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Small-Scale Mining in Bolivia: National Study Mining Minerals and Sustainable Development

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Summary

A wide range of different types of operations come under the category of small-scale mining in Bolivia, from formally established mining operations capable of moving large volumes of ore, to informal mining carried out by clandestine ‘gravel scratchers’.

Most small-scale mining activity is carried out by cooperatives, although there are also private companies and concession holders involved in the sector. Many mining cooperatives work year round and rely on mining as a full-time means of subsistence. However, climatic conditions and the temporary availability of water also obliges other miners to abandon their camps and look for alternative sources of work at certain times of the year. In the south of the country, for instance, the population tends to combine mining with agricultural activities.

Women play an important role in small-scale mining. Women’s work mainly involves gathering and hand picking the ore, breaking it up with sledgehammers or crushing it with *quimbaletes* (semi-circular stone-filled rockers). Children also help their parents with these activities, and are often expected to work to the limits of their physical endurance. Because of this the International Labour Organization began implementing its IPEC programme (International Programme on the Elimination of Child Labour) in Bolivia in August 2001.

During the course of last five years, important pieces of mining legislation have been passed in Bolivia, introducing new development concepts and procedures to the small-scale mining sector. The most important of these include the Mining Code, tax regulations affecting small-scale mining activities and a specific decree for the mining sector regarding the payment of annual patents and tax obligations. Important steps have also been taken with respect to environmental regulations, in particular the Environmental Law, the Environmental Regulation for Mining Activities and further complementary decrees which establish the time-scale for the presentation of an environmental certificate (a document that allows operations to get an Environmental Licence).

Yet the small-scale mining community still pays scant attention to environmental standards. There are several reasons for this. The Bolivian government does not provide any financial incentives to encourage environmental protection. Most small-scale mining operations are located in remote areas which makes it extremely difficult for the understaffed Environmental Unit to monitor, never mind control, what is happening on site. Pollution from mines contaminates land and cattle, but the farmers are bribed by the miners to keep quiet. Also, the small-scale mining sector, and cooperatives in particular, lack formal organization and transparency. They are characterized by unpredictable seasonal closures and frequent changes in leaders and representatives, making it difficult for anyone to be held accountable.

The MEDMIN Programme (now the MEDMIN Foundation) was established in 1994 to support environmental protection measures, with a particular focus on the small-scale mining industry. It is financed by the Swiss Agency for Development and Cooperation and the Ministry of Planning and Sustainable Development. It has carried out research into the environmental impacts of different sorts of small-scale mining and tested and distributed

economically viable technological alternatives to help protect the environment while at the same time supporting the miners and helping to increase their levels of productivity.

Table 1. Number of People Employed in Various Mining Sectors 1989–1998

Year	State mines	Medium-Scale Mines	Small-scale Mines	Co-op Mines	Total
1989	70,385	7,448	4,397	14,000	44,500
1990	73,514	8,056	4,415	12,500	48,543
1991	74,946	7,817	4,300	11,000	51,829
1992	70,980	6,412	3,540	9,000	52,028
1993	62,914	4,257	2,937	3,000	52,720
1994	59,994	2,847	2,819	3,500	50,828
1995	52,465	1,500	3,187	3,605	44,173
1996	56,029	1,473	3,345	3,731	47,480
1997	51,256	1,200	4,036	3,700	42,320
1998	(p)* 46,921	1,200	3,353	3,600	38,768

Source: Annual statistics VMMM 1998 *(p) = preliminary figures

Definitions:

- State mines: large-scale mining operations that were state owned and run by the Bolivian Mining Corporation (COMIBOL) from 1952 until the minerals crisis in the 1980s. Now closed.
- Medium-scale mining: operations treating more than 500 tons per day. This category includes operations that in other Latin American countries would be considered to be large scale.
- Small-scale mining: mining operations treating less than 500 tons per day. This category includes private companies, cooperatives and artisanal mining.
- Mining cooperatives: these belong to small-scale sector, but for the purpose of this analysis are separated according to their specific characteristics. They tend to be small groups of between 50 and 80 workers that come together to work on a concession granted by the state. In the majority of cases, cooperative mining is synonymous with artisanal mining.
- Artisanal mining: although this term is rarely used in Bolivia, it can be taken to include groups of workers who use little or no machinery in the extraction and production process and consequently have very low production levels. This category can include cooperatives and small-scale private companies.

