UNEP

Gold Prices On The Rise, Environment Under Pressure

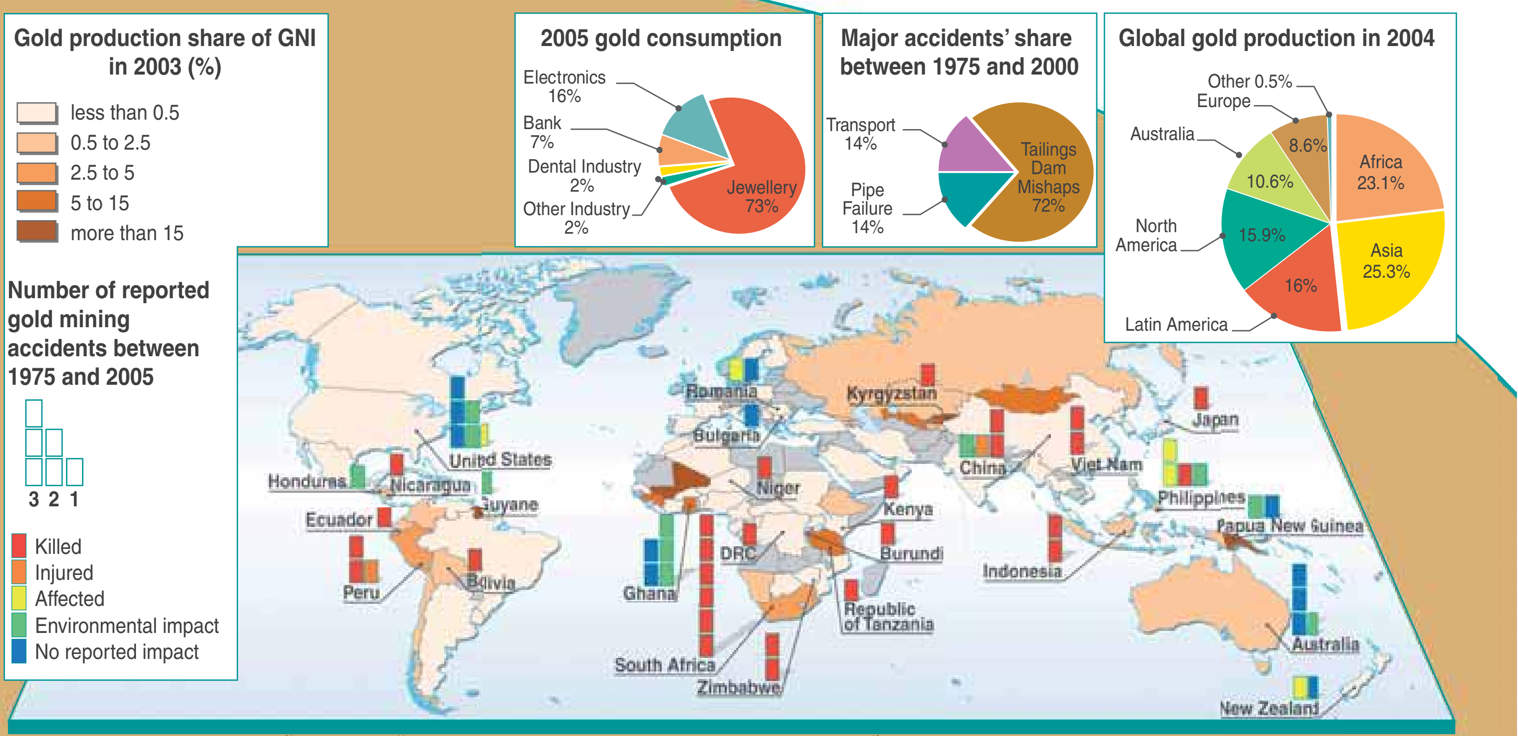
Although the gold industry is often presented as a “first foreign direct investment” leading to positive outcomes in many developing countries and securing the wealth of many nations, it is also clear that some of its practices have negative environmental impacts. The use of hazardous chemicals and the generation of large amounts of mining waste[1] often result in lasting pollution for the environment. Are such current extraction processes sustainable and, if they are, at what costs?

For the year 2005, the global end-use gold consumption amounted to 3 727 tonnes, of which 73% was used in the jewellery sector[a]. The geographic distribution of gold production is widespread (Fig.1). Extraction in developed countries is now complemented by production in developing regions, not least as a consequence of liberalisation of trade, transport expenses' decline and lower labour costs. While it can be a significant source of economic growth, gold extraction and related processes can raise both social issues (such as conflict for water and land) as well as environmental ones. Soil and water pollution (e.g. from cyanide, mercury) in gold extraction facilities' surroundings constitute a threat to human health, fauna and flora.

