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**Swiss Agency for Development and Cooperation SDC**

# SDC experiences with Formalization and Responsible Environmental Practices in Artisanal and Small-scale Gold Mining in Latin America and Asia (Mongolia)

# Contents

# Foreword

Fifteen million people worldwide – almost twice as many as Switzerland's population – are dedicated to artisanal and small-scale gold mining (ASGM). Many more, approximately 100 million people, depend on this activity for their livelihood. Mostly all of them were driven into artisanal mining by poverty, and for many of them this activity has become an opportunity to escape poverty.

The Federal Constitution stipulates that Switzerland "shall in particular assist in the alleviation of need and poverty in the world and promote respect for democracy and human rights, the peaceful co-existence of peoples, as well as the conservation of natural resources".

Increasingly over the past years, the international community has become aware of artisanal mining, and more often than not ASGM is perceived in the public opinion as a "problem", related to resource conflicts, human rights violations, informality and severe environmental degradation through mercury emissions.

SDC identified ASGM as a development topic some 20 years ago and since then supported a continuous series of projects in this sector. These projects demonstrated clearly that the core "problem" is not the artisanal way of mineral extraction, but the way how this sector is often dealt with. Marginalization and oppression of ASGM only drives it deeper into the informal sector and aggravates the social and environmental problems. Responsible ASGM in turn can be achieved within an enabling legal environment that promotes organization, formalization, implementations of best available technologies, rights and responsibilities, as well as local development and conservation of natural resources.

The present paper summarizes the lessons learnt by SDC and its cooperation partners at governmental, institutional and community level during the past two decades. It is dedicated to the millions of artisanal miners and their families who deserve a life in dignity, and intended as a contribution to the common global goal of reducing mercury emissions.

Maya Tissafi
Ambassador, Assistant Director General
Head of Regional Cooperation

# Foreword

I am pleased to have the opportunity to write this foreword for the booklet from SDC, "ASM Best Practices in South American Countries and Mongolia".

The Ministry of Mineral Resources and Energy of Mongolia has been implementing the SAM project jointly with the Swiss Agency for Development and Cooperation since 2005.

During this period, the two have focused on establishing an ASM legal framework, introducing health and environmentally friendly techniques and technologies to ASM, elaborating and ensuring compliance with environmental rehabilitation standards, and organising artisanal miners into partnerships.

Within the framework of capacity building for ASMs, both have been engaging with miners, local governments officials and experts in the field to provide a variety of trainings in such areasas environmental rehabilitation, health, occupational safety, human rights and management.

I am happy to note that in 2010, the Parliament of Mongolia included the statements to the Minerals Law, and the Government of Mongolia approved the Regulation on the Extraction of Minerals from Small-Scale Mines which completed the small-scale mining legal framework.

Project implementing parties have established a mercury-free gold-processing plant in Bornuur soum in Tuv aimag and another processing plant is being constructed in Bayankhongor aimag.

At the local level, miners' formalisation is in progress and some positive changes are happening, such as rehabilitating already mined areas, which demonstrates that the ASM operation is heading toward responsible ASM practice.

May all good deeds prosper!

Yours sincerely,

D.Khurelbaatar,
State Secretary of MMRE of Mongolia.

# 1. Summary

**Artisanal and Small-scale Gold Mining** (ASGM), carried out by an estimated number of 15 million miners, provides an approximate **100 million people** with a living, and accounts for about 15% of the worldwide primary gold production. Global awareness about the importance and extension of this sector is rising and focusing on social and environmental responsibility.

ASGM is usually a spontaneous **self-organizing social system**, while industrial mining is planned and centrally coordinated. Artisanal miners engage in mining to earn a living, while industrial mining is driven by corporate economic considerations. Miners focus on industrially not economic small high-grade mineral deposits in '*open access*' condition, and employ a '*common pool resources*' management approach. ASGM is an **important source of local income** and often drives **local developmen**t. Low technologic levels, at the budget of rural communities, have however **serious consequences on health, safety and environment**. The widespread use of mercury is a matter of global concern. Legal frameworks (or their absence) and economic interests of power groups force ASGM in many countries into the **informal sector**. To address the issues related with ASGM appropriately, it is important to distinguish clearly between permanent and seasonal community mining, gold-rush situations, and people pushed into this activity as a last resort to cope with economic shocks.

Given a certain complexity of the issues related with ASGM, a common approach of the past was to ignore and marginalize artisanal miners. This made problems and especially resource conflicts, e.g. between communities and industrial mining only worse. National and even networked efforts remained isolated. Only recently, the **need to engage in formalization processes** in a multi-stakeholder context of Governments, Industry, Civil Society, ASGM, Consumers, and Development Agencies is slowly becoming a common consensus.

The Swiss Development Agency SDC started to engage with the ASGM sector in the early 90s. Four major projects in Ecuador, Bolivia, Peru and Mongolia over the past two decades have contributed to shape the **evolution of development approaches** for ASGM. Starting out from initial technology-centric '*appropriate technology*' approaches, the impact of projects increased by incorporating community-centric '*livelihoods*', '*empowerment*' and *'human rights'* approaches. Approaches are

evolving towards incorporating market-based '*social and environmental certification*' as a driving force.

The **impact of SDC projects** in terms of **mercury emission reduction** can be quantified as (i) a documented reduction of 11 tons annually within pilot sites for demonstration purposes, and (ii) an estimated total reduction in the range of a multiple of this volume, through **replication of solutions**. This accumulated experience allows to draw conclusions and demands to share lessons learnt:

Mercury emission reduction in ASGM can be achieved through emission reducing technologic improvements or through substitution of the amalgamation process. Prohibiting mercury use is not an enforceable environmental management approach. It drives amalgamation into clandestine spaces, which are often the miners' households, and make things worse! Mercury reduction and substitution approaches will only be successful in a longer term, if miners are formalized and organized. **There is no "quick fix" to the "mercury problem" of ASGM, because it is not a "mercury problem" but a formalization challenge**. A broad and global conversion of the currently marginalized ASGM sector into the formal economy and in conformance with mandatory social and environmental standards can only take place through a **proactive and coordinated development effort** by national and international decision makers. Market based voluntary social and environmental standards will strengthen this process.

# 2. Preface

Global awareness about the importance and extension of Artisanal and Small-scale Mining (ASM) is rising and the topic increasingly receives private, public, and political attention from different viewpoints. On the "global agenda" are issues such as corporate social responsibility of the supply chain (e.g. RJC - Responsible Jewellery Council), conflicts originating from or fuelled by mineral extraction (e.g. OECD, Dodd Frank Act, WGC - World Gold Council standards), poverty reduction strategies within the Millennium Development Goals (Bilateral and Multilateral Cooperation), and use of global pollutants like mercury (UNEP led process towards a mercury treaty). While all these topics are intimately related, the present paper attempts to approach the issues from the environmental, and specifically from a "mercury reduction" perspective, which in 1992 had been the entry point for the involvement of the Swiss Development Agency (SDC) in this sector. 20 years of accumulated experience have demonstrated the feasibility of responsible ASM, if ASM is given a chance through appropriate policies. The paper aims for systematizing the experiences and observations of SDC funded projects in the ASM sector, and lessons learnt during these 20 years.

Chapter 3 and 4 are out to 'set the scene', attempt to describe and 'demystify' ASM in a wider context and summarize the evolution of policy and environmental approaches during this period of two decades. Chapter 5 and 6 draw mainly on SDC's own experiences from projects in Ecuador, Bolivia, Peru, and Mongolia. Chapter 7 summarizes lessons learnt and attempts to draw conclusions.

# 3. Introduction – What is Artisanal mining?

## 3.1. Relevance of the topic

Artisanal and Small-scale Gold Mining (ASGM), carried out by an estimated number of 15 million miners [1], provides an approximate 100 million people with a living, and accounts for about 15% of the worldwide primary gold production [2]. About half of the world's estimated 30 million ASM miners are dedicated to gold extraction.

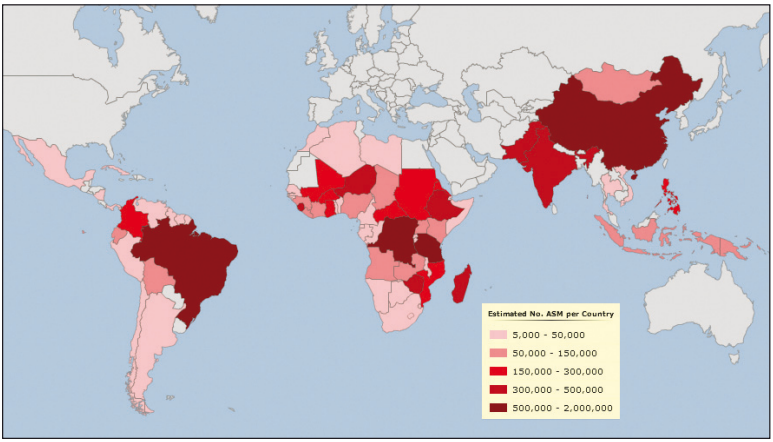


Figure 1: Estimated number of ASM miners by country [3] (Countries in grey: No ASM or no data available)

The number of people involved in ASM in general has risen dramatically during the last years [4], and ASM is often referred to as a new "phenomenon" and alleged "problem". ASGM is however as old as human civilization and only recently, during the first half of the past century, the technological divide between large and small-scale mining occurred.

**History -** This divide started in the gold mining sector with the first industrial use of cyanide leaching in 1898 [5], replacing progressively the traditional amalgamation process. Only recently, by about 1950, cyanidation had become the predominant industrial gold processing technology [6]. With a gold price fixed at 35 USD/oz by the Bretton Woods System [7], temporarily only industrial gold mining was economically

attractive. ASGM resurged in 1980 when the gold price reached for the first time a record high above 800 USD/oz and "digging for gold" became suddenly an opportunity to escape poverty. Amalgamation, as a simple and cheap technology became the preferred – and in most cases the only – choice for miners to process the gold ores.