Economic Role of Small-Scale Mining in Bolivia

Employment

The main contribution that the small-scale mining industry makes to the national economy of Bolivia is the employment it generates. The number of people employed in the cooperative sector has increased from about 20,000 people in the early 1980s to about 50,000 people by the early 1990s (see Table 1). It should also be noted that these statistics only refer to those people employed in legally recognized mining operations. There is also a significant (but as yet uncalculated) number of people working in illegal mining activities (mainly gravel scratching and tailings).

Current statistics show that artisanal mining provides 85 per cent of the employment generated by mining industry as a whole (see Table 2), as compared to only 30 per cent in the 1980s. This increase came about because a large number of mine workers employed by the state-owned COMIBOL mines were made redundant in the 1980s. The medium-scale mining sector meanwhile increased its production through intensive capital investment in

technology, which reduced the demand for manual labour in this sector. The small-scale sector has responded to these changes by absorbing the available labour and rapidly grown in size as a consequence.

Table 2. Percentage of Workers in the Bolivian Mining Industry Working in the Artisanal Mining Sector (Mainly Cooperatives) in the Last 20 Years

Year	Percentage
1981-1984	32.80
1985-1988	55.08
1989-1992	60.67
1993-1996	84.40
1997-1999	85.53

The 50,000 workers belonging to the National Federation of Mining Cooperatives also indirectly create further employment, increasing the total number of people employed to approximately 175,000. Among these are administrative workers, women miners, vendors of various products within the camps, traders of mineral products, legal advisers, school teachers, technicians and mining and metallurgical professionals.

Gross Domestic Product

In 1996, the gross domestic product (GDP) of the mining sector had a negative annual rate of growth of 3.86 per cent compared to the 1995 GDP (Bs.1,123,434,000). This contraction was due to the fall in international metal prices and a drop in the production of minerals such as zinc, gold, silver, lead and copper. In 1997, the mining GDP began a recovery which was maintained until the first half of 2000, when the growth rate of the mining GDP reached 5.81 per cent due to the increase in production of the above-mentioned minerals.

Table 3 shows the annual percentage values of the most important minerals in relation to the total production value within the various mining sectors until 1995.

Production Methods and Environmental Impact of Small-scale Mining

In order of the scale of production (greatest first), the metals worked by small-scale miners are: zinc, tin, lead, antimony, gold, wolfram and copper. The exploitation of non-metallic substances such as ulexite, boric acid, barytes, amethyst and arsenic trioxide are also important to the small-scale mining sector (see Table 4).

The most common types of small-scale mining operations in Bolivia are:

- Traditional cooperatives working tin and wolfram.
- Cooperatives in working in alluvial gold deposits.
- Cooperatives working in primary gold deposits.

- Informal mining (gravel scratchers, individual miners, tailings re-treatment, 'pirquiñeros').

Together these mining operations provide 27 per cent of the direct and indirect employment generated from national mine production.

Table 3. Values of Most Important Minerals as a Percentage of Total Production Value

	1982	1986	1990	1994	1995
<i>COMIBOL mines</i>					
Zinc	8	9	36	28	34
Tin	72	69	37	72	66
Gold	0	0	0	0	0
Silver	12	17	20	0	0
Others	8	4	7	0	0
<i>Medium-scale mining</i>					
Zinc	12	34	57	26	35
Tin	58	27	7	1	1
Gold	1	5	12	53	44
Silver	5	9	12	13	12
Antimony	9	20	5	3	4
Others	14	5	7	4	4
<i>Small-scale mining and cooperatives</i>					
Zinc	4	2	16	17	21
Tin	55	47	40	33	24
Gold	20	15	31	22	26
Silver	6	9	6	18	19
Others	14	27	18	10	10

Small-scale miners work under extremely difficult conditions. They move in to extract the little that is left from mine deposits already abandoned by large- or medium-scale operations due to low reserves or because they are no longer profitable to investors. The cooperative members are lucky if they are able to eke out enough money to live on from this activity and are often forced to put their whole families to work with them.

In terms of its impact on the environment, the small-scale mining sector generally causes more damage than the medium-scale mining and production industry. Furthermore, in the small-scale industry, large numbers of contaminators tend to be concentrated in small areas, leading to very severe localized environmental pollution. For example, in the San Simon region, in an area approximately 20km by 5km about 25 tons of mercury used in the gold-mining process contaminates the environment every year. Muddy material produced by the concentration of the alluvial gravels leads to more damaging impact on the environment.

About 40 per cent of the tropical national parks are threatened by mining projects and activities, although in this case, the small- and large-scale mining sectors are equally to blame in terms of the danger they present to protected areas.

