As observed in the literature, petty commodity producers have the objectives of small entrepreneurs but are limited by lingering subsistence behaviours and an unstable and unfavourable context. Like subsistence miners, they are unable to effectively allocate their resources mainly because, as it is characteristic in this sector, capital and labour are not yet divided, they have little access to formal input markets and are subject to a great deal of risks and threats.

This group is difficult to identify in the ASM literature. It lies between subsistence mining and small-scale capitalist mining; where capital accumulation is impossible or too difficult and where the miners are still subordinated to capitalist producers (including small, medium and large scale); but have, in general, more access to capital and tools, that allow them to maintain not only themselves but their 'business'.

The petty commodity literature, on the other hand, does suggest a series of characteristics common to this sector which can help us identify those ASM miners that fall into this category. Again, like in the case of subsistence mining, its organisation and specific characteristics vary according to the mineral, its occurrence, and the social, cultural, economic and political characteristics of the context. However, some of the overlapping characteristics of the sector are the following (McCay 1982: 2-3):

- Activities are relatively small scale;
- They use simple technology;
- Work groups are organised around kinship, friendship or other close social relations;
- There is a widespread sharing of costs, risks, benefits and losses among participants of different and similar power;
- Allocation of production varies between subsistence and market ends;
- Production involves considerable pooling of resources;
- Seasonal changes are important;
- Very few have to pay salaries every week or month –more flexibility;
- The sector is highly adaptive in terms of formal structures;

As in subsistence mining, capital and labour have not been separated in the producer/consumer unit. For instance, in Peru the new Formalisation and Promotion of the Artisanal and Small Scale Mining Sector Law (Ley Nº 27651) has driven the formation of artisanal miners associations (Hruschka 2003) and some of these associations function as enterprises with an independent management body. However, production is still decided in smaller independent groups and profits are still distributed according to their daily labour participation.

The predictions of Foweraker´s framework can be tested in this case. Anecdotal evidence shows that the tendency is to develop capitalist (Bolivia) or quasi-capitalist (Peru) mining organisations. As this process occurs, demand for labour increases attracting migrants and expanding capitalist social relations in other areas of economic activity, such as related and unrelated services. Land ownership concentration can also increase as associations become firms and have access to more land. In the case of Peru, formalisation and access to legal rights to land within the petty-commodity mode of production can lead to suggest that land concentration will in fact decrease. This is because the advantages to small-scale capitalist miners of owning land have been reduced by the new legislation.

Another characteristic of this sector is that it includes those indirectly related to the mining activity. For instance, traders or those providing supporting services at mining camps, either directly related to the work in the mine (e.g. renting and operating tools or machinery, or even providing food for the workers) or at the mining camps or communities (e.g. rental accommodation for seasonal miners) (Martinez 1999; Heemskerk 2003).

In conclusion, petty commodity could help explain a real sub-sector among the ASM sector. This is mostly characterised for being ambivalent between capital accumulation and subsistence strategies. Table 5 provides some of the characteristics of the sector. More qualitative work is required to properly identify petty commodity production within the ASM sector. It is still not clear yet what are the key differences between subsistence mining and petty commodity. And, it is possible that, in fact, these two categories are two versions of the same one.

Table 5: Characteristics of Petty Commodity Mining

Factor/issue	**Characteristic/Status**
Labour capital division	No/ not completely
Agent	Consumer/Producer (micro-entrepreneurs) Not only miners
Capital accumulation	Difficult
Resource allocation	Inefficient
Objective 1	Maximise Utility
Objective 2	Minimise risk and variability of income
Legal status	Informal or in process of formalisation
Organisation	Associations or co-operatives
Mining sector environment	Unstable
Relation with large scale mining	Conflictive
Access to working capital	Own resources; from providers and buyers; informal lenders
Inputs	Mostly local but depending on scale and mineral they should be internationally traded
Number of intermediaries	Some/Many
Negotiation/bargaining power	Medium/low
Ability to stock or hold production while waiting for changes in market conditions	No/some

6 Conclusions - policy implications

This paper concludes with some policy implications which can be drawn from the study of the ASM sector under this new categorisation.