## 3.2. Characteristics of ASGM

Workable definitions of ASM are in place at national levels, but at global level ASM still "*means different things to different people*" [8]. Nevertheless, ASM operations all over the world share common characteristics, which distinguish this activity clearly from industrial mineral extraction: ASGM is usually a spontaneous self-organizing social system, while industrial mining is planned and centrally coordinated. Artisanal miners engage in mining to earn a living, while industrial mining (large, medium and small-scale) is driven by profit expectations. Large and medium-scale mining are easy to distinguish from ASGM. The criteria to distinguish industrial small-scale mining enterprises from typical ASGM operations may appear somewhat blurred for outsiders; to community members it is a very clear distinction between '*they*' and '*we*'.

Figure 2: Artisanal miners of Lomo de Camello, Peru. (GAMA, 2001)

**ASGM deposits -** The amount of mineral, which one miner can extract and process has to provide for the livelihood of the miner's family. Mineral deposits are usually either large-and-low-grade, requiring heavy earth-moving equipment and high capital investment, or small-and-high-grade requiring high selectivity through manual work. Large low-grade deposits, are attractive for industrial mining but of very limited interest for artisanal miners. ASGM miners rather prefer small high-grade deposits. Similarly, abandoned tailings, and abandoned industrial mines are preferred ASGM targets. The miners' ability for highly selective scavenging often extends mine life for years after supposed resource depletion. Artisanal miners are also often laid off mine workers who turn to artisanal mining upon mine closure, to make a livelihood.
Mineral resources are in most countries owned in first instance by the State. The

State makes either direct use of its right for prospection, exploration, and extraction or licenses concessions to the private sector. In contrast, communities often claim mineral resources in their territory as their property, especially when these have traditionally been part of their livelihoods. Mineral deposits suitable for ASM share characteristics of open access resources [9] with characteristics of common pool resources. The "open access" situation (minerals are easily available on the earth's surface) usually enables artisanal miners to skip the exploration phase and to proceed with extraction immediately after discovery. Common pool resources are characterised by the difficulty of excluding anyone from using them, but face problems of congestion or overuse, and the use by one actor implies that less is available for others [10]. The opposed perceptions of communities and States explain most Governments' problems in dealing with ASM, as well as the fact that ASM will persist in the long term. Artisanal miners extract deposits under a common property regime, where the common-pool resource appears as a private good to an outsider and as a common good to an insider of the community [11, 12].

**ASGM miners -** Aside of the mineral deposit, labour is the second most important production factor in ASGM. Mechanization usually starts at a basic level and the primary purpose of mechanization is not to substitute workplaces, but to ease physical work conditions and to increase productivity. High labour intensity and therefore low productivity are always characteristics of ASGM, in contrast to industrial mining where productivity depends mainly on the capacity of machines. ASGM produces "only" about 15% of the worldwide gold production but employs more than 80% of the workforce.

The term "small" in ASGM refers to the scale, but not necessarily to the size of operations. Each individual artisanal miner or workgroup (usually 4-10 miners) can only work a very tiny piece of the mineral deposit, but the number of miners working in one single deposit can ascend to hundreds and in some cases even thousands of persons. In case of widely scattered outcrops (e.g. series of small veins) or placer deposits such operations can even extend over many kilometres and sustain, within a larger area and sometimes during decades, a large number of small artisanal workings. ASGM is therefore not characterized by the mine size in quantitative terms of number of workers or extension of the mining area, but by "small" as a quality attribute.

Figure 3:
Huaypethue – one of the largest artisanal and small-scale mine sites in Peru. (GAMA 2004)

**Entrepreneurial attitude -** Independent of the number of artisanal miners working jointly one deposit, the operational organization of miners into somewhat "autonomous" individual small workgroups or production partnerships and from there into larger clusters is a common feature of ASGM. Such spontaneous self-organizing social systems appear suspicious to most Governments and are often understood as "uncontrollable" [13]. Artisanal miners are however just characterized by entrepreneurship at individual level, in the grey zone between self-employment and self-exploitation. As such, they just do not want to join the usually large amount of unemployed urban and rural poor, expecting the Government to provide jobs.

**Income and local development -** ASGM provides in the majority of cases income levels similar or superior to alternative employment opportunities. Gold, unearthed by ASGM's manual workforce, has de facto international currency status and is as such (at formal or informal markets) freely convertible into any national currency. ASGM activity produces therefore a direct cash inflow into local economies, which – by starting to circulate at local level – contributes directly to local development. More often than not, this positive aspect is limited by restricted access of ASGM miners to markets and by local "gold shops" and national middlemen scraping off considerable trading margins.

**Informality -** By not expecting external solutions to their precarious economic situation, population with rural background takes increasingly the "open access / common pool" approach, and starts ASGM (as well as ASM for other minerals) where suitable deposits provide any opportunity to escape poverty. ASGM is therefore sometimes understood as a synonym for informal or illegal mining. The underlying structural problem is that minerals laws are usually designed for industrialized mining, promoting foreign investment and aiming for tax revenues. Large mining companies (LSM) and medium scale mines (MSM) employ highly qualified technical and legal staff and have access to the required financial means. ASGM and sometimes even

industrial Small-scale mining (SSM) is not capable of meeting these legal requirements or regulations designed for MSM and LSM. By maintaining ASGM informal, miners are kept vulnerable and at the mercy of unscrupulous middlemen involved in money laundering and even financing conflicts. Countries with workable legal frameworks for ASM usually do not face mayor problems with informality and demonstrate that informality is not a generic characteristic of ASGM.

**Technologic level -** One of the key characteristics of ASM is the low level of mechanization. The technological level is characterized by skilled manual work using any kind of available tools and machinery in an astonishing creativity. These, often as "simple" or "obsolete" described techniques, represent usually the cost optimum at their scale of operation. Unfortunately, this is also the case with the use of mercury for amalgamation, which ceased to be the mainstream gold processing technology of LSM during the middle of the past century, but remains of vital importance for the daily income of more than 90% of the worlds' ASGM miners [14].

Global mercury emissions from ASGM are currently estimated in the range of 1000 tons per year. Only half a decade ago, in 2005, estimations were still in the range of 320 tons or 17 per cent of anthropogenic mercury emissions [15]. These data suggest a high correlation between the increase of the gold price (500 >1500 USD/oz), the number of ASGM miners (5-7 mio 10-15 mio) and the volume of mercury emissions (320 >1000 t/a). Under current conditions, it is reasonable to expect this trend to continue in the coming years.

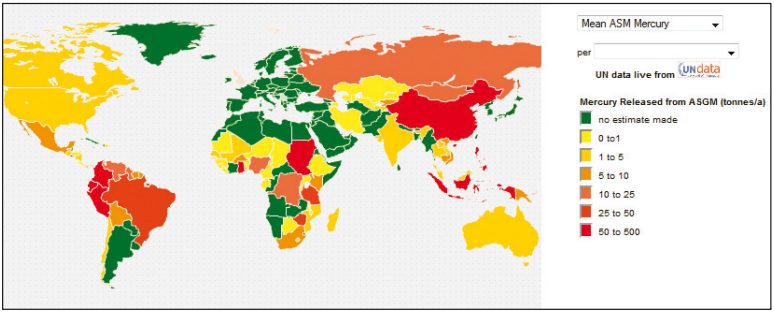


Figure 4:
Estimated mercury emission from ASGM [16]

While LSM converted to the use of cyanide as "state of the art" leaching technology for industrial processing of gold ores, this process is often not accessible to ASM or even considered banned technology at artisanal scale. While a vast variety of mercury and cyanide-free methods to recover gold [17, 18] are known, almost all of them lack the ease of use of amalgamation or the efficiency of cyanide leaching. Many of them are only feasible under certain circumstances, and some work even only under experimental laboratory conditions. For many ASGM miners this will create an exceptional challenge: While used to (or even obligated by law to) operate only simple technology, phasing out of mercury will require them to operate innovative chemicals-free processing techniques which are currently not even economically feasible for the most advanced LSM operations.

**Negative impacts –** Despite all positive effects of ASGM, such as employment and income generation in remote rural areas, strengthening of local development, economic use of marginal mineral resources, etc., negative impacts must not be ignored. Due to the low technological level, occupational health and safety represents in most cases a vast area with room for improvement and environmental impacts such as water-, air- and soil-pollution, deforestation and lack of rehabilitation go well beyond the widely discussed mercury emissions. On the social side issues like child labour, gender imbalances, bonded labour, and local conflicts are only some of the frequent problems. Conflicts with Mining authorities and concession holders are the consequence of non-existing or unsuitable ASM policies, but also relate in cases of gold rushes to particular mindsets related with expectations of sudden fortune.

Figure 5: Child panning gold in the sewer of La Rinconada, Peru. (Fact finding mission GAMA 1999)

Besides of ASGM causing negative impacts, a series of issues exist which affects ASGM miners themselves negatively. ASGM miners and their families are the group most affected by all occupational, environmental, and social impacts. In case of informal ASGM, any investment in improved working conditions is at risk by lack of security of tenure. The cost of informality (bribes, personal risks etc.) is often at the level or higher than taxes, fees and royalties established for formal mining operations [19]. In consequence of informality, ASGM miners have no access to formal financing or credit schemes and therefore suffer from chronic lack of investment and operating capital. Especially the lack of operating capital requires even ASGM miners with established semi-industrial mercury-free processing plants to recur occasionally to amalgamation, as this process is able to produce instantly gold for immediate sale.

**Categories of ASGM mines -** As seen above, the "ASGM sector" is extremely diverse, ranging from formal and responsible ASM communities as pillars of the local economy to chaotic and uncontrollable mining sites where negative impacts prevail. The below categorization has proven useful to distinguish types of ASGM, which share similar characteristics; four types of ASM can be broadly observed [20]:

1. *Permanent artisanal mining.* Full time, year round activity. For the involved people mining is frequently the only economic activity or sometimes accompanied by other activities like farming, herding or other extractive tasks of indigenous groups
2. *Seasonal artisanal mining.* Seasonal switching of activities or seasonal migration of people into artisanal mining areas, e.g. during idle agricultural periods to supplement their annual incomes
3. *Rush-type artisanal mining.* Massive migration based on the perception that the expected income opportunity from recently discovered deposit far exceeds the current actual income of the people who are lured into it. It is not uncommon to observe former rush areas converting into new communities and rush miners converting into settlers
4. *Shock-push artisanal mining.* A clearly poverty driven activity, emerging after recent loss of employment in other sectors, conflicts or natural disasters. Many of the individuals, mostly itinerant and poorly educated, have no other choice and miners remain trapped in the poverty cycle

The increasingly used term '*community mining*' refers to permanent and seasonal ASM, carried out by the local population, building their own livelihood strategy upon the mineral resources within their communal territory. Rush-type and shock-push artisanal mining have the potential to create new communities and convert into community mining.