Although the environmental pollution caused by mining is an issue regularly raised by the Bolivian media, the statistics available vary from one institution to another and there is no

comprehensive information available on the scale of environmental contamination and the damage caused to ecosystems and local people.

Traditional Cooperatives Working Tin and Wolfram

Traditional mining cooperatives work tin, wolfram, lead/zinc/silver complexes, antimony and bismuth deposits. They mainly work old COMIBOL mines and are composed of ex-workers from the national corporation. In some cases, several large cooperatives work the same deposit where several thousand workers are concentrated (for example, between 6,000 and 8,000 in the Cerro Rico de Potosi mine).

Some of these miners sell their ore to private mechanized milling plants, which process the material using crushers, mills, concentrating tables or even flotation methods (such as in the case of complex ores in the city of Potosi). Other miners carry out their own primitive concentration procedures using *quimbaletes* (rocking crushers), straw washers, hand jigs and buddles. Such procedures would particularly be used for tin and wolfram.

Small-scale and cooperative miners working the Cerro Rico mine in the city of Potosi extract around 1,000 tons of lead/silver/zinc ore per day. This material is concentrated in 35 flotation plants situated in and around the city. Of this, about 200 tons is recovered as usable metal. The remaining 800 tons is discarded as tailings, 30–40 per cent of which is made up of pyrite. The waste material from the flotation plants not only contains sulphurous solids, but also flotation reagents (collectors, frothers and cyanide) and appreciable quantities of dissolved heavy metals (zinc, lead, cadmium, copper and iron) that have been contaminating the Pilcomayo river basin for many years.

The cooperative workers located in other ex-COMIBOL mines such as Siglo XX, Viloco and Kami tend to process their own ore extracted from the mine in outdated concentrating plants. As they do not have any tailing-retention systems, most tailings (usually containing pyrites) are discharged directly into the rivers. The outdated flotation system employed uses reagents such as sulphuric acid, xantates and diesel oil to separate the pyrite from the cassiterite. Lack of training often results in excessive quantities of these reagents being used, which again end up going straight into the rivers.

The *relaveros*, who treat old tailings, use the same outdated flotation technology. They also often destroy tailings dams previously built by the large-scale mining companies in order to recover some of the value still contained in them, and subsequently throw the new tailings into the local rivers.

Traditional cooperatives also discharge highly acidic waters charged with heavy metal ions emanating from mine tunnels, dumps and tailings straight into the rivers. It is, however, unclear as to whether this practice is solely the responsibility of the cooperatives or if it was inherited from COMIBOL.

There are also a considerable number of small mining companies that work the traditional minerals. They are mainly centred in antimony mines (some gold bearing), but also work on complex ores of lead/silver/zinc and some of tin and wolfram. Generally these

companies have mechanized processes for extraction and concentration, but treat less than 50 tons per day.

Table 4 Production of Mineral Concentrates by the Small-scale Mining Sector in Bolivia (Jan to Dec 2000) (in US\$)

Description	Values (US\$)	Unit	Small-scale mining			Cooperatives			Total
			Volume	Value (\$)	%	Volume	Value (\$)	%	
Totals	431,111,058			64,153,121	14.88		89,805,514	20.83	
Zinc	168,049,812	FK	16,798,601	18,925,098	11.26	27,713,962	31,222,210	18.58	149,134,278
Tin	67,657,107	FK	2,458,888	13,266,216	19.61	5,065,690	27,497,725	40.64	12,463,937
Gold	107,723,167	FK	442	3,960,185	3.68	1,818	16,295,598	15.13	12,001
Silver	69,100,448	FK	91,446	14,576,563	21.09	80,993	12,910,340	18.68	433,592
Antimony	1,589,698	FK	1,593,798	1,319,601	83.01				1,906,668
Lead	4,318,659	FK	1,917,241	869,945	20.14	998,317	452,985	10.49	9,552,994
Wolfram	1,897,718	FK	119,493	471,062	24.82	361,896	1,426,656	75.18	481,389
Copper	199,434	FK	109,654	199,434	100				109,654
Bismuth	46,292	FK	5,675	46,292	100				5,675
Ulexite	4,647,798	NK	33,951,463	4,647,798	100				33,951,463
Boric acid	2,706,203	NK	7,068,491	2,706,203	100				7,068,491
Borax		NK	2,270	5,500	100				
Arsenic trioxide	178,440	NK	318,000	178,440	100				318,000
Barytes	223,100	NK	3,050,000	223,100	100				3,050,000
Slate	82,463	GK	269,155	82,463	100				269,155
Sulfur	7,126	NK	29,390	7,126	100				29,390
Amethyst	772,434	NK	319,571	772,434	100				319,571
Granite	3,531	GK	51,000	3,531	100				51,000
Marble	642,935	NK	672,764	642,935	100				672,764
Tantalite	409,608	NK	9,443	409,608	100				9,443
Ametrine	17,803	NK	142	17,803	100				142
Natural Salt	106,662	GK	327,150	106,662	100				327,150
Rose quartz	3,288	NK	51,000	3,288	100				950
Others	711,834	GK	672,764	711,834	100				217,290