First, generalisations are dangerous. Even within countries, it is difficult to identify a typical ASM sector; distinguishing artisanal and small-scale is even more so. Traditional parameters to classify the sector (level of mechanisation and size of operation) do not characterise the high level of heterogeneity across ASM operations and do not address the livelihoods of those involved. Similarly, the regulatory classification fails to address economic and livelihood issues in a broader way.

Second, subsistence mining best describes the situation of most artisanal and small scale miners (75% of ASM in the Philippines according to Bugnosen 2001). This category

highlights the short term needs of the miners that extract whatever minerals they can in order to earn enough cash to maintain a basic livelihood.

Third, subsistence and petty commodity miners are both producers and consumers and seek to maximise household utility while minimising risk and income volatility. Hence they allocate their resources according to the needs arising in the household and business, making capital accumulation impossible in the case of subsistence mining and very difficult for petty commodity miners. Small-scale capitalist mines, on the other hand, show a separation between capital and labour and have as an objective maximising the business benefits subject to production costs.

Fourth, their ability to accumulate capital is also defined by their participation in profitable markets and their access to technology, market and financial services which reduce their production and commercialisation losses. As miners increasingly participate in formal markets they depend more on formal funding and input sources and market fluctuations in their activities.

An important characteristic of the sector is that not all have the same ability to stock or hold production while waiting for changes in market conditions. When large-scale mines face low international prices, they can reduce the rate of production or sale. Subsistence and petty commodity miners, however, have to cover very short term needs and require cash quickly. Transitional drops in commodity prices hence would not have the same effect on production levels: as prices drop, subsistence miners need to mine more to maintain a fairly constant income level (which is already at a minimum). This difference in accumulation capability is fundamental when determining the degree of protection from negative shocks that each group enjoys. Subsistence miners, at one end are clearly unprotected. And, while petty commodity producers might be better protected, capital accumulation becomes extremely difficult and negative shocks are frequent.

Table 4: Characteristics of the Three Groups

Factor/issue	**Subsistence**	**Petty commodity**	**Small-scale capitalist**
Labour capital division	No	No	Yes
Capital accumulation	No	Difficult	Yes
Resource allocation	Inefficient	Inefficient	Efficient
Objective 1	Maximise utility	Maximise utility	Maximise benefits
Objective 2	Minimise risk and variability of income	Minimise risk and variability of income	Minimise production costs
Legal status	Mostly informal or illegal	Process of formalisation	Formal
Organisation	Individual or family	Associations or co-operatives	Small-scale business or syndicates
Mining sector environment	Unstable	Unstable	Stable
Relation with large scale mining	Conflictive and irrational	Conflictive	Good or neutral
Agent	Consumer/Producer	Consumer/Producer (micro-entrepreneurs)	Producer
Access to working capital	Own resources; from providers and	Own resources; from providers and	Venture capital funds

	buyers; employers	buyers; informal lenders	
Inputs	Mostly local but depending on scale and mineral they should be internationally traded		
Number of intermediaries	Many	Some/many	Few
Negotiation/bargaining power	Low	Medium/low	High/medium
Ability to stock or hold production while waiting for changes in market conditions	No	No/some	Yes

Sixth, the two main short-term drivers of artisanal and small-scale mining are weather shocks and finds. In both cases, however, it must be recognised that those involved are already in the sector and new miners only join after prolonged price increases or if finds are large enough (Hruschka 2003; D'Souza 2003). Long-term drivers refer to livelihood strategies to satisfy basic needs.

Seven, vulnerability to price induced shocks can be expected to be higher in the cases where the entire household is involved and lower when only one of its members is involved. However, covariate shocks would affect households even if their income is diversified.

Eight, policies directed to the sector should be oriented towards the development of legal frameworks that properly recognises (but not necessarily condones) the prevailing labour and production arrangements.

Nine, although far more research is required in each category to properly identify the sector's main characteristics, it is possible to suggest that policies towards the sector should be oriented towards each one's particular context. Subsistence mining, for instance, requires above all, direct social policies to provide basic goods and services. Once these are satisfied, their ability to accumulate capital (at least at the level of petty commodity) would increase. On the other hand, petty commodity producers could be better assisted through the provision of consumption credit or insurance to avoid redirecting their productive resources and accumulated capital during bad periods.

Finally, identifying the roles that household members play within each sub-category could help design better targeted policies to help, both the individuals and the groups (household, community, association, etc.), achieve more sustainable, and less vulnerable, development.

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