Figure 6: Community mining in Jargalant, Mongolia. (SAM 2008)

Some aspects like mercury use and environmental issues may appear similar in all types of ASGM, but strategies, in order to address the problems successfully, need to differentiate clearly between these four types of ASGM.

# 4. Responses to ASM

## 4.1. Response from Governments

ASGM situations are manifold and furthermore vary between countries. Similarly widespread were and are the responses from Governments vis-à-vis this activity, oscillating in a spectrum between marginalizing ASM, ignoring the issue, and actively promoting formalized ASM.

The need for an appropriate legal framework [21] for ASM had been identified in early days of the recent ASM history [22] and countries with high incidence of ASGM, such as Ghana, pioneered in the late 1980s the legalization of the artisanal subsector [23]. Only a few countries, like Ecuador, Brazil and a few others had small-scale mining provisions in their legislation at that time. However, lengthy processes associated with excessive paperwork, costly procedures, and lengthy waiting periods, combined with the complexity of administrative procedures rather served as a means to restrict miners from formalizing their operations [24]. Where more "liberal" approaches, like "carnetization" [25], were attempted, conflicts with rightful license holders instead of solutions were often created. Although legalization of ASM proved to be in the long term the only sustainable way forward [26], perception of ASM, policies and actions from Governments are in most country "cyclic". Typically, short phases of ASM promotion are followed by disappointment about initially sceptical and cautious response by the ASM sector and cause subsequent longer phases of adverse opinion and marginalization of ASM [27].

More often than not, the response from Governments is also to ignore the reality of ASM. Reasons might be manifold, from real lack of knowledge about the extent of the informal sector, to deliberate denial as a justification for not taking action. The lack of an ASM policy, a denial policy or the '*policy to not have a policy*', and the related underreporting of numbers of ASM miners [28] is occasionally also related with a perceived conflict potential between LSM and ASM and considered part of the efforts of Governments to attract foreign investment in the mining sector.

Reasons for unsuccessful ASM policies can be attributed to several causes:

- The ASM sector is seen as a whole, without discriminating between different types of ASM. While stable permanent and seasonal ASM and especially community mining are usually highly responsive to formalization, gold rush situations and shock-push subsistence mining will most probably always remain uncontrollable [29, 30, 31].

- Governments and Parliaments expect rapid and ideally instant results from ASM legalization initiatives. Legalization of ASM needs however to be seen as a first step that is part of a larger strategy for ASM formalization integrating social, environmental, labour, health and safety, economic, commercial, gender, organizational and technical dimensions [32]. Such processes require time and a consistent long-term policy.
- A frequent handle of ASM policies are tax issues and specifically issues related with the illegal export of gold, diamonds, and precious stones. The approach to tackle this issue through ASM regulations is doomed to be unsuccessful, because it fails to distinguish between ASM miners involved in the extraction of minerals (which are not illegal products per se and contribute to national income) and well connected middlemen involved in criminal activities [33].
- Environmental aspects and particularly mercury use in ASM are mostly always aspects of major concern and key elements of ASM regulations. Typical approaches are attempts to ban mercury use (e.g. Brazil in the 1980s, Mongolia in 2008) or to regulate its use. Prohibition of mercury has proven to be inefficient [34, 35], and even counterproductive as it forces miners into clandestine use of mercury (often in domestic areas) and frustrates efforts to raise awareness and introduce good practices. Even regulations of mercury use have often proven to be unsuccessful, because of (i) difficulties of control and enforcement in remote areas, (ii) lack training programs for ASGM miners, and (iii) fundamentally because of isolated regulations unlinked from a broader ASM formalization strategy and process.

## 4.2. Response from Large-Scale Mining

Although the focus on different types of deposits (small high grade vs. large low grade) of ASGM and LSGM suggests little points of contact, relations have traditionally been tense.

The industrial mining sector has long seen ASGM as an annoyance and depicted artisanal miners as villains, irresponsibly 'destructing" mineral deposits and the environment, and opposing against modern mechanized mining. In areas where LSM works, ASGM is often either a traditional activity or artisanal miners had discovered the gold deposits. There are abundant cases – where these deposits turned out to be outcrops of a larger mineralization – where ASGM was subsequently displaced by LSM companies [36]. Concession areas for LSM are often significantly larger than the area actually required for the mining operation, sometimes covering thousands of

square kilometres. Such areas limit the possibilities of artisanal miners to do ASGM formally, and even on community land where ASGM had been a traditional activity, miners are often considered illegal and criminal invaders. Admittedly, also real cases of rush type invasions of mining properties are observed.

The typical reaction of LSM was (and still is in too may cases) to protect their property by creating enclaves and through private and public security forces, leading to police and military raids, direct confrontation, arrests and trials [37] with – in some cases – rampant violations of human rights.

Back in 2002, the position of the International Council on Mining and Metals (ICMM), the leading LSM industry association, was still quite distanced to ASM, stating, *"Artisanal, small-scale mining and orphan site legacy issues are important and complex. However, they are beyond the capacity of ICMM to resolve. Governments and international agencies should assume the lead role in addressing them"* [38]. By 2008 ICMM had changed its position, recognizing the need of engaging more proactively with ASM [39], as part of their member's Corporate Social Responsibility; and commenced to work towards improving the interfaces between ASM and LSM [40].

Figure 7: Left side: Invasions of LSM mines by Mongolian Ninja miners. Right side: Organized artisanal miners working under a formal agreement with the Mon Dulaan mining company in Zaamar, Mongolia. (SAM 2011)

## 4.3. Responses from Development Agencies and Civil Society in general and SDC in particular

Since ASGM had been identified as a "development topic" in the late 1970s, approaches have undergone major changes.

Initial interventions were more at investigative level, trying to understand the implications of "small-scale mining" [41]. Extensive field investigations on mercury

use, emissions, and impact in humans and in the environment were conducted in the 1980s in Brazil and particularly the areas of Pocone and Tapajos. Simultaneously, the 'appropriate technology (AT) movement' discovered ASGM, approaching the topic from a practical perspective. The late 80s and early 1990s were characterized by merging and applying the AT approach to solve the mercury problem [42], but gradually realizing that the problem cannot be addressed without considering the related socio-cultural aspects.

In this context, in 1992, the first SDC Project in the ASM sector (PMSC) was planned in Ecuador. It focused initially exclusively on mercury as a global pollutant and expected appropriate technologies (e.g. retorts for amalgam burning) to propagate solely because of their technologic advantage and through awareness rising. Field experience during the first year suggested widening the scope of PMSC [43], and allowed to plan the second SDC Project in Bolivia (MEDMIN) already under an Integrated Development approach [44].

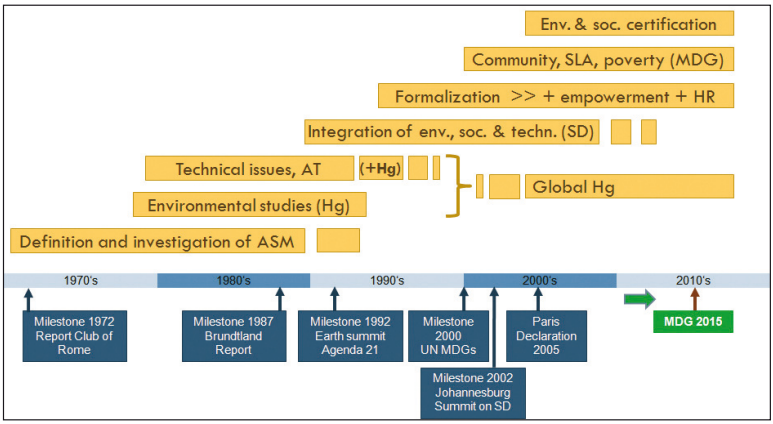


Figure 8: Evolution of mainstream ASM development topics during the past decades

In the mid 90s it became common consensus, that solutions need to include the legal dimension of ASM formalization in order to allow for sustainable development of ASM. Simultaneously the broader international community involved in ASGM started to realize the global dimension of mercury emissions from ASM, and UNIDO started its efforts towards the "Global Mercury Project" [45]. The early 2000's saw another shift – or rather an extension – in the way ASM was focused. The Millennium Development Goals (MDG) and the upcoming Johannesburg Summit broadened the perception towards a community focus. In 2001 World Bank took the initiative to convene the "Communities

And Small-scale Mining – CASM" initiative [46]; and the MMSD Project [47] included ASM in the agenda of the Extractive Industries in the Summit on Sustainable Development of 2002 [48].

SDC, implementing two mature ASM project at that time in Ecuador and Bolivia, and having started its third 'Project GAMA' in Peru in 1999 [49], was at that time one of the major donors in the ASM sector and correspondingly participated actively in all before mentioned initiatives and key events. As the World Bank hosted CASM initiative evolved into the lead initiative, SDC-Projects hosted in two occasions the CASM Annual Conferences (in 2002 in Peru and later in 2007 in Mongolia).

The decade of the 2000's, with increasing orientation of the development cooperation towards the MDG's was shaped by an increasing focus on poverty alleviation, sustainable livelihoods (which matched the community mining approach) and development of empowerment concepts for the ASM sector. Simultaneously, and triggered by growing concerns about conflict diamonds from Africa [50] the need to address human rights aspects in ASM projects became increasingly a priority. Empowerment and rights based approaches underpin even more the importance of supporting formalization processes in ASM as an essential tool to achieve sustainable environmental improvements and improved livelihoods.

By around 2005 a completely new approach to ASGM appeared. Growing consumer demand for socially and environmentally responsibly sourced mineral raw materials for jewellery and consumer electronics inspired for adapting the fair trade approach from agricultural products produced by small farmers to gold from small miners. After 5 years of participatory standards development and broad consultations, ARM and FLO published in 2010 the "Fairtrade and Fairmined Standard for Gold from ASM" [51]. Responsible mercury use is a key requirement of the Standard.