FK = Fine kilograms

NK = Net kilograms

GK = Gross kilograms

Although some of these operations do have primitive tailing dams, the environmental degradation caused by the emission of acid mine waters, flotation effluents and solids into the rivers is serious. Many of these companies employ mining and metallurgical engineers, but they are more concerned with production levels than with protecting the environment.

Cooperatives Working in Alluvial Gold Deposits

Small-scale alluvial mining was extremely common a few decades ago but is now mainly concentrated in the Tipuani and Kaka river basins. The alluvial deposits are generally worked by open-cast methods, although in some cases by deep-timbered shafts that penetrate loose gravel. The operations range from manual ones (in tunnels in the old courses or with small pumps along the river beaches), to small- and large-scale mechanized operations and the

techniques used vary accordingly. In the smallest manual operations, miners have to enter tunnels crouching and use picks and shovels to work at the deposit. Gold gravel is transported out of the mines in bags and wheelbarrows.

The larger mechanized underground operations, on the other hand, have as many as 500 workers in terraces or in river beaches with heavy equipment such as bulldozers, rear excavators, shovel loaders and dump trucks that can move up to 2,000m³ per day. Although most small-scale operations cannot afford such expensive equipment, such mechanized operations are still considered to belong to the small-scale mining category because of the cooperative structure of the workforce.

Once material has been extracted from an alluvial deposit, the coarse material is eliminated with the help of static or vibrating screens. The gold is then extracted from the gravel using sluice boxes, which are generally made of wood and are between 60cm and 90cm wide and 10m and 25m in length. Gold traps consist of a layer of *tojilla* (cobblestones) or metallic riffles. The coarse gold from the sluice box preconcentrates is recovered directly by panning and the fine gold is extracted by amalgamation with mercury. Amalgamation is either carried out manually or mechanically in amalgamation drums or small cement mixers. Retorts are usually used to separate the mercury from the amalgam. Mercury emitted as a result of these processes is very damaging to the environment.

Large cooperatives using heavy modern equipment to move large volumes of material (sterile and gold bearing) generally dump the remaining material into rivers once the gold has been extracted. This practice has a serious impact on the environment: the large volume of mud being dumped into the rivers alters their natural course; terraces and fertile beaches are being destroyed and turned into sterile heaps of stones; and nothing is being done to restore either.

Where cooperatives work the tertiary channels, extraction is carried out by mining underground using compressors, drills and explosives. In many cases, entire hills are destroyed to remove the overburden. The gold-bearing material is washed down by large volumes of water, muddying and blocking the rivers that run at the base of the hill or mountain and consequently causing serious destruction of the landscape.

Cooperatives Working in Primary Gold Deposits

Some cooperatives work primary gold (hard rock) deposits that contain gold quartz veins generally accompanied by metallic sulphides or oxides. The gold is present in a visible form in the quartz and is also intergrown with the sulphides.

The veins are worked both manually with the help of compressors and pneumatic drills and broken with the use of explosives. Production and development is not usually executed systematically; preference is given to the richer zones, which are frequently exploited using dangerous methods, without leaving adequate pillars and using large unprotected stopes.

Various methods are used in the preparation of the ore and gold purification. The most rudimentary involves breaking the ore with sledgehammers followed by grinding it with wet or dry *quimabaletes*. When this approach is used, it is common practice to combine the

grinding with mercury amalgamation. The amalgam is then separated from the quartz by panning.

Jaw crushers, ball mills or Chilean mills are used in the concentration plants. The first steps in this process are carried out with the aid of sluices with cobbles or riffles. The next steps employ jiggers (particularly hydraulic Baltar jiggers), concentrating tables or amalgamated sheets. Such plants are capable of dealing with 2 to 20 tons per day. It is also common to add mercury to the Chilean mills or ball mills, thereby grinding and amalgamating simultaneously in the same unit. Plants employing this method do not go through further stages of concentration and the gold is recovered in the form of an amalgam from the milling device.