Despite the environmental and social concerns, global gold consumption has continued to rise, 9.6% between 2003-2004 and 6.6% between 2004-2005[a]. Gold is seen as a safe investment in an unstable global economy, and increasing demand from emerging Asia, the Middle East and most of all India, which increased its gold consumption by 47% between 2004 and 2005, means that it will continue to be a highly lucrative industry. The distribution of financial compensation after the South Indian Ocean tsunami on 26 December 2004 for example, was followed by spectacular jewellery sales, no other savings option being easily available, as the banking system access remains limited in the region[a].

Like most other mining activities, gold mining facilities have a notable impact on the landscape: open-pit (Fig.5) or gallery extraction sites, waste rock storage surfaces, tailing storage facilities, access roads and various other constructions. At the same time, with extracted ore generally having a very low gold grade (the extraction of gold required for a single ring generates 18 tonnes of waste[3]), significant amounts of energy are needed for processing the raw material.

Fig. 1: Reported accidents and revenues from gold



Data sources: Chronology of major tailings dam failures[b], Cyanide incidences[c], European Commission's Joint Research Centre, "Global Perspective of Cyanide" (T. Mudder[d]), EM-DAT: The international disaster database, USGS Mineral Information, The World Bank, World Gold Council

Sources of pollution

Transport

The transport of hazardous compounds, such as cyanide, mercury, explosives or fuel, constitutes, in the case of an accident, a risk for the environment and for local population (a coffee spoon of a cyanide solution at 2% is sufficient to kill a human being[(2)]). In 1998, two tonnes of sodium cyanide ended up in a river after a truck accident at the Kumtor gold mine (Kyrgyztan), and more than 1 000 people had to be hospitalised[(3)]. In June 2000, 150 kg of mercury, by-product of the Yanacocha gold mine in Peru, leaked from of a truck along 43 km of road. 925 people were affected, either by picking up what they thought to be a valuable material, or when employed by the gold mine to clean up the leak without appropriate protective equipment[(4)]. In Papua New Guinea that same year, a river was polluted by cyanide leaks from a helicopter[(5)]. While these events resulted from transportation failures, they are closely linked to the gold extraction industry.

Fig. 2: Mining waste unloading

The following satellite images show the Ok Tedi mining area in 1990 and 2004. Due to land instability, the company is not able to maintain a proper waste dam and, as a result of this, directly dumps mining waste in the near-by rivers. The dumping of heavy metal-bearing sediment poisons aquatic life and the release of large amounts of sediments disturbs watercourses and obstructs hydrologic systems. Similar processes can take place along ocean shores, seriously threatening coastal ecosystems as well as the health and economy of coastal populations. Even though international agencies such as the World Bank have condemned such behaviour and refused to fund industries which act irresponsibly, there continue to be firms refusing to comply with international standards.

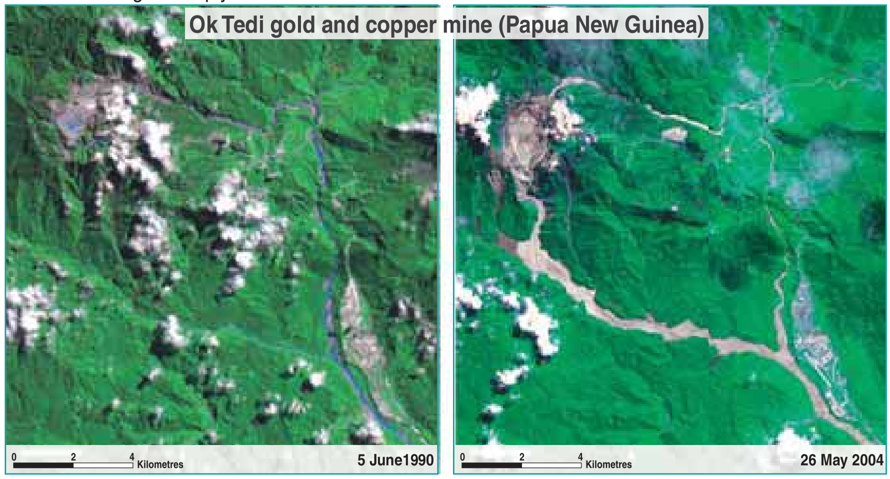


Image Source : "One Planet, Many People: Atlas of Our Changing Environment", UNEP, 2005

Ore processing

Different techniques are used to separate gold from the surrounding ore material. The most commonly used today by the industry is spraying crushed ore with a cyanide solution that dissolves gold. The gold concentration in the solution rises as it circulates through the ore's porosity. The solution is subsequently collected and undergoes treatment to extract the diluted gold. The solution can then be re-used for other extractions. However, the recycling process is not 100% efficient, and ore residues (mining waste) hold a cyanide content that can possibly affect the environment if not properly managed, neutralised and disposed of (Fig.3 pt.2).

