



Fostering Entrepreneurship in Artisanal Mining to Build Sustainable Communities

UTEP – CENTER FOR ENTREPRENEURIAL GEOSCIENCES

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Where to Begin?... Start with People



Fondo Santa Barbara



Rinconada
Peru


DRC



Nicaragua

This Presentation

- ▶ **Introduction**
- ▶ The Bonanza Model
- ▶ Broader Perspective

- 
- ▶ Paraphrasing psychologist and humanistic philosopher Erich Fromm
 - ... *'The art of communication is saying and being understood. Whenever possible use the language of the person with whom you want to communicate.'*
 - ▶ Who is here?
 - ▶ Why are you here?
 - ▶ View of Entrepreneurship?
 - ▶ View of Artisanal mining?

Artisanal Mining is
Entrepreneurial **Survival** Mining
for 175 Million People

With unacceptable  **To affluent people**
social and environmental
practices

Help them create more value,
more efficiently with acceptable practices

Child Labor? – What Did You Expect?

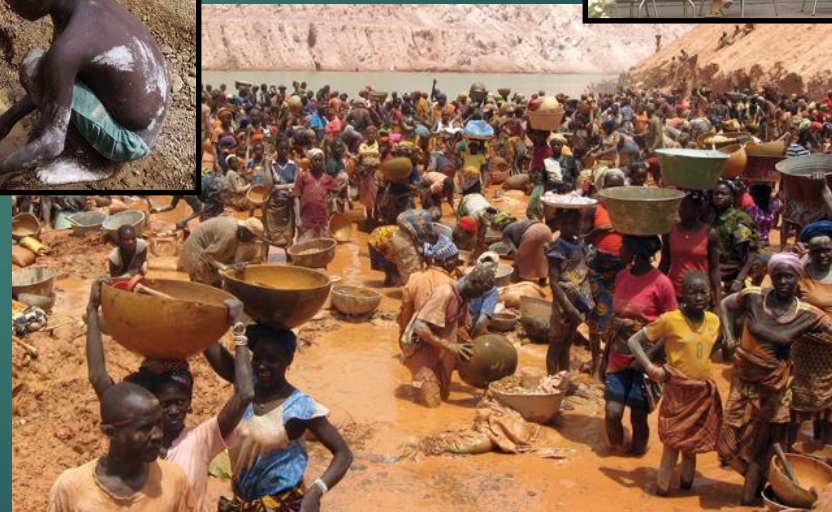


Mining, commonly male



Expand society's view point:
Is the solution to child labor making
artisanal mining illegal, or
boycotting gold? or
Building day care centers!

Day care?