The use of mercury by primary gold cooperatives has serious environmental consequences. The intense grinding in the milling systems pulverizes the mercury (flouring) into tiny particles, making it incapable of forming into an amalgam. The miners are therefore obliged to use more mercury (frequently ten times the volume of gold recovered). As almost no mines have tailing ponds, the floured mercury ends up in the rivers with the rest of the tailings.

Another problem related to this outdated mining method is that only a small percentage of the potential value held in the gold deposit is actually recovered. Environmental pollution can be decreased while gold production is increased (to the financial benefit of the miners) by improving the production processes. For instance, gold and mercury are traditionally separated from the amalgam by 'burning' in the open air. In many cases it has been possible to improve this system by introducing retorts manufactured in local workshops.

Some miners store part of their tailings in impromptu, unprepared or undesignated areas without respecting the surrounding landscape. The sulphuric acid produced by the oxidation of the sulphides seeps out carrying dissolved heavy metals to the surrounding areas.

Gold produced by the cooperatives and private companies is sold freely on the open market. It is estimated that small-scale mining operations in primary gold deposits yield about five tons of gold per year — an important contribution to the Bolivian economy — but the environmental costs of such operations are very high.

Informal Mining

Informal mining is carried out by individuals or groups without concessions. They work on a temporary basis in any type of deposit using outdated methods and equipment. There are several types of informal miners. The *jukus*, for instance, enter mines during the night and extract high-grade minerals. The *palliris* search for high-grade material in mine dumps. The *relaveros* work old tailings belonging to COMIBOL or to private companies. The *pirquiñeros* work primary veins in abandoned mines.

Most of the gravel scratchers or *barranquilleros* who work in primary and secondary deposits are also informal miners. Some follow in the wake of mechanized cooperatives to work their tailings using pans or small sluice boxes. These miners are very mobile and appear quickly in

large numbers when a cooperative finds an area rich in minerals. They even invade the producing pit, thereby jeopardizing the work of the cooperative. Others find their own locations outside the cooperative concession area, such as at the banks of gold-bearing rivers, where they remain for longer periods. Some of these own their own small motor-driven suction pumps and sluice boxes.

As they mainly work fine gold, the *barranquilleros* often develop their own techniques for recovery that are more efficient than those used by the mechanized cooperatives. They use appropriate fabrics and small sluice boxes that are just wide enough to recover fine gold efficiently, but they also use mercury to extract gold from pre-concentrates. Although the small-scale and the manual nature of their work means that the river does not get so churned up, the indiscriminate use and burning of mercury in the open air severely contaminates the atmosphere and water.

Income of Small-scale Miners

Despite their hard work, miners employed in the small-scale sector earn barely enough to survive. Cooperative members make on average only \$2.4 per day, while in a highly mechanized mining operation, wages can reach \$1,500 per day. When mineral prices are low, a cooperative member would be lucky to earn a monthly income of Bs233, which is less than the minimum monthly wage of Bs400. An entire family might make about Bs700 per month. (These statistics were provided by Cerro Rico cooperatives in June 2001.)

Despite this situation, people continue working in mines because they are unable to find alternative stable employment. Mining cooperative members live in constant hope that metal prices will recover. When prices do rise, members who had previously abandoned their jobs are not allowed to return.

The cooperatives working in gold mines are better placed economically as the price of gold has not declined substantially in recent years. Cooperatives and small companies working wolfram and scheelite also have better incomes due to the recent increase in the prices of these minerals.

In certain areas, such as Atocha and Tupiza, the inhabitants are traditionally agricultural workers but become miners when economic conditions are favourable. During most of the year they combine agricultural work with mining.

The Role of Women in Small-scale Mining

As described above, there are two important sectors within the small-scale mining industry in Bolivia. One sector includes tin and various other metals, previously produced by the large mining companies. The other is the more lucrative gold sector, which is at present central to the small-scale industry.

Women work in both sectors and carry out a range of roles. Some women are active members of cooperatives with full rights; some are 'representatives' (substitutes for members who work for an agreed salary); others are 'volunteers' who perform the same work but only

receive a remuneration equivalent to 20–30 per cent of what they produce in their shift. At the bottom of the ladder are female traders and gravel scratchers, who perform precarious clandestine work, as well as the *palliris* (hand pickers).