Formalization of ASM under an empowerment approach has become a pivotal component of all SDC supported ASGM projects since the early 2000's. The projects have contributed to create or improve legal frameworks for ASM in Bolivia, Peru, and Mongolia, which in consequence has enabled ASGM communities to later progress and adapt to international social and environmental standards. By end of 2011, all Fairtrade and Fairmined certified ASM communities in Bolivia and Peru have been former pilot sites of SDC projects.

# 5. SDC experiences with ASM Formalization and Responsible Environmental Practices

## 5.1. Swiss supported ASGM Projects

Switzerland's engagement with the ASGM sector dates back to 1992, when SDC identified mercury pollution as an environmental problem of global dimension and a priority topic, to be addressed within the '*Jubilee Fund*' (marking the Confederation's 700th anniversary in 1991) as a specific Swiss contribution to the Global Environmental Facility (GEF). Inspired by a prior pilot intervention of GTZ/Projekt-Consult in Colombia, the Swiss PMSC project in **Ecuador** [52] started in 1993 and the MEDMIN project in **Bolivia** [53] in 1994. Both projects initiated with very strong technical components oriented towards technical solutions to mercury emissions. Both projects realized soon that the implementation of technical solutions requires an implementation strategy incorporating socio-cultural, organizational and legal aspects, but the projects continued to produce a series of technologic innovations which spread far beyond the project regions [54] and experiences were summarized in 1998 in a joint publication [55].

The "second wave" of SDC projects in the ASM sector started with the GAMA project in **Peru** [56] in 2000 and the SAM project in **Mongolia** [57] in 2005. Based on lessons learnt in Ecuador and Bolivia, both projects incorporated from the outset (within an integrated approach) the aspects of ASGM formalization as a precondition for sustainable and responsible ASGM. Given the fact, that a long-lasting impact and further progress beyond the lifespan of a project can only be expected from "bottom-up", with artisanal miner as "actors of change", the GAMA project evolved in its main implementation phases towards an economic empowerment approach and the SAM project towards a rights based empowerment approach.

## 5.2. Formalization approaches to environmental compliance

**Approaches 1992 – 2000**

INECE's publication on Principles of Environmental Enforcement from 1992 [58] inspired and reflects the initial steps towards a formalization approach of ASGM in the early SDC projects: "*There are many approaches to managing environmental problems. The need for and scope of enforcement depends, in part, on which management approach or approaches are being used. Some approaches are purely voluntary - that is, they encourage and assist change but do not require it. Other approaches are regulatory - that is, they require change. At the heart of regulatory approaches are environmental requirements … The first step in fostering compliance is to ensure that the environmental requirements themselves are enforceable.*"

Initial approaches in Ecuador and Bolivia were based on voluntary compliance; through offering technical-economic win-win options and supported by awareness rising campaigns. Both countries had the advantage of having a legal framework in place, which was in principle compatible with ASGM, although compliance of ASGM operations was rather 'circumstantial'. The introduction of individual retorts for amalgam burning was therefore one of the main mercury emission reduction strategies [59]. Dissemination of the retort technology showed better results in Bolivia, as miners were organized into cooperatives, which undertook burning of amalgam in larger batches. In Ecuador, miners resulted rather reluctant to use any kind of retorts as they burned amalgam individually in batches of only a few grams [60].

Figure 9: Demonstration of individual retort in Portovelo, Ecuador. (PMSC 1993)

- As it became clear from both projects, that voluntary compliance is desirable but not sufficient to achieve compliance with environmental requirements, MEDMIN started to elaborate a field-tested and therefore "*enforcable*" technical norm on mercury use [61] and to support the drafting of ASGM specific regulations by the State Environmental Secretariat [62]. Use of retorts for mercury recovery is obligatory under the current legislation.
- The PMSC project had a local NGO as counterpart. Therefore, only indirect incidence on the legal framework was feasible. In order to address environmental problems in a required wider context, and having identified the existing legal requirement of individual Environmental Impact Assessments of more than 150 small processing plants in the two valleys of the Zaruma Portovelo region as a "*not enforceable*" bottleneck, PMSC proposed a new approach to State Environmental Secretariat [63].

Figure 10: Mineral processing plants in the Rio Calera valley in Portovelo, Ecuador. (PMSC 1996)

The "Plan ECO+" [64, 65] introduced the concept of "collective EIA's" based on the trivial assumption that "*processing plants with similar technical characteristics within one given ecosystem cause similar environmental impacts and therefore require similar environmental management plans*". The State Secretariat approved in 1996 a pilot implementation in the Rio Calera valley, covering 58 processing plants. At the end of the PMSC project in 1999, implementation of environmental measures was in good progress and the follow-up was handed over to the World Bank funded PRODEMINCA project, with initial support from SDC. Further hand-over to the

Ecuadorian Government for sustainable broad implementation failed however [66].
The concept of "collective EIA's" made the environmental regulations "enforceable", as it relieved miners from the financial burden to contract expensive EIAs for each individual plant and redirected (by means of financial guarantees) these "saved" funds into implementation of environmental measures. Additionally, it contributed to institutional strengthening of the involved miners' organization APROPLASMIN and to peer-pressure as an additional element of enforcement.

## Approaches 2000-2001

By end of the 1990's it was clear that ASGM is not able to develop and improve in the informal sector. The SDC projects in Peru and Mongolia included from the outset a component dealing with ASM policy [67]. By coincidence both countries had no ASM legislation in place when the projects began, and ASGM miners – in Peru called "informales" and in Mongolia "ninja miners" – were marginalized, criminalized and subject to human rights violations. Situations and obstacles encountered in both countries have a series of similarities.
ASGM had begun in both countries as a shock-push activity [68].Both countries are very rich in gold deposits and frequent new discoveries lead easily to rush-type situations. The precarious situations of shock-push ASGM and the uncontrollable characteristics of rush-type ASGM had created a negative public opinion regarding "informal mining". However, ASGM was, for the involved miners and their families, an opportunity to escape worst poverty and many mining sites had already converted into stable permanent and seasonal mining communities. Similar situations and negative public opinions on ASGM can be observed in many countries. Without external support, a vulnerable and weakened ASGM sector cannot make the required initial step to start a public information campaign.

Figure 11: Women miner milling and amalgamating ore in a "quimbalete" processing plant (traditional mortar type mill made out of two big stones) near Tulin, Peru. (GAMA 2003)

Figure 12: "Ninja miner" panning for gold near Bayangol, Mongolia. (SAM 2007)

The informal situation of ASGM creates a unique profit opportunity for a small economically (and in many cases politically) influential group. As long as miners are informal or illegal and therefore right-less, they can be extorted to sell their gold significantly below the real market price [69] and the unregistered volumes of gold can be used for all kind of economic transactions in the grey and black market [70]. Formalization of ASGM is seen by these groups as a menace of their illicit source of funding and any attempt to create a legal framework for ASGM has to expect resistance from a strong lobby against "legalizing environmentally damaging and uncontrollable criminal activities". Both projects (GAMA and SAM) faced strong resistances against their efforts to facilitate a legal framework for ASGM [71].

Resistance against formalization of ASGM can only be overcome through consistent efforts at policy and public opinion level, supported by strong evidence of the development opportunity of ASGM. Such work needs to distinguish clearly between the stakeholder role of the national counterpart, the beneficiaries, and the facilitator role of an international development agency like SDC, respecting the host country's sovereignty. Additionally, a democratic process of facilitating a legal framework for ASM needs to build on a broad consultation and in the ideal case a bottom-up approach including all interested and affected parties.

- The facilitation strategy in Peru consisted of bringing all stakeholder (artisanal miners, mining industry, Government and civil society) to the table for building a broad consensus and then to support a gremial ASGM organization in their efforts to convince the Congress and the Mining Ministry. Within a context of

transition towards democratization, following the Fujimori regime, the entire process from consensus building, consultation to enactment of the ASM law took less than a year [72, 73].

Figure 13: Participatory workshop on Peruvian ASM legislation. Arequipa meeting. (GAMA 2001)

- In Mongolia, in absence of a gremial ASGM organization, and a historically stronger top-down governance approach, SAM and particularly its national counterpart had to take the lead. Based on broad and participatory stakeholder consultation [74], several drafts of an ASM law were presented between 2005 and 2007 and discussed in Parliament; until the Government decided to start resolving the increasing issues with informal AGM at a temporary regulation level [75]. The SAM project further supported the law-making process until an ASM Law was finally passed in 2010 [76].

In both cases, the enactment of the law (and as soon as regulations for its implementation were in place) was followed by a numerous first wave of ASM organizations applying for formalization. This proves the strong desire of community based ASGM to formalize their operations.

While community mining (stable permanent and seasonal ASGM) is usually keen to formalize, and subsistence shock-push ASGM has a high potential to formalize as soon as the acute condition of a livelihoods crisis is overcome, the menace of rush-type ASGM is omnipresent. The experiment of Sailstorfer [77] demonstrates clearly that gold rush phenomena are (i) not limited to ASGM, (ii) independent of the economic development level and (iii) hardly controllable by legal frameworks or cultural norms [78]. Even the best ASM law will therefore not prevent "uncontrollable" gold rush situations. Gold rush situations remain however only "uncontrollable", if no efforts are made towards converting the rush sites into a stable community-mining situation. The GAMA project in Peru started to intervene in Cuatro Horas in 2002, when it was one of the worst gold rush sites in Peru. Ten years later, the site is a recognized village with extraordinary livelihood quality and its own local Government, economically driven by a fully formal community owned ASGM company, and with good progress towards compliance with the Fairtrade and Fairmined Standard.

## 5.3. Role of ASM organizations

Experience over the past 20 years demonstrates that ASM cannot be formalized at the level of the individual miner. The '*individual gold panner*' is a myth and ASGM miners are usually organized into small workgroups and larger clusters of workgroups. Governments can never be in a position to efficiently enforce the compliance of thousands of individual miners, addressing them individually. The organization of the ASM sector therefore improves governability as well a empowers artisanal miners. The creation of national and/or regional gremial ASM organizations furthermore constitutes a competent partner for dialogue with the Government.