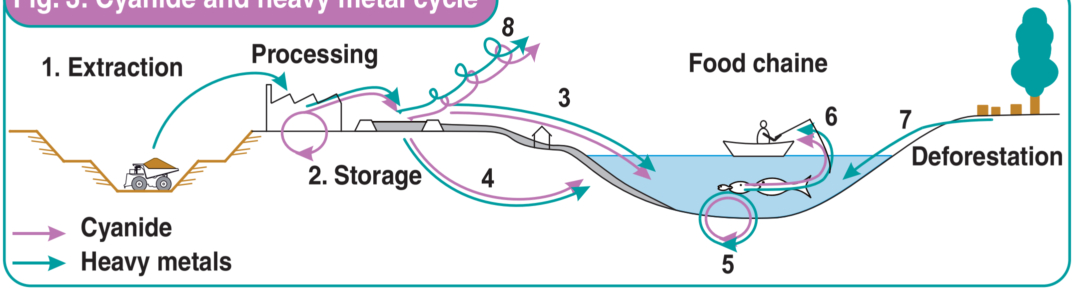
Even if the use of mercury has been abandoned by large-scale gold mining companies, it is still common in small-scale mining, which accounts for approximately 20% of global production[(6)]. The environmental impact of small-scale mining production is recognized as higher than that of industrial mining, since each unit of gold is produced in a more harmful way than when gold is produced through large-scale, high-tech industrial processes[(3)]. Mercury contaminates rivers and soils during manual ore separation, and is also a source of air pollution when it is evaporated from the solution to recover gold. In addition, health threats due to poorly managed mercury-based gold extraction to workers of small-scale mining companies, globally estimated at 13 million people, is also an important issue to consided[(7)].

Waste

Along with a generally low gold grade, the extracted gold ore often holds large quantities of sulphidic minerals (Fig.3 pt.1) which, once in contact with air and water (Fig.3 pt.2), produce acid. This in turn releases heavy metals contained in the ore (mainly arsenic, cadmium, lead). Mining waste consists of an ore mud called "tailings", which often contain a high concentration of toxic elements. Waste storage on mining sites is generally done behind tailing dams (Fig.2) which may engender two types of threats, one short-term and one long-term. The first threat, spectacular and newsworthy, is the breaking of the dam, followed by a dramatic downstream pollution event (Fig.3 pt.3). Six major accidents of this kind have been reported since 1991[(b)]. The second threat is a slow onset and less visible one, occurring through the permanent leaching of acidic waters and/or toxic elements into ground and surface waters (Fig.3 pt.4). As the tailing's volume increases due to mine exploitation, the dam's structure (solidity and permeability) remains difficult to maintain.

In developing countries, gold mining companies are less likely to see the rehabilitation of polluted areas as their responsibility, and therefore do not even try to minimize the long-term environmental impacts of their activities (Fig.5). In some industrialised countries, where mining projects are required, by law, to allow funds for a complete site rehabilitation and sanitation, budgets for environmental recovery are systematically underestimated. As a consequence, for example, it has been estimated that between one to 12 billion US dollars from public funding, will be necessary for the clean-up of all the United States mining sites[(8)].

Fig. 3: Cyanide and heavy metal cycle



Consequences

Landscape modification due to mining facilities (Fig.2 and Fig.5), as well as chronic water pollution and hazardous mud slides after tailings dam failure are but a few notable repercussions that can result from mining practices. Other harmful consequences are explained below.

Water contamination

Water contamination remains undoubtedly the biggest threat from gold mining operations. The accidental release of material containing high concentrations of cyanide (such as the Baia Mare leak, Romania, in 2000[9,10] and the truck accident in Kumtor, Kyrgyztan, in 1998[2]) which result in the death and/or contamination of most of the aquatic life of affected rivers, along with human beings and animals, and leave water unsuitable to drink. Even if a majority of mining operators agree that cyanide degrades and disappears within a few days after an accident in water and through the effect of sunlight, being an organic compound, it also easily combines with living organisms[2], and thus accumulates in the environment along with heavy metals such as those coming from soil leaching after deforestation took place (Fig.3 pts.5 et 6).