There are more than 100 mining cooperatives in Bolivia with over 60,000 members. Of these members, about 7,500 are women who make up the Association of Women Miners. Many more women work unofficially in the mining industry. For example, more than 8,000 women work under extremely difficult conditions in the gold mines north of La Paz. These women work excessively long hours at high altitudes. They often have to work in contaminated water with no protection. They earn very low wages and have no social protection or any hope of improvement.

The *palliris* select and gather the discards from the concentration plants or mines, washing the material themselves in order to extract small quantities of mineral (principally tin). They also select and pick material from dredging discards. Some women work in alluvial pits down to depths of 20m, extracting metal-bearing gravel with picks and shovels. All gold-extraction work is difficult and painful, especially for the gravel scratchers. The life expectancy of these women is rarely more than 40.

Because the picked material is low grade, the *palliris* will also often crush and concentrate the material selected from the minerals produced by cooperatives from old mine workings. Although they work independently, they are sometimes associated with the cooperative with which they work. The *palliris* earn no more than 25 per cent and mine caretakers between 55 and 66 per cent of the official minimum wage. Many *palliris* are widows of miners. Widows who are employed as caretakers at mines often also work as *palliris* in their spare time to supplement their wages. Miners' wives sometimes work as *palliris*, but they do not get paid. Their work simply increases their husbands' earning capacity.

Another group of women working in the small-scale mining industry are the retail buyers, who also work as intermediaries between the *palliris* and wholesalers. The wholesalers, in turn, accumulate small quantities of ore for sale to treatment plants or smelters. Some of these women have their own capital; others are financed by the wholesalers. Although, strictly speaking, this activity is illegal as the women have no licences, it is a common practice within the cooperatives as it frees workers from having to negotiate with ore buyers.

Child Labour

Many children in Bolivia are put to work from an early age. Unfortunately there are no reliable statistics relating to the numbers of children working in the mining industry. According to International Labour Organization statistics, for example, there are least 369,385 economically active children between the ages of 7 and 14 in Bolivia. Research carried out by IPEC estimates that about 120,000 children and adolescents under the age of 18 may be involved in small-scale mining activities in Bolivia. The National Institute of Statistics (NIS), on the other hand, indicates that there are approximately 800,000 child and adolescent workers in Bolivia. Of these the NIS estimates that 29 per cent live and work in urban areas while 71 per cent work in rural areas, mainly in mining.

Whatever the exact figure, it is clear that although the Children's and Adolescents' Code (1999) specifically prohibits them from working in dangerous and unhealthy occupations (such as in quarries, underground, mine tunnels and other hazardous places), it is very apparent and widely accepted that child and adolescent labourers are becoming more, not less, common in the mining industry.

Child labour in mines is mainly in response to extreme poverty. Families must increase their income if they are to meet even the basic needs of subsistence. This situation is exacerbated by the economic depression in the mining industry and the high unemployment levels and depressed state of the Bolivian economy as a whole.

One of the reasons behind the lack of statistics on the participation child workers in the mining industry is that the work performed by children is considered as 'help' or 'support', rather than work that should be paid in relation to the effort and sacrifice put in. Yet, however it is defined, such work is not only a consequence, but also a cause of poverty. Children that leave school in order to work are condemned to continue to be lowly paid for the rest of their lives.

The following shows the types of work most commonly undertaken by children in mines:

Work area	Occupation
Underground	Gathering and transport of ore after blasting Handling, preparation and use of explosives
Concentration	Ore processing, sometimes with chemical reagents without adequate protection
Grinding	Grinding the ore extracted from the mine with primitive equipment (rocker mills)
Tourist guides	Guiding groups of tourists underground to explain mining work

Traditionally, certain groups have placed particular emphasis on child labour. Among the *jukus* who enter the mines at night to extract ore, it has recently been discovered that children are used to enter small-diameter tunnels or ventilation shafts that are inaccessible to adults. Also, female *palliris* who search for rocks with mineral content in the mine dumps often work together with their youngest children. The *relaveros* who work the old COMIBOL or private mine tailings use children to transport the material, and in the drying and manipulation of the concentrates. Finally, *pirquiñeros* who work primary veins in abandoned mines use children in all phases of extraction and ore purification.

Health

Evidence given by cooperatives and backed up by occupational health studies shows that the environmental conditions that miners work in can have a serious impact on their health. For example:

- Silica and rock dust can cause fibrosis.
- Inert dust from carbon and emery can lead to respiratory problems.