- In this regard, conditions for formalization in Peru were more favourable. ASGM miners were, already before the enactment of the ASM law, organized in larger local associations (with the main purpose of self-defence) and these associations could easily develop into collectively owned ASGM enterprises or cooperatives. Even more, miners understood the initiative towards the creation of a legal framework as a common task and the formalization process triggered a simultaneous process of gremial organization. The resulting ASGM organizations AMASUC at regional level and SONAMIPE at national level have strengthened since and continue to be a partner of the Government for a proactive and constructive public policy dialogue. SONAMIPE has even evolved towards an international ASGM stakeholder, by becoming a leading member of the Alliance for Responsible Mining ARM [79].
- In the Mongolian case, formalization focused on smaller workgroups, locally known as '*partnerships*'. In combination with local administration of land rights for ASM activities this provides a workable formalization model, but lacks the scalability towards more entrepreneurial business models and growth opportunities for ASGM. ASGM miners are therefore in parallel organizing in associations, locally known as '*miners NGOs*' to address issues of common concern. Further evolution of ASGM will require a more business-oriented role of the miners associations and the conformation of gremial ASGM organizations.

General economic concepts like '*economy of scale*' are also valid in the ASGM sector, and are not in contradiction to the employment generating characteristics ASGM. While '*economy of scale*' is achieved in the industrial mining sector through mechanization, it is achieved in the ASM sector through organization. Only larger and organized clusters of artisanal miners, such as the Bolivian Cooperatives or the Peruvian ASM companies are able to develop beyond subsistence economy, overcome

dependencies from local middlemen and even engage with international markets on their own. The economic success of the 'HAMO company' in Mongolia [80], a spin-off from the 'Bornuur miners NGO', fully validates this appreciation.

## 5.4. Technical-environmental approaches towards compliance

Creating the legal bases for ASM formalization (and even the opposite of ASM prohibition) creates a framework for enforcement; i.e. demanding environmental compliance. But legalization alone makes environmental compliance not enforceable. Enforceability can only be assured if solutions on how to achieve compliance can be offered, and if technical and economic feasibility of at least one solution can be demonstrated in practice.

A typical characteristic of all SDC projects in the ASM sector was to always incorporate practical fieldwork as well as engineering and adaptation of technical solutions to environmental problems.

- Individual retorts were the initial approach for reduction of mercury emissions chosen by the PMSC and MEDMIN projects
- For cases where individual retorts did not provide satisfactory results, PMSC and later GAMA started to develop fume hood and filter systems which the miners started to call "retorta communal" [81].


Figure 14: Inauguration of community retort in Cerro Rico, Peru. (GAMA 2005

- The MEDMIN project started in 1994 to address mercury losses in whole-ore amalgamation through introducing gravimetric pre-concentration [82] and improved amalgamation technologies to reduce or capture '*flowered mercury*' [83]. GAMA continued with this approach in the early 2000s [84]
- Both, PMSC and MEDMIN presented and implemented solutions to reduce emissions of suspended solids from processing plants, such as flocculation in decantation ponds, use of lamella clarifiers, etc. as well as solutions to reduce air contamination by nitrous gases during gold refining.

Figure 15: Introduction of shaking tables for gravimetric concentration in the Cotapata Cooperative, Bolivia. (MEDMIN 1998)

- The GAMA project combined technologies and elements developed earlier in Ecuador and Bolivia to design in 2001 the first "technical" cyanidation plant for ASGM in Peru for complete substitution of mercury; which was then implemented in Santa Filomena [85] through a rotating fund credit from ILO.


Figure 16: Initial processing plant of SOTRAMI with vat leaching section, upgradeable for later agitation leaching. Santa Filomena, Peru. (GAMA 2002)

- The SAM project in Mongolia started to continue along these lines, drawing from earlier experiences. When mercury use in ASGM was banned in Mongolia in 2008, the broad background of field experience allowed SDC to respond quickly and present a viable technical solution for a mercury and cyanide free processing plant in Bornuur [86].

Figure 17: Gravimetric, mercury-free processing plant of the "Hamo Company" in Bornuur, Mongolia. (SAM 2008)

The above list only highlights the most important milestones with proven sustainable impact through replication or further development. Many other technical solutions had been tried, but were abandoned due to lack of practical feasibility. The "failed experiments" however were as important as the successful ones, as they contributed to solid lessons learnt.

The main lessons learnt are that

- The portfolio of pure "win-win options", potentially successful in a "formalization-free" context, and therefore achievable through pure voluntary compliance, is very limited.
- From the apparently vast portfolio of gold processing techniques [87], only very few are appropriate and feasible for use in ASGM.
- Traditional gold recovery of ASGM by amalgamation is in the long term (e.g. through repetitive scavenging) much higher than usually measured in short term diagnostics. This is a challenge for mercury free processing alternatives [88].
- The implementation of most technical environmental improvements requires a balanced combination of (i) their demonstrated feasibility (ii) capacity building in miners as well as in support organizations and supervision agencies, and (iii) realistic enforceable requirements for which the technology provides a solution. Within a formalization process, this creates intentional artificial win-win options.
- Wrongly understood "enforcement" (as "by force") is utterly counterproductive, as it leaves miners who's life depends on ASGM with no other option than entering into clandestine and even more contaminating operation modes.

## 5.5. Socio economic aspects, empowerment and human rights, conflict management

ASGM is poverty related and – with the presented characteristics – only present in economically less developed countries (LDC). Most ASGM miners (with exception of shock-push ASGM) have managed to escape extreme poverty. This explains why, apart from being reluctant of working in the '*mining sector*', relatively few development agencies engage with ASGM. Most ASGM does not need '*humanitarian aid*' [89]. However, ASGM miners are also not rich, as often insinuated, confusing miners with smuggling middlemen. ASGM is an economic activity in most opportunity LDCs, which offers the best opportunity to escape poverty, often at the price of the highest vulnerability. Unfortunately, more development programmes focus on

poverty-doomed (and -perpetuating) sectors than on opportunities to escape poverty. While "high mobility and flexibility in the job market" is praised as a "virtue" in economically developed countries, migration of the urban and rural poor into ASGM areas is almost everywhere condemned as a "problem".

It has been a common experience in all ASGM projects of SDC during the past 20 years that community based ASGM contributes significantly to local economies [90], and often even allows (as seasonal ASGM) the continuation of otherwise not anymore sustainable traditional activities.

For example Alpaca herding in the Puno region of Peru is often only economically feasible if other family members procure cash income from ASGM [91]. Another example from SDC project sites were coffee smallholder in Zaruma/Ecuador who kept growing coffee by tradition, while economically sustaining their families through income from ASGM. In Mongolia ASGM started only in the early 2000s, but soon after already provided income for an estimated 100,000 people affected by the economic crisis and natural disasters; while many still argue that ASGM miners should return to herding, Mongolia already faces a serious problem of overgrazing [92].

It has been observed in most places, that ASGM communities present faster economic development than neighbour communities without ASGM. The question is whether this development is sustainable. While this question could be considered answered since the American gold rush of 1849 evolved from the '*Wild West*' into the State of California [93], an in-depth analysis was carried out in Peru, analyzing and comparing the development of ASGM communities under a sustainable livelihoods approach [94]. The results demonstrate clearly that empowerment reduces primarily vulnerabilities, and reduced vulnerabilities lead then to long-term and sustainability-oriented development. Informality is the upmost vulnerability and to overcome informality requires in a first instance an enabling legal framework.

A widely published case is Santa Filomena in Peru [95]. Having become one of the most "empowered" ASGM communities in Peru, by being able to settle the conflict regarding their mining concession and having obtained their own processing plant [96], the community continued to develop towards responsible ASGM without major external support since 2005.

Figure 18: Community development in Santa Filomena. Left: the improvised former Santa Filomena "shanty town" in 2006. Right: the new community location after relocation in 2008. Peru. (GAMA)

By contracting engineers in 2006 to direct the artisanal mining operation and to train their members, efficiency and safety increased. By deciding to abandon the old shanty-town and to relocate the entire community to a nearby area in 2007, quality of life improved dramatically. By deciding to phase out amalgamation in their old "quimbalete" mills in 2009, they increased the capacity of the processing plant and converted the entire gold production into "mercury-free". By deciding to work towards Fairtrade and Fairmined certification in 2008, Santa Filomena became in 2011 Peru's first internationally certified ASGM community.

A similarly exciting case is Bornuur in Mongolia. After having organized as an association ('miners NGO'), resolved their land issues with the license holder, and when Mongolia had enacted a ban on mercury, the Bornuur miners obtained a credit line from the Mongolian Government and support from SAM/SDC for the technical design of Mongolia's first mercury free processing plant for ASGM. Reinvesting the revenues in support for extracting workgroups and in up-scaling the capacity of the processing plant, the '*HAMO company*' provides now employment to more than 60 women and men from the community. The economic situation of the people of Bornuur has improved considerably [97].

Conflict resolution in ASGM became – due to the high vulnerability of the ASGM sector – a transversal element of SDC's empowerment strategy. Most conflicts are related to mineral rights, and a rights based approach, considering ASGM not only as victimized rights-holder but also as duty bearer contributed to resolve several conflicts between LSM and ASM. Obviously, in case of human rights violations, SDC projects support the ASGM miners to obtain the needed legal advice and support, or in case of imbalance of negotiation power, SDC projects provided facilitated dialogue platforms (e.g. Peru: La Rinconada [98]; Mongolia: Bornuur, Jargalant, Zaamar, etc.).

## 5.6. Convergence with market-based approaches

By 2009, INECE had published a revised publication on Principles of Environmental Enforcement, indicating: "*Three different overlapping management approaches -- voluntary, market-based, and mandatory -- make up the framework underlying most environmental programs*" [99].

The introduction of a new market-based approach occurred in the ASGM sector by mid of the 2000s. The B2B (business-to-business) model of the "Oro Verde / Green Gold - Initiative" in Colombia [100] inspired in 2004 the foundation of the Alliance for Responsible Mining (ARM), as a global civil society initiative acting from the 'Global South', to agree on '*Principles for Responsible ASGM*' [101], and to develop an ASGM certification scheme that would enable ASGM producers to enter fair trade markets. Former and current SDC project staff as well as gremial ASGM organizations (such as AMASUC and SONAMIPE) from Peru were invited to participate in the Technical Committee to contribute with lessons leant to an ASGM Standard. In 2010, ARM and Fairtrade Labelling International (FLO) signed an agreement to work jointly towards producer certification in Latin America and market introduction of "*Fairtrade and Fairmined Gold* ®" [102].