Unlicensed and unregulated small-scale mining facilities (artisanal miners) often use mercury to extract gold. Such operations often lead to dumping mining wastes, containing mercury, into the nearest surface water bodies where toxic mercury accumulates within living organisms through the food chain. The consumption of fish with high rates of mercury can lead to neurological complications for humans, as well as an increase in cardiovascular diseases and cancers[6].

Such pollution can remain as a potential environmental threat for many generations. For example, the current Rio Tinto river pollution in Spain is a result of silver and gold mining activities during the Roman and Phoenician age[4].

Air contamination

Ever since environmental legislation was prepared to reduce greenhouse gas emissions, the mining industry sector has been working to adapt its technology. This sector, however, remains one of the most demanding in terms of energy needs, and therefore continues to cause a high impact on global environment. Mines are also responsible for emission of large amounts of dust into their surroundings, as in the case of Johannesburg, South Africa, for example[6].

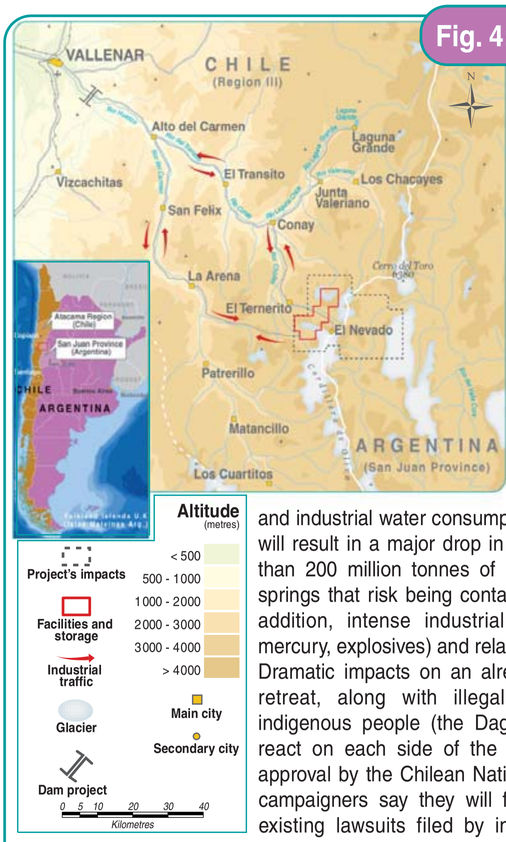
Soil contamination

Soils can be contaminated by heavy metals and by substances containing cyanide or mercury, either directly on the mining facility site, or via contaminated waters and air pollution coming from the mined ground (Fig.3 pts.3, 4, 8). Soil erosion caused by soil washing processes, and aggravated by deforestation, can result in the release of noxious substances from the earth, which in turn contaminate downstream rivers and lakes (Fig.3 pt7).

Other consequences

Dumping mining wastes directly into rivers (Fig.2) will firstly add sediments to the river and threaten the aquatic ecosystem's stability. Secondly, the hydrologic system can be affected so that streams are deviated and dry areas become flooded, increasing threats to biodiversity and the local population. Thirdly, large amounts of water either withdrawn or disposed of by mining activities have an impact on groundwater flows directly under the mining ground or in nearby surrounding areas (Fig.5).

Fig. 4: Pascua-Lama mining project



A gold, silver and copper mining pit project is planned on the border of Chile and Argentina. 75% of the deposit is in the Huasco province of Chile, and 25% in the San Juan province of Argentina. The project plans to implant facilities between 3000 and 5200 metres, affecting three vital glaciers, source of rivers supplying farming activities in low lands as well as the city of Vallenar of more than 40000 inhabitants in the Atacama desert.

Extraction operations call for huge investment and large-scale technological devices, making their potential impact on the environment a concern for the region. The company is planning to cut out and transfer nearly one million tonnes of ice, and industrial water consumption estimates are as high as 400 l/s, which will result in a major drop in water resources for downhill regions. More than 200 million tonnes of mining waste will be stored close to river springs that risk being contaminated with cyanide and heavy metals. In addition, intense industrial traffic of hazardous material (cyanide, mercury, explosives) and related risks will emerge from the industry. Dramatic impacts on an already fragile arid ecosystem due to glacier retreat, along with illegal land expropriation processes towards indigenous people (the Daguitas) have brought local communities to react on each side of the border. Despite recent (early June 2006) approval by the Chilean National Environment Commission (CONAMA), campaigners say they will file further lawsuits. They will also pursue existing lawsuits filed by indigenous rights groups who contest the company's ownership of the property.

Sources : "El ABC del Proyecto Pasca-Lama", Observatorio Latinoamericano de Conflictos Ambientales and Mining Watch Canada.