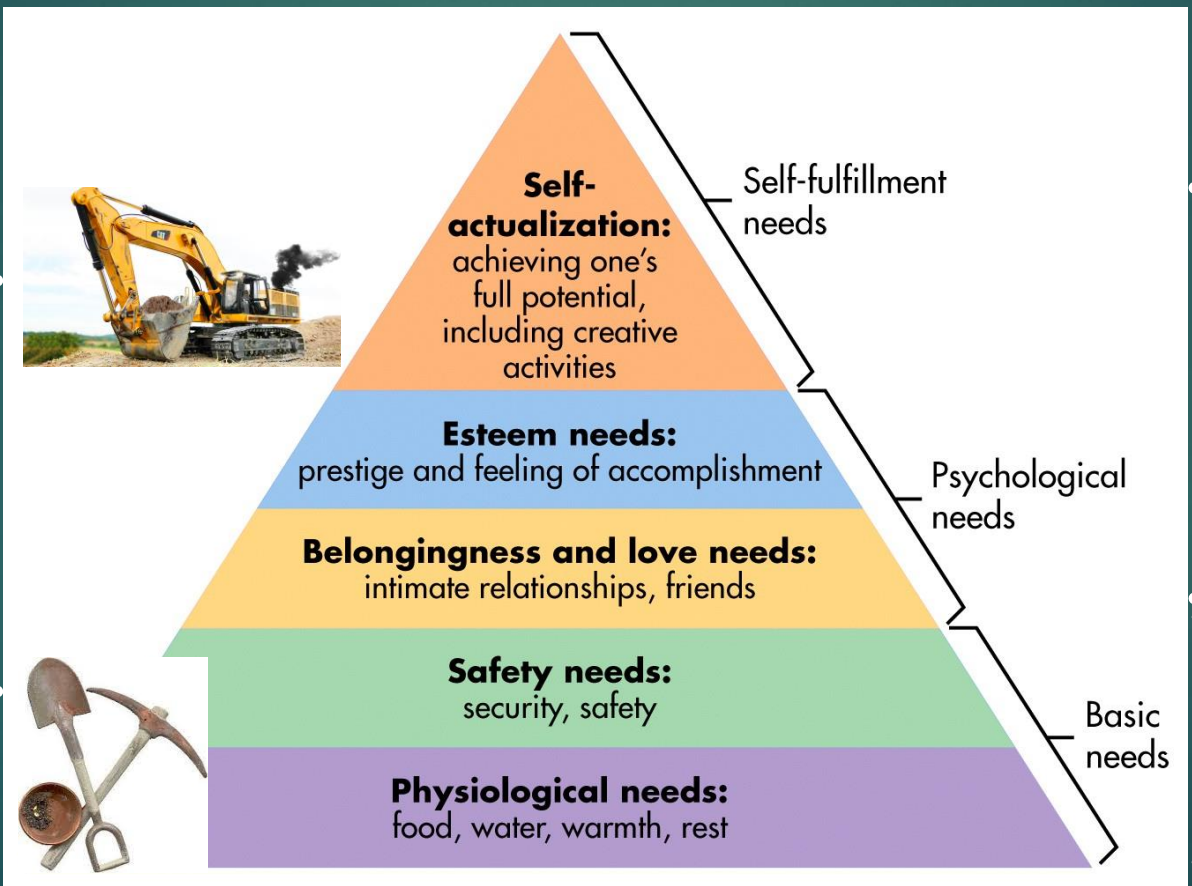


Processing, commonly female

Maslow's Hierarchy of Needs

(Theory of Human Motivation 1943)

For community based mining consider appropriate Technology (mechanization) in the context of meaningful earnings in stakeholder communities



Formal mining
4 million people
\$50-250/da

Artisanal mining
25-175 million people
\$1-10/da

Facts: 'Breaking New Ground'

The Mining, Minerals and Sustainable Development Project Executive Summary, Jan 1, 2002.

▶ **Artisanal and Small-Scale Mining**

▶ In many parts of the world minerals are extracted by artisanal and small-scale miners – people working with simple tools and equipment, usually in the **informal sector, outside the legal and regulatory framework.**

▶ There are also many artisanal mineral processors, such as diamond polishers. The **vast majority are very poor**, exploiting marginal deposits in harsh and often dangerous conditions – and with considerable impact on the environment.

▶ Small-scale mining is thought to **involve 13 million people directly and affect the livelihoods of a further 80–100 million.**

▶ A broad range of minerals is extracted by artisanal and small-scale miners, including gold, gems, precious stones, and metals.

▶ ASM is an important aspect of rural livelihoods. **It often represents the most promising, if not the only, income opportunity available.**

▶ But it can also be very disruptive – particularly when it takes the form of a sudden 'rush' causing local people to desert their farms or resulting in in-migration. When the rush is over, most of the **profits are likely to have disappeared** – while the social and environmental damages persist.

▶ The environmental impacts of ASM are of greatest concern **to many observers**: mercury pollution, direct dumping of tailings and effluents into rivers, threats from improperly constructed tailings dams, river damage in alluvial areas, river siltation, erosion damage and deforestation, and landscape destruction.

▶ A lack of awareness combined with a lack of information about affordable methods to reduce impacts and a lack of obvious incentives to change all contribute to these problems. **To many people these are unacceptable** and a sufficient reason to **ban many forms of ASM.**

▶ Chapter 13 Artisanal and Small-Scale Mining <http://pubs.iied.org/pdfs/G00905.pdf>

Crazy Talk

'Breaking New Ground'