ASGM communities formerly supported by SDC projects in Bolivia and Peru were in a good position to apply for Fairtrade and Fairmined certification [103]. But the fact that it still took the mining communities a lot of efforts and almost two years of preparation to reach certification level, demonstrates that a market-based approach is able to go far beyond voluntary and mandatory compliance with environmental requirements [104, 105].

Given the potential for socially and environmentally responsible development, SDC incorporated, for year 2011 onwards, Fairtrade and Fairmined standards compliance as a benchmark indicator for Phase 3 of the SAM project in Mongolia [106].

# 6. Environment impacts of SDC projects and lessons learnt

Environmental concerns, and especially mercury emissions, stood in the centre of all SDC supported ASGM projects. Both contamination paths, amalgamation of ore and decomposition (burning) of amalgam, were consistently addressed since 1993. Quantitative impacts are however difficult to measure, as discrimination between direct and indirect impacts is required.

## 6.1. Attempt to estimate the achieved reduction of mercury emissions

Global mercury emissions from ASGM are estimated in the range of 1000 t/a, at an average ratio of 2 Hg : 1 Au when amalgamating concentrates and 5 Hg : 1 Au for whole ore amalgamation [107], although the local ratios may vary widely. Mercury losses during amalgam burning are usually in the range of 1 Hg : 1 Au. As a rough approximation it can be assumed that introduction of retorts reduces mercury emission in at least 50% and introduction of pre-concentration reduces mercury emission in more than 80%.

**Ecuador and Bolivia -** The project lines along the implementation of small individual (and more importantly larger cooperative-size) retorts in Ecuador and Bolivia had an outreach in the range of 3-400 retorts in total [108].The MEDMIN project intervened in 16 ASGM cooperatives, converting whole ore amalgamation into processes with pre-concentration [109]. With an estimated average production of 5 kg gold per month and cooperative, this corresponds to 900 kg gold produced at 80% reduced mercury contamination, or a direct absolute reduction of 3.6 tons of mercury per year. The total mercury reduction achieved by the MEDMIN project was estimated in 2001 by IIED in about 5 tons per year [110]. In analogy, reduction of mercury emissions through the PMSC project in the 58 processing plants of the Rio Calera valley (which already used pre-concentration) can be estimated in the range of 1 ton annually.

**Peru** - The traditional *quimbalete* mills for whole ore amalgamation have extremely high mercury losses of not less than 10 Hg : 1 Au. The project intervened through total substitution of mercury, and introduction of community retorts.

- Between 2000 and 2008, community retorts have been installed in 15 ASGM communities by the project or by Regional Governments. Recovered mercury is recycled to cover the operating costs, and surplus revenues from mercury sales are used for community projects. The community-audited bookkeeping of retort operators allows for the precise determination of 1,440 kg mercury recovered in 2008 [111].
- The processing plant of Santa Filomena [112] has in the meantime been replicated in many places. Admittedly, in some places the technologic level had been 'downscaled' by miners, but as such processing plants cannot be hidden, they are regularly inspected by authorities and therefore kept reasonably safe. The exact number of replicas is not known, but at least 3 processing plants (in communities which were also SDC intervention sites) are in excellent shape which allowed the ASGM communities to apply for Fairtrade and Fairmined certification. The consolidated gold volume of these 3 plants is known (as '*committed fairtrade volumes*') and in the range of 25 kg gold per month [113]. Given the high Hg : Au ratio of the formerly used quimbalete amalgamation mills, these 3 processing plants alone substitute the use of 250 kg mercury per month, or 3 tons annually. It is not unreasonable to consider a factor of 4 to 5 to extrapolate mercury substitution by the rest of plant replicas.

**Mongolia** – Gold production from ASGM is estimated in the range of 4 to 7 tons, depending on the estimating institution. Most alluvial miners recover coarse gold without use of amalgamation, but hard rock miners usually rely on mercury to recover the gold. Officially, these emissions have been reduced completely in 2008, when mercury use was prohibited in Mongolia.

The ban of mercury in Mongolia is unfortunately a typical case of a well-intentioned environmental requirement, which by lack of practical feasibility is not enforceable [114]. Hard rock gold miners had no alternative technology available to process their ore and to economically sustain their families. As indicated earlier, in response to this emergency, the SAM project was able to design a mercury-free processing plant in Bornuur. This plant combines pre-concentration, high-grade concentration, and direct smelting technology and allows for a gold recovery presumably in the same range as amalgamation [115]. As this plant is the only legal processing facility for ASGM gold ores in Mongolia and therefore despite of high investment costs de facto the 'best available technology', acceptance by miners is extraordinarily high. However, officially this plant does not contribute to the reduction of mercury emissions, as mercury is already "banned".

The Mongolian Government decided to 'tender' licenses for the establishment of

further similar processing plants. One of these plants is under construction since 2010. Further plants are still in planning stage. The question arises, "Where do ASGM hard rock miners from other regions process their ores in the meantime?" The official answer is, "They stockpile the ore until processing plants are available." The question, "How do miners sustain their families in the meantime?" could not be answered [116]. Despite all limitations, the several thousand Mongolian hard rock ASGM miners continue "stockpiling".

**Overall achieved reduction of mercury emissions** – Reduction of mercury emissions achieved through direct interventions of SDC projects in pilot sites ascends to approximately 11 tons annually. Cooperation projects however have not the purpose to solve all problems in their host countries, but to demonstrate the feasibility of solutions and to hand them over to the national stakeholders for broad implementation. Indirect impacts or "sustainability" are therefore more significant than results in pilot sites. At indirect impact level it becomes however impossible to distinguish between impacts generated exclusively by the project, impacts generated through interaction with other initiatives (as technical solutions are not 'patented'), and even technical evolution which would anyway have occurred and was just triggered by projects at an earlier moment.

The fact that replication of all technical approaches is observed, such as

(i) increasingly miners are aware of mercury toxicity and use retorts voluntarily, and the use of retorts has become in most countries a minimum requirement for ASGM miners,

(ii) other initiatives continue to promote (their design) of fume hoods which serve similar purposes as 'community retorts' [117],

(iii) an increasing number of miners is abandoning whole ore amalgamation and shifting to pre-concentration, and

(iv) an increasing number of miners organizations is substituting mercury use by leaching plants,

strongly supports the appreciation that the achieved indirect impact is a multiple of the direct impact of 11 tons annually. A quantification is however not possible.

## 6.2. Other positive impacts on health, safety and environmental performance

Environmental management of ASGM needs to be seen in a wider context of responsible mining. Acute mercury poisoning is very rare in ASGM, opposite to chronic poisoning which accumulates often over years. For miners, the toxic effects of

mercury are not as obvious as for scientists. Concerns of workplace safety, the risks of accidents, and the often lacking health services in ASGM communities in combination with generally harsh and unhealthy living conditions in remote places are perceived a much higher priority. These concerns have to be taken serious, as they directly affect the quality of life of the miners and their families, and because without addressing them, projects not only lose credibility in the eyes of the miners but fail to contribute to responsible ASGM and sustainable development.

Since the first project in Ecuador, where these issues were addressed instantly by renaming the project from '*Proyecto Mercurio*' to '*Proyecto Minería sin Contaminación*' and adjusting the project goals, an integrated approach has become a common element in all SDC projects. The latest and current project, SAM in cooperation between the Swiss and the Mongolian Government, even frames environmental and technical issues in a '*community mining component*', under a human rights based empowerment approach.

| **Key human rights …** | **… strengthened through SAM** |
|---|---|
| The right to equal treatment and non-discrimination … | … by being granted legal access to mineral resources similar to the mining industry |
| The right to be recognised as a person before the law … | … by being allowed to escape the informal sector through formalization |
| The right to a standard of living – food, water and housing – adequate for health and well-being … | … by environmentally responsible practices and sustainable livelihoods |
| The right to the highest attainable standard of physical and mental health … | … by safer workplaces and access to social security |
| The right to work and to just and favourable conditions of work … | … by obtaining rights to mine and the duty to mine responsibly |
| The right to education … | … by capacity building and training |
| Freedom of association and the right to participate in the political process … | … by organizational strengthening and ASM organizations becoming a partner for dialogue with the Government |

# 7. Recommendations and Conclusions

## 7.1. Technical solutions for reduction of mercury emissions from ASGM

Mercury is emitted during amalgamation and during amalgam burning, whereby the most losses occur during the amalgamation process.

**Reduction of mercury emissions during amalgamation**

Whole ore amalgamation is still a widespread practice. Through introduction of a previous step of gravimetric pre-concentration, the amount of mineral material which comes in contact with mercury can be reduced dramatically. A pre-concentration of 10:1 already reduces mercury emissions by 90%.

Amalgamation (even of pre-concentrates) has in most cases room for improvement. Amalgamation in appropriate closed amalgamation devices can reduce the formation of floured mercury escaping into tailings. Many other ways to improve amalgamation are extensively documented in the technical literature.

All mercury losses during amalgamation are at the same time gold losses. Improvement of amalgamation is in the vast majority of cases equivalent to higher gold recovery and higher income.

**Reduction of mercury emissions during amalgam burning**

Closed circuit retorts are the technically best solution for recovering mercury during the amalgam decomposition process. Practice has shown that practically all retorts can recover more than 95% of mercury and the best models achieve a recovery above 98%. Miners' choice of the retort design that inspires them most confidence, needs to be respected.

Fume hood approaches are a good solution for situations where miners are reluctant to use retorts for various reasons (e.g. superstition), or where conditions are not suitable for retorts (e.g. smelting of burned amalgam in gold shops). Simple fume hoods in combination with appropriate filters can recover more than 80% of the mercury. Acceptance of fume hoods is usually excellent, but requires a certain level of organization and peer pressure in the community.

**Substitution of amalgamation**

The main challenge is that a basic domestic amalgamation process can be carried

out with an investment as low as 50 USD and requiring only a couple of hours. A subsistence miner can in principle mine the ore in the morning, process it in the afternoon and sell the gold before dinner. Gold recovery through amalgamation is in the range of 40-80%.