- Asphyxiating elements such as carbon monoxide and hydrogen cyanide can mix with haemoglobin in the blood to impede oxygen transport. Hydrogen sulphide in particular produces respiratory paralysis.
- As some mines are more than 5,500m above sea level, the miners cannot stay at the camp for more than 15 days as they will then get headaches, swelling, elevated red corpuscles and high blood pressure.
- The fact that many of the mines are distant from the camps and food has to be transported over mule tracks leads to problems with the quality and amount of food that does reach the miners. In addition to this, lack of hygiene in handling the food leads to diarrhoea and more serious outbreaks of infection in the camps.
- Many cooperatives work mines in the cold mountain climates which results in frequent influenza, colds, eye irritations and rheumatism.

Health services are now run by municipalities. These lack sufficient experience or funding to provide an effective health service. This situation is exacerbated by the health risks associated with mining activities and the long distances and poor roads between mine camps and health centres. At best, companies and cooperatives have health centres only capable of dealing with the most minor accidents and health problems.

The fact that neither the services nor the medicines offered by the Ministry of Health are free is particularly detrimental to the health of the small-scale mining community and to child labourers in particular.

External Support for the Small-scale Mining Sector

The Danish Agency for Development Assistance (DANIDA) funds a programme that is administered and co-ordinated by the central government through the prefectures and principally deals with the city of Potosi and the surrounding region. The prefecture of Potosi has put various projects out to tender. One such project is the 'Monitoring and classification of water accumulations in the city of Potosi and its environs'; while the La LAVA project involves the re-installation and maintenance of a water-treatment plant to treat water from the tailings of concentration plants. These and other projects are divided into several phases and extend to the end of 2003.

DANIDA has also recently prepared a study investigating the feasibility of a programme to help prevent environmental contamination caused by mining activities in the Province of Sur Chichas in the Department of Potosi.

The Canadian International Development Agency (CIDA) and the government of Quebec (Canada) have a development programme with the Vice-ministry of Mining and Metallurgy which propagates industrial safety for mining generally, and for small-scale mining in particular. An environmental project analyses different aspects of small-scale mining with an emphasis on economic and technical pre-feasibility studies for mining operations. Their reports include 'Geo-information studies in Bolivia and indicators for measuring the impact that mining has on the environment, the population and the economy of the city of Potosi'.

They have also been involved in the preparation of a series of basic guides on safety in the mining industry.

The World Bank and the Nordic Fund subsidizes the Bolivian government for running the Environment, Industry and Mining project, which also covers the small-scale mining industry. This project has, however, run into problems and been criticized for the fact that although various feasibility reports have been written, there is little evidence of any practical action.

As a result of complaints, the project has recently been reviewed and priority has been given to the practicalities of addressing the contamination of micro-municipal basins by the small-scale mining industry, particularly by improving relevant infrastructure. The dissemination of three environmental guides for the mining sector: *Guide for Handling Tailings*, *Guide for Managing and Monitoring Mine Waters* and *Guide for Obtaining Environmental Licences* has also been highlighted as a high-priority activity for the forthcoming year.

The International Labour Organization through IPEC is now addressing problems specifically related to children working in small-scale mines in Bolivia. The main action zones are the city of Potosi, Llallagua (Potosi) and Tipuani (north of La Paz) as large numbers of children work in the mines of these areas. The programme carries out national and local studies to record systematically the experiences of child labour and current means of intervention, and distributes the resulting information.

The IPEC small-scale mining programme should help to promote a process of sustainable development in Bolivia. It will contribute to the elimination of child labour and prevent more children from entering the mining industry in the future. Its main areas of activity are:

- The improvement and expansion of social services for workers (education, health, nutrition).
- The implementation of low-cost alternative technology to replace child labour in the mines and improve the working conditions of their parents.
- The development and implementation of programmes to increase total family income, with the emphasis on the employment of women to replace and prevent child labour.

APEMIN (an EU-funded programme for small-scale mining in Bolivia) provides technical assistance and financial support to small-scale mining operations working in ex-COMIBOL mines in Oruro. Its main undertaking to date has been to reduce the migratory flow from the depressed areas on the Altiplano to urban areas and to areas where illegal activities (such as the cultivation of the coca leaf) are rife.