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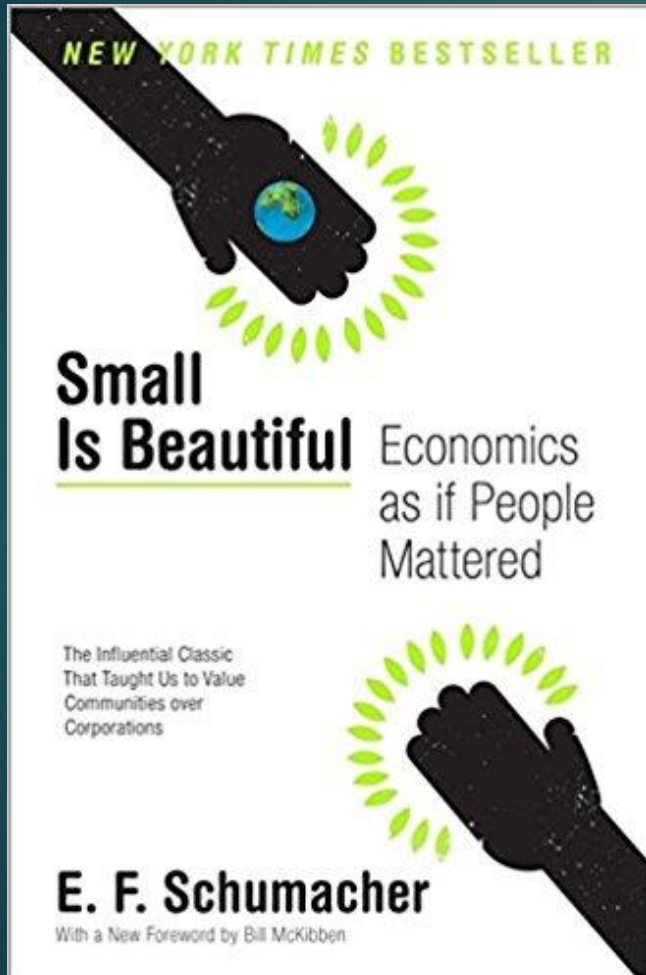
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A lack of awareness combined with a lack of information about affordable methods to reduce impacts and a lack of obvious incentives

What about survival of marginalized people in abject poverty?

- ▶ Chapter 13 Artisanal and Small-Scale Mining <http://pubs.iied.org/pdfs/G00905.pdf>

Consider Mining/Milling in the Context of *Small is Beautiful* (1st ed 1973)



The Times Literary Supplement ranked *Small Is Beautiful* among the 100 most influential books published since World War II.

Consider mechanization in the context of mining compensation:

US: \$250/da

Nicaragua: \$5/da

DRC: \$1.50/da

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- ▶ **The Bonanza Model**
- ▶ Broader Perspective

Fondo Santa Barbara



Mitigating poverty and conflict by allowing willing hands to work in meaningful and sustainable jobs.

Creating mining-based employment in marginalized communities.

Creating and sharing tangible wealth from the local geological endowment with boots-on-the-ground.

Memorandum of Understandings

- ▶ Lowell Institute of Mineral Research, University of Arizona
- ▶ Mines Ministry – Nicaragua
- ▶ HEMCO (Mineros)
- ▶ Informal
 - ▶ Community of Bonanza, Nicaragua
 - ▶ Mining Co-ops (7) in Bonanza, Nicaragua
- ▶ Non Disclosure Agreement – China Moly (Tenke Fugurume)

HEMCO Bonanza, Nicaragua

1,200 tpd



The average wage in Nicaragua is <\$5/day, and there are limited employment opportunities. FSB's Bonanza business model offers an opportunity for \$10/day with minimal barriers of entry.

Lack of economic opportunity can lead to conflict. In Nicaragua, many artisanal miners are drawn from the 180,000 combatants in the generation-long civil war.

Co-op Miners High-grading Veins



Four co-op miners working in a three-meter epithermal gold vein dipping from left to right.

The shallow portions of this oxidized vein can be worked with simple hand tools. No explosives are necessary.

Miners are selecting high-grade quartz within the wider vein and putting into white sacks seen in the lower middle of the picture.

Hand selected ore assays 3 to 30 gAu/t and averages 8 gAu/t.

Co-op Family Hand-Selecting Ore



Three members of a co-op family are breaking rocks to sort high-grade ore for shipment to the processing plant.

No specific skills are necessary to mine and sort ore. Miners learn to recognize high-grade ore.

When in doubt they can hand crush the rock and pan it to verify that it contains gold.

Young Co-op Miner Sorting Ore



A single young co-op miner is breaking ore to be transported to the processing plant.

Ore will be loaded into sacks holding approximately 60 kg. At a grade of 8gAu/t each bag will contain approximately \$20 in gold. Miners are paid for half of the gold. The balance of the value pays for processing the ore including recoupment of the capital costs.