Amalgamation can be substituted by '*Direct Smelting*' (or also called '*Borax Method*'), if concentrates of a sufficiently high grade can be produced. Recovery by direct smelting is in most cases similar, sometimes below but sometimes even better, as amalgamation. The process step to create smeltable high-grade concentrates (especially in case of larger volumes with very fine gold) is however either extremely time consuming or requires costly high-quality equipment in processing plants. The process has very low environmental impacts, but is only attractive to miners in case of coarse gold (which would not even need amalgamation if buyers accept gold dust) or if other options are excluded (as in Mongolia). The process is for that reason very rarely used in industrial mining.

Amalgamation can be substituted by '*Cyanide Leaching*'. This technological progress assembles the technical evolution of industrial mining, starting in the 1950s. Leaching can significantly improve gold recovery to over 95%. While mercury toxicity causes mainly chronic diseases, cyanide poisoning acts instantly. Miners know this and therefore handle cyanide usually with care. The fundamental difference is that mercury is a toxic '*Chemical Element*' which cannot be detoxified, while cyanide is a chemical composite which can be destroyed and detoxified, and which even decomposes by itself in presence of oxygen and ultraviolet light (sunlight). In any case, handling of cyanide and controlling the cyanidation process requires sufficiently qualified, trained operators. This is achievable.

Mostly all above solutions have two requirements in common:

- They are only feasible for organized groups of miners.
- They are only feasible for formalized miners.

## 7.2. Legal solutions for reduction of mercury emissions from ASGM

Experience has shown that prohibiting mercury use is not an enforceable environmental management approach. It drives amalgamation into clandestine spaces, which are often the miners' households, and make things worse!

A formalization process, to convert "uncontrollable" informal miners into responsible community miners is an indispensable requirement. It is important to focus on formalization as a process and through the creation of an enabling legal

framework. Restrictive legal frameworks have a similarly counterproductive effect like prohibiting mercury. It is important to understand the term of '*ASGM legalization*' not as approving a current unsatisfactory situation, but as shaping a desirable future scenario of responsible artisanal mining.

Formalization is more successful if the formalization scope is on organized groups of miners. '*Economy of scale*' is also a valid concept in ASGM and larger organized groups of artisanal miners have better chances to evolve into small-scale and eventually into higher leagues. Also for Governments, it is more efficient to administrate license areas of a smaller amount of ASGM organizations than of a large number of individual miners or workgroups.

ASGM is –per se– not a short-term rush-type activity. It is in most cases forced to be nomadic by legislators, by not enabling formalization or by allowing mineral extraction only for very short license periods. Similar to industrial mining, ASGM needs long term legal security. Miners will and can only invest in safe mine development or in processing plants for mercury reduction or substitution, if they have security of tenure over the mineral deposit and therefore the security that they will be able to recover their investment.

A gradually reduced supply and a therefore gradually rising price can contribute in principle to a faster transition of ASGM towards reduction of mercury consumption and mercury substitution. However, in view of the current rapid rise of the gold price such mechanisms mercury price would need to rise exorbitantly to be effective. Extreme short-term supply and price movements of mercury will only create new profit opportunities for those networks that already scrape the profit from ASGM gold.

In conclusion, there is no "quick fix" to the "mercury problem" of ASGM, because it is not a "mercury problem" but a formalization challenge. The only successful way forward is seen in a solid and fair formalization process.

## 7.3. Social solutions for reduction of mercury emissions from ASGM

Responsible ASGM cannot be done in an unorganized way. ASGM can only be organized if ASGM organizations are in place. ASGM organizations need to be empowered to be able to organize the extractive activity.

ASGM is a (self-)employment generating activity in remote areas, whereby the location is determined by the mineral deposit. Miners and their families create their communities and livelihoods and aspire development … still in the same way as

miners did 150 years ago by creating the gold rush settlement of Sacramento and converting it into the Capital of the US State of California. In the already existing and regulated societies of today, a broader formalization approach must support and accompany the miners in this process.

An ASGM formalization process therefore must not be limited to the pure legal aspects, but incorporate community development and broad capacity building. This creates the capacity to comply with social end environmental requirements and makes requirements enforceable. ASGM communities require equal rights and a similar level of attendance by the public sector as other communities; most "problems of ASGM" are home-made and are created by denying miners these rights, and marginalizing them.

A broad and global conversion of the currently marginalized ASGM sector into the formal economy and in conformance with mandatory social and environmental standards can only take place through a proactive and coordinated development effort by national and international decision makers. Market based voluntary social and environmental standards will strengthen this process.

## 7.4. Global solutions for reduction of mercury emissions from ASGM

The decision of the Governing Council of UNEP in 2009 to develop a global legally binding instrument on mercury and the ongoing intergovernmental negotiations are unique opportunities to not only reduce mercury emissions from ASGM but also to improve the livelihoods of more than 100 million people in the Global South.

In practical terms, the implementation of an instrument to reduce mercury emissions from ASGM, legally binding for signatory Governments, will only be feasible if Governments of ASGM countries facilitate the above-mentioned technical, legal and social solutions. Artisanal miners from Asia, Africa and Latin America, participating as observers in the intergovernmental negotiating committee (INC) in Manila signed in 2010 the joint '*Mercury Declaration*' [118], indicating responsible ASGM miner's endorsement to reduce mercury emissions considering themselves the most exposed population group, but highlighting the need for legal recognition of the sector, facilitation of formalization processes, capacity building, technology transfer and access to basic public services for ASGM communities.

Such an approach, which is coherent with lessons learnt from two decades of Swiss supported ASGM projects, needs a coordinated effort of the international development community. A globally shared right to live in a world free of mercury

contamination, requires a globally shared responsibility to support ASGM miners in their development efforts.

Without a coordinated and proactive effort to de-marginalize ASGM and to offer solutions, even accompanying measures of an international mercury treaty, such as reducing mercury supply, can only fail to produce the desired positive effects.

Figure 19: Mercury-free produced ASGM Gold from Mongolia (SAM 2010)

# 8. References and remarks

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   *In* **1999** *revised figures by ILO already indicated* **13 million** [Jennings, N.S.: Social and Labour Issues in Small-Scale Mines: Report for Discussion at the Tripartite Meeting on Social and Labour Issues in Small-Scale Mines. Sectoral Activities Programme, TMSSM/1999. ILO, Geneva 1999.].

   Some experts considered already in 2003 and **2005** figures of up to **30 million** artisanal miners and 15 million artisanal gold miners as realistic. [Veiga, M., L. Bernaudat: The Global Mercury Project (GEF, UNDP, UNIDO). Proceedings 3rd CASM AGM, Elmina, Ghana, 2003. || Veiga, M.: Global Mercury Project. GEF/UNDP/UNIDO. In Presentations of 5th CASM ACC 2005]

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    Telmer, K., M. Veiga: World Emissions of Mercury from Artisanal and Small Scale Gold Mining. In N. Pirrone and R. Mason (eds.), Mercury Fate and Transport in the Global Atmosphere, Springer Science, 2009. *(http://mercurywatch.org/userfiles/file/Telmer%20and%20Veiga%202009%20Springer.pdf)*

15. UNEP/DTIE: Study on mercury sources and emissions, and analysis of cost and effectiveness of control measures "UNEP Paragraph 29 study". UNEP, Geneva, Switzerland, November, 2010. (http://www.unep.org/hazardoussubstances/LinkClick.aspx?fileticket=BCcJWXkn0aQ%3d)

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*20.* *Weber-Fahr, M., J.E. Strongman, R. Kunanayagam, G. McMahon, and Ch. Sheldon:*. Mining. Volume 2 — Macroeconomic and Sectoral Approaches, World Bank, Washington DC, USA 2002.

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38. ICMM: ICMM Toronto Declaration, 15 May 2002. (http://www.icmm.com/document/31)

39. Op. cit. 38

40. ICMM: Working Together. How large-scale mining can engage with artisanal and small-scale miners. (www.icmm.com/document/789)

41. The term ‚artisanal' appeared later in the 90s.

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44. Project name: "Programa Manejo Integrado del Medio Ambiente en la Pequeña Minería – MEDMIN", starting in 1994.

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46. The initiative emerged from shortly earlier created „Consultative Group for Artisanal and Small-scale Mining" of the World Bank, with the same acronym CASM. (http://go.worldbank.org/6OCES521R0)

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50. Addressed by the Kimberley process (www.kimberleyprocess.com) and a series of NGO initiatives

51. The Fairtrade and Fairmined Standard is published on the websites of ARM „Alliance for Responsible Mining" (http://www.communitymining.org) and FLO "Fairtrade Labelling Organizations International" (http://www.fairtrade.net).

52. Op. cit. 43

53. Op. Cit 44

54. Mercury retorts based on the initial design of PMSC (http://www.servigema.com/manual/moa_5_4_3_2_3_1.html, http://www.servigema.com/manual/moa_5_3_3_2_3_1.html) are - as an example - currently even commercialized as "prospecting supplies" for recreational artisanal miners in the USA (http://www.abprospecting.com/id1.html).

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56. Op. Cit. 49

57. Project name: „Sustainable Artisanal Mining – SAM". (http://www.sam.mn)

58. INECE: Principles of Environmental Enforcement. International Network for Environmental Compliance and Enforcement. INECE. First Edition 1992 (http://www.inece.org/enforcementprinciples.html)

59. The MEDMIN Foundation (http://www.medmin.org), which emerged from the MEDMIN project, still uses the promoted mercury retort (op. cit. 54) as its logo.

60. Miner's arguments against retorts (http://www.servigema.com/manual/moa_5_3_3_2_3_2.html) were similar to those observed by other projects (e.g. Veiga M. et. al.: Manual for training artisanal and small-scale gold miners. Global Mercury Project, UNIDO, 2006 P.69 http://www.globalmercuryproject.org/documents/non_country%20specific/training%20manual%20for%20miners%20Marcello%2015.pdf ).

61. Op. cit. 55, Annex 3 (only in printed version)

62. "Reglamentación de la Ley 1333, Ley de Medio Ambiente" Supreme Decree No. 24176 in December 1995..

63. Ministry of Energy and Mines, Ministerial Agreement No. 217, 1994.

64. PMSC: El Plan ECO+ (http://www.hruschka.com/pmsc/ecoplus.html)

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66. According to unofficial sources due to lobbying efforts of environmental consultants for whom this model represented a grievous reduction of potential clients.