Solutions

Various international organisations have started information campaigns about environmental damage caused by gold mining (UNEP[e], UNCTAD[f], The World Bank[f]...), as well as a range of governments and NGOs (No Dirty Gold[d], Oxfam, Earthworks). They are however counter-balanced by the gold industry's publicity[b]. International legislation needs to become more robust, and organisations which have the mandate to control legal aspects of gold mining require more support. The introduction of a quality label for processes that are respectful of social

(continued)

Fig. 5: Kalgoorlie gold mine

Kalgoorlie "Super Pit" is the largest gold mine in Australia. It is 4 km long, 1.5 km wide and 500 m deep. On January 30, 2004, the Western Australian Government confirmed allegations from surrounding community members that cyanide leaking from tailings dams was affecting the surrounding groundwater.

conditions and environmental impacts could also be beneficial. Such initiatives will only emerge via a strong public demand. In 2005, 3 727 tonnes of gold were employed[g] while "only" 2 590 tonnes were extracted by the gold mining industry. That is, a lack of gold reserves already leads to a 35% rate of recycling, reuse and storage reduction[g]. Last but not least, a wide range of more friendly technologies is available, from extraction to processing, which could significantly reduce the environmental impacts of gold mining.

arge scale mining

The final volume of mining waste could potentially be reduced by using more of it for land fill in the construction sector, or by mixing wastes of different sizes. However, the re-use or recycling of hazardous mining waste needs to be preceeded by a very strict impact study after which well-tested practices should be implemented[3].

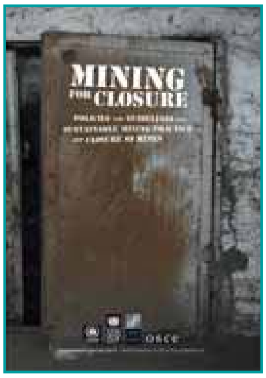
A range of alternative technologies, such as hydrometallurgical techniques or biotechnologies using bacteria[12,13] have emerged as possible substitutes for cyanide and mercury, and are starting to be used by the mining sector. Biotechnologies are also used for the decontamination of mining waste[14]. However, the potential environmental impacts of such technologies have not yet undergone a thorough review, and therefore cannot yet be applied on a large scale. The rise of gold prices in stock markets along with technological advances has prompted the mining of ore with lower concentrations, thereby leading to reopening of old mines and former mine waste sites for a second, more thorough extraction, while at the same time generating more profits[11].

Small scale mining

Even though alternative solutions for recycling and recovering mercury exist (e.g. filters, condensation), technology transfer to small-scale mining is often difficult due to lack of training, insufficient financial resources and the illegal character of most of the sector. Setting up a simple ore treatment facility has been successfully done in Venezuela, offering various benefits including a noticeable decrease or complete elimination of the use of mercury, minimisation of negative health and environmental impacts, improved efficiency and less private implication. Such sites can also be a place for education and awareness-raising regarding environmentally-friendly mining practices. Fair-trade projects are also resulting from some initiatives, which have a more responsible social and environmental approach.

Fig. 6: Closure of mines

UNEP, UNDP, NATO and The Organization for Security and Co-operation in Europe (OSCE) jointly published a report on abandoned mines and their closure in South Eastern Europe and the Tisza River Basi[11]. The studies confirm that in order to leave a mining site environmentally and socially safe, closing measures and costs should be evaluated and anticipated even before opening the mine, and must be followed until its closure. The report also details examples of follow-up uses for former mining sites and infrastructures including fish farming basins, schools, and recreational areas.



gislation

No specific international legislation is currently in place for the mining industry. However measures exist that can be applied to this sector, particularly when signing countries adapt their national legislation. At the same time, documents are available such as guidelines[15], codes[h,i] and international charters published by private entities[j], UN agencies (UNEP, WHO, ILO, World Bank) or NGOs (Oxfam, Earthworks) to provide a preliminary framework. Unfortunately, compliance with such codes and guidelines are subject to the decisions of individual mining companies. Thus advocacy, greater information and public awareness campaigns will be necessary in order to bring about more sustainable gold mining practices, as well as a reduced jewel production.

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d A Global Perspective of Cyanide at www.mineralresourcesforum.org/initiative
e UNEP/DTIE Production and Consumption Branch on Mining at www.unep.fr/pc/mining
f Mining Environment and Development CD-ROM at www.natural-resources.org/minerals/cd
g USGS Mineral Information at http://minerals.usgs.gov/minerals/pubs/commodity/gold
h The International Cyanide Management Code at www.cyanidecode.org
i The Equator Principles at www.equator-principles.com/principles.shtml
j International Council on Mining and Metals at www.icmm.com

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