Each co-op miner typically produces one sack of ore per day. For this they earn an average of US\$10/day per person, depending on the grade of the ore they ship to the processing plant.

Mine Workings, Co-op Miners, Road and Ore Hauling Truck



The swarm of veins with mine working can be seen traversing from the lower left to the upper right of this picture.

A simple road system has been constructed by the owners of the processing plant to assist the co-op miners with access.

The truck seen near the center of the picture will be loaded with 60 kg sacks of ore. The truck can haul 10 tonnes.

Loading Ore Sacks for Transport to the Mill



Loading ore sacks into a 10-tonne truck for transport to the processing plant.

Miners are organized in co-ops and mining teams. The co-op arranges for transport.

The operators of the processing plant pay the co-op, based on the gold contained in each 10-tonne shipment. These proceeds are then distributed by the co-op to its individual miners.

10-tonne shipments are the norm for this district. Other districts may use smaller shipment sizes, depending on the co-op and the geology.

Ore Receiving Facility for 100 tpd Mill



Ore is unloaded from each truck via a conveyor. Each 10-tonne shipment is kept separate. Ore is sampled from the conveyor belt to determine its grade. Co-ops are paid immediately for half of the contained gold. The balance of the value covers processing and capital costs.

Very sophisticated sampling methods are used to make sure that the miners understand that they are being paid appropriately. This is perhaps the most important aspect of this process. Without trust, the relationship between the co-op miners and the processing plant will breakdown.

100 tonne/day Gold Processing Plant

Hub-and-spoke.



The processing plant is very simple. It can be configured to concentrate gold or recover gold by gravity, flotation, or by cyanide leach methods.

All water is recycled. Tailings are stored in an engineered impoundment facility. If cyanide is used, it is neutralized before it leaves the plant.

The basic plant design can be modified to recover or concentrate other metals including oxide or sulfide copper.

What We are Trying to Eliminate



Miners that do not have access to a modern gold processing plant use an arrastra, such as the one shown in the picture.

This 'technology' is many hundreds of years old. Holes are drilled through large rocks which are then drug over a foundation of other rocks to grind up the ore.

In this particular case, electricity is available to drive a motor that drags the rocks in a circle. Lacking electricity, people, burros or horses are used for power.

What We Can Eliminate



Gold-mercury amalgam. Typically mercury is dumped into the arrastra with the gold ore. As the gold is liberated by the grinding action of the arrastra, it is amalgamated with the mercury. The gold-mercury amalgam is then collected and heated to remove the mercury, leaving a gold sponge for sale.

Needless to say, this process is very dangerous and very damaging to the environment. The mercury vapor is extremely toxic to the miners, and the tailings containing residual amounts of mercury are typically dumped in drainages or nearby hillsides.

What We Are Creating



We are creating an economic foundation for **sustainable communities**.

This is the community of Bonanza, Nicaragua. It is a mining community dependent on the formal and artisanal mining sectors.

Each 100 tpd milling plant provides meaningful and sustainable employment for 1,500 miners and a community of 10,000 people.

Gold mining is used in this example. This socio-economic system is readily adaptable to other metal mining including copper, lead, zinc and silver.

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Capital Efficiency To Serve Society