67. The initial design of the Peru project, prepared in 1999, contained a component dealing with ASGM formalization and policy advice (http://www.gama-peru.org/gama1/contenido/02-objetivos/informe-taller.pdf). Unsurprisingly, this component had to be suppressed on demand of the Government of the Fujimori regime. After democratization by end of 2000 the project was allowed to continue work in this component .

68. In Peru as a result of the economic crisis at the end oft he 1980's, in Mongolia at the end of the 1990's as a result of the economic crisis and natural disasters affecting traditional herders.

69. Prelatura de Caraveli: Proyecto de Promoción y desarrollo de los productores auríferos artesanales del distrito de Huanu-Huanu. Lima 1995.

70. Reports on gold smuggling ‚mafias' are abundant in all national newspapers … attributing the criminal activities usually to informal miners instead of the middlemen behind. A series of international initiatives to curb using the proceeds for fuelling conflicts is currently part of the international agenda. Op. cit. 33

71. In case of one SDC project even through raising of false accusations of terrorism against project staff (names withheld).

72. G.Medina, V.Nuñez, F.Hruschka: La Luz al Final del Túnel. Proyecto GAMA, Lima 2005. (http://www.gama-peru.org/gama/tiki-download_wiki_attachment.php?attId=58)

73. Ley 27651, Ley de Formalización y Promoción de la Pequeña Minería y la Minería Artesanal. (24.01.2002) (http://intranet2.minem.gob.pe/web/archivos/dgm/legislacion/LEY N_27651.pdf)

74. National Forum on Mining, Regulation, and Environment, May 24-25, 2006 (http://www.swiss-cooperation.admin.ch/mongolia/en/Home/News/News_Detail?itemID=92602)

75. Government of Mongolia: Sub-Programme for Development of Small Scale Mining up to 2015 (Government Resolution No: 71, February 27, 2008); Temporary Regulation on Artisanal Mining Operations (Government Resolution No: 72, February 27, 2008)

76. Law amendment to the Minerals Law (http://www.sam.mn/images/amendments_to_the_minerals_law eng.pdf) and Law on Land related to ASM (http://www.sam.mn/images/amendment to the law on land eng.pdf)

77. Op. cit. 31

78. Private land property in Germany is highly protected and a very respected cultural norm. In the case of the Sailstorfer's experiment (art project) Gold was hidden on private property. In order to not create confrontations, it was internally agreed that local government and police would not intervene to protect the property. The gold rush situation created by the artist caused people to trespass land rights and "forget" their own cultural norms.

79. In 2010 the president of AMASUC was elected Vice-Chair of ARM.

80. SDC: Artisanal Mining – An Alternative Income Source (http://www.swiss-cooperation.admin.ch/mongolia/en/Home/Natural_Resource_Management/Sustainable_Artisanal_Mining): " *In introducing chemical-free technology for ore-processing, SDC, in conjunction with the Mongolian government, sponsored the establishment of a mercury-free gold-processing plant in Bornuur soum, Tuv aimag, in 2008. The plant is now owned by the HAMO company and has become the soum's largest employer, providing permanent jobs for more than 60 people.*"

81. Hruschka. F.: Retorta Comunal. Proyecto PEMA, Lima 2009. (http://www.gama-peru.org/gama/tiki-download_wiki_attachment.php?attId=102)

82. Op. cit. 55; (flow sheets only in printed version)

83. "Floured mercury" = microscopic droplets of mercury, caused by choppy processing or impacts, and too small to re-join into liquid mercury; easily washed away into the tailings.

84. http://geco.mineroartesanal.com/tiki-index.php?page=Mejoras+del+proceso+de+amalgamacion+en+el+quimbalete

85. http://geco.mineroartesanal.com/tiki-index.php?page=S-01+Dise%C3%B1o+ambiental+de+una+planta+de+beneficio+artesanal

86. When mercury was banned, no technical alternative was available in Mongolia. Having lost their livelihoods, many already settled ASGM miners nationwide were pushed back to informal ninja attitudes. This is one of the few cases where permanent ASGM retroceded into shock-push ASGM. This negative process could be stopped - at least at pilot level and to demonstrate the feasibility of stable community mining - in Bornuur.

87. Op. cit. 17

88. Op. cit. 48

89. Except the extreme cases of human rights violations and exploitation of ASGM miners which are victims of conflict minerals situations

90. UNDP: Mongolia Human Development Report 2011. Background Paper: Mining Sector, 2011. http://undp.mn/nhdr2011/Background%20paper/NHDR%202011_Background%20paper%20draft%202_B.Altantsetseg%20_Mining_Eng.pdf *"Income from informal mining not only sustains households'*

*livelihood but also creates opportunities for better health care and funding their children's education. Moreover, a large number of people concentrated at one site creates demand for some services and hence creates opportunities to earn additional income for local people."*

91. E.g. in Ananea, before the situation got out of control and into a gold rush due to delaying decisions on the state owned mining license.

92. SDC: Pastureland – Mongolia's "Green Gold". SDC Website 08/2011. (http://www.swiss-cooperation.admin.ch/mongolia/en/Home/Development_Cooperation/Pasture_Ecosystem_Management_Project)

93. de Soto, H.: El Misterio del Capital. Edición Sudamericana, 2002. ISBN 978-9500722384. (currently only printed versión) "**Note**: de Soto describes the formalization process which converted local rules into written law, empowering miners and reducing vulnerabilities"

94. Bobadillo, P., D. Tarazona: Nosotros hacemos los pueblos … el empoderamiento en la minería artesanal. Ediciones Nova Print SAC, Lima 2008. (Only printed versión)

95. A Google search for "Santa Filomena SOTRAMI Peru" on 31. August 2011 produced 816 results.

    "Development support " in Santa Filomena began in the late 1990 by the Peruvian NGO CooperAcción, and the community received until about 2005 coordinated support from ILO (addressing child labour) and SDC/GAMA (addressing environmental issues and providing capacity building under an empowerment approach)

96. Op. cit. 85

97. Chinchuluun, N., T. Undarya: Situation assessment and recommendations on supporting Bornuur and Zaamar artisanal miners' associations and Ensuring human rights of artisanal miners in Mongolia. MONFEMNET, 2011 : *"In Bornuur income form artisanal miners and the HAMO company enabled the development of 2 supermarkets in the soum center. One of which is of the Ulaanbaatar quality"*

98. Garcia Larralde, E., G. Medina, M. Priester: Contruyendo concensos en la mineria artesanal. GAMA 2008. http://geco.mineroartesanal.com/tiki-index.php?page=Publicaciones+sobre+Formalizaci%C3%B3n , http://geco.mineroartesanal.com/tiki-download_wiki_attachment.php?attId=1392

99. INECE: Principles of Environmental Compliance and Enforcement Handbook. International Network for Environmental Compliance and Enforcement. INECE. Second Edition 2009. (http://www.inece.org/principles/index.html | Note: compare with Op. cit. 58

100. http://www.greengold-oroverde.org

101. ARM: The Golden Vein. A Guide to Responsible Artisanal and Small-scale mining. ARM Series on Responsible ASM Nr.1, Medellin, 2008. http://www.communitymining.org/index.php/en/the-golden-vein--english-version

102. ARM/FLO: Fairtrade and Fairmined Gold: A Unique Partnership. 2011. http://www.fairgold.org/

103. By end of 2011, all certified producers in Bolivia and Peru have been former SDC pilot sites.

104. ARM/FLO: FAIRTRADE and FAIRMINED Standard for gold from artisanal and small-scale mining, including associated precious metals. Version: March 15th, 2010. http://www.communitymining.org/index.php/en/standards and http://www.fairtrade.net/716.html

105. ARM/FTF: FAIRTRADE and FAIRMINED Gold: Empowering responsible artisanal and small-scale miners. Alliance for Responsible Mining, and Fairtrade Foundation UK. 2011. http://www.communitymining.org/attachments/134_FT_Gold_policy_report_2011_download.pdf

106. SDC: Project Document Sustainable Artisanal Mining Project (SAM), Phase 3, 2011 - 2014

107. Op. cit. 14

108. Source: Annual reports of PMSC and MEDMIN projects. Note: Both projects avoided from the outset unsustainable "free distribution" of retorts! All retorts were voluntarily bought by the miners from the manufacturers. It can therefore be safely assumed that the retorts were also used.

109. Op. cit. 55

110. Bocangel, D.: Small-Scale Mining in Bolivia: National Study Mining Minerals and Sustainable Development. IIED/MMSD 2001. http://pubs.iied.org/pdfs/G00713.pdf

111. Op. cit. 81

112. Op. cit. 85

113. Personal information from ARM

114. Op. cit. 58 | Note: *„The first step in fostering compliance is to ensure that the environmental requirements themselves are enforceable"*

115. Source: SAM reports. | Note: No tests to compare performance could be done, as mercury use was prohibited

116. Interview by author in August 2011.

117. Habegger, L.J., L Fernandez, M. Engle, J.Bailey: Technology Demonstration for Reducing Mercury Emissions from Small-Scale Gold Refining Facilities. Argonne National Laboratory. US Environmental Protection Agency. 2008. http://artisanalmining.org/casm/sites/artisanalmining.org/files/publication/ANL_EVS_TM_08-6GoldShopTechDemo.pdf

118. "THE MANILA MERCURY DECLARATION
We, miners, as the most exposed to mercury releases, recognize that mercury is a dangerous substance. Mercury releases need to be reduced, as well as its health and environmental impact minimized. However, its use is important for gold recovery process.
We consider that our mining activity generates high employment, livelihood opportunities and that extraction of minerals is contributing to local, regional and national economic development.
We embrace the commitment to:
➔ minimize and where feasible, eliminate the mercury releases of our activity;
➔ adopt over time mercury-free techniques
This commitment can only be honored if:
➔ our activity is legalized and recognized as part of the mining sector;
➔ this formalization has to be facilitated and promoted by our governments;
➔ capacity building and technology transfer programs are made accessible with our participation;
➔ basic public services and infrastructures are put in place.
Our commitment needs governments´ reciprocity to become a reality.
*UNEP Global Forum on Artisanal & Small-scale Mining*
*Manila, 8th December 2010"*

**Prepared by: Felix Hruschka**
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