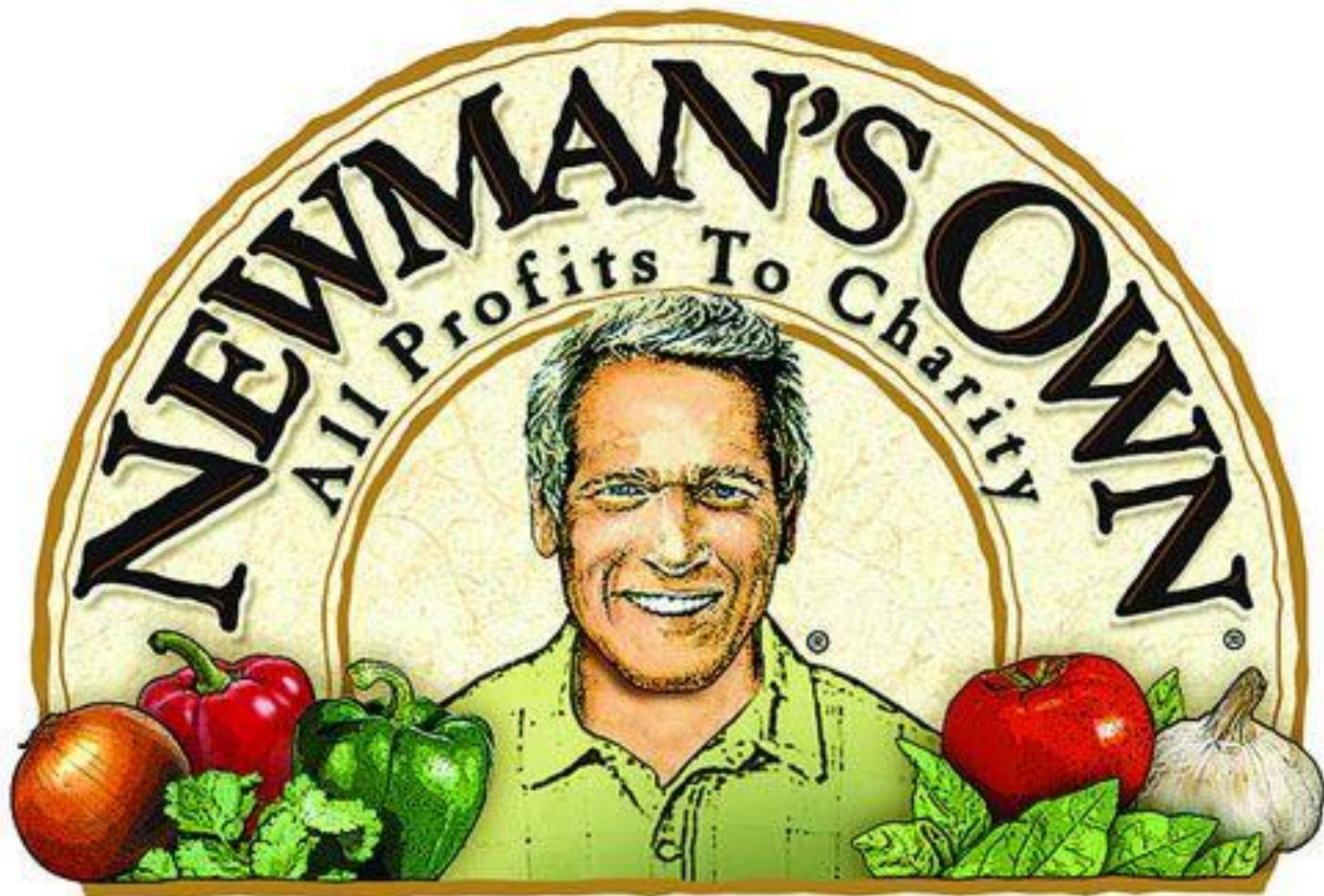
- ▶ Formal Mining: Nevada Heap Leach. nominal 1,000 tonnes/man-shift
 - ▶ 1.1 gpt, 65% recovery
 - ▶ Annual production: 65,000 oz Au
 - ▶ Capital cost: \$75 million ... **\$1,150/oz annual production**
 - ▶ Direct jobs: 200 ... **\$375,000/job** (\$65,000/yr)
 - ▶ **3 jobs/thousand ozs annual production**
- ▶ Artisanal Mining: Bonanza mill ... nominal 0.05 tonnes/man-shift
 - ▶ 8 gpt, 85% recovery
 - ▶ Annual production: 7,650 oz Au
 - ▶ Capital cost: \$5.5 million ... **\$725/oz annual production ...**
(65% of heap leach cost)
 - ▶ Direct jobs 1,500 ... **\$3,500/job** (\$2,750/yr)
 - ▶ **5,100 jobs/thousand ozs annual production**

Efficiently:
produce metal,
make profit



Efficiently:
create meaningful
jobs as foundations for
healthy communities

FSB is a Community Social Enterprise



A **social enterprise** is an organization that applies commercial strategies to maximize improvements in human and environmental well-being. What differentiates social enterprises is that their social mission is as core to their success as any potential profit.

Projects Under Review

- ▶ Guatemala
- ▶ El Salvador
- ▶ Nicaragua
- ▶ Peru
- ▶ DRC
- ▶ Ghana
- ▶ Afghanistan



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Unusually good
examples of CSR

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Entrepreneurial Exploration

Formal Mining – Artisanal Mining

- ▶ 'Borrow' a mineral right
- ▶ Pay a Royalty or Net Profits Interest
- ▶ Report geology
- ▶ Reclaim