APEMIN's aim is to increase the income and improve the working conditions of small-scale miners and generally help to regenerate the local economy. The project in Oruro has been running for three years, and there are plans to extend its remit to cover La Paz and Potosi, although as yet there are no official statistics with which to evaluate its impact. In particular APEMIN focuses on:

- Mine works support: funding equipment and appropriate machinery; partial financing for mine and metallurgical work; technical, administrative and environmental training; loans for working capital.
- Regeneration and expansion of employment opportunities: labour training and creation of artisanal workshops; support for small- and medium-scale companies; promotion of non-traditional activities such as non-metallic production, eco-tourism and the creation of local service companies to provide machinery, maintenance, repair and transport to the mining industry.
- Basic infrastructure: drinking-water and drainage for municipalities; health support; education and means of communication.

APEMIN also funds credit for working capital which is administered by FONCRESOL-CEPAS (Episcopal Commission for Bolivia). According to CEPAS, nearly \$216,000 worth of loans have been granted so far. In contrast to the MEDMIN-CEPAS fund (described below), the FONCRESOL-CEPAS credit committee has approved and disbursed 14 of the 17 applications it has received for APEMIN credit. The beneficiaries of APEMIN loans are involved in a broad spectrum of mining activities including working tin, making jewellery, volatilising antimony concentrates; producing copper oxy-chloride and copper sulphate and processing lead and silver ores. This diversity can, however, make it difficult to predict what impact the credit will have on their businesses. A report to APEMIN covering the period up to 31 August 2001 indicates that of the 14 loans granted, only four companies/cooperatives had managed to repay their loans. The rest were either running up interest, in serious arrears or facing legal action. One-quarter of the loans had been written off as unrecoverable and this figure may rise over time.

The Swiss Agency for Development and Cooperation (SDC) finances the MEDMIN programme (Integrated Environmental Management in the Small-Scale Mining Sector in Bolivia). This programme continues in the form of the MEDMIN Foundation, which gives technical assistance, credit and funding to certain aspects of small-scale mining.

MEDMIN (Phase I, 1994–1997) identified, manufactured and introduced technology to help protect the environment and improve production in the mining industry. In a post-project evaluation this project was criticized for putting too much emphasis on improving ore purification and concentration plants and disregarding other aspects of mineral production. As a result, MEDMIN has now started to identify measures to improve both mineral production and the quality of life for underground miners.

MEDMIN itself is supported by two other funds. One is the Fondo Lamellas which provides the gold-mining sector with a 50 per cent subsidy and the traditional mining sector with a 100 per cent subsidy for the installation of clarifiers for mill tailing waters to prevent contamination downstream. The other fund is jointly managed by MEDMIN and CEPAS, and provides 50 per cent of the funding (total funding is \$200,000) for credit to small-scale mining operations and mine-reactivation projects.

The fact that CEPAS have had experience of bad debts in administering the APEMIN fund, however, has made them extremely cautious in granting loans from their own money. As a result, the bureaucracy and regulations involved in actually gaining access to credit has meant

that few miners have actually benefited from this fund to date. A year after the fund's establishment, of the 34 applications received by MEDMIN, the San Lorenzo company was the only company actually to have received credit. To get it, the company had to produce a range of documents including a market guarantee for the sulphur they were producing (contracts for the duration of the credit), a mortgage guarantee (a house in the city of La Paz or El Alto) and a technical-assistance contract for the project covering at least the loan repayment period.

It is very difficult for most small-scale mining operations to satisfy these sorts of conditions to access such credit. The vast majority of potential loan applicants are put off from even applying. While the initial idea was that it should be a rotating fund, with money from repaid loans going to another applicant, it is clear that at present the system is not working. Other options as to how the fund should be administered, such as providing grants that do not have to be repaid, are being seriously considered.

The MEDMIN Foundation (MEDMIN Phase II, 1997–to date) has aimed to increase productivity while reducing the environmental damage caused by small-scale mines. Activity has been focused on helping the small-scale mining community to implement and comply with environmental legislation by developing new equipment and techniques, and on providing training and support to various state institutions, academic and private entities, as well as to the mining communities themselves.

Phase II of the MEDMIN programme started in 1997 and, in order to ensure its long-term sustainability, one of the first tasks was the creation of a new MEDMIN Foundation. The foundation receives international backing from the SDC and advice from the German consultancy firm Projekt Consult GmbH.

Any new methods and equipment to be introduced are first tested thoroughly by the miners, in order to assess their performance and profitability as well as their role in protecting the environment. Various pieces of equipment have been introduced by the project including retorts for mercury distillation (60 retorts have been sold), hydro-separators, amalgamation drums, jigs, spirals and more. Upwards of 20 primary gold-mining cooperatives have also had their concentration plants either modified or rebuilt by MEDMIN in order to avoid the use of mercury in open-flow circuits.

The emission of mercury by the small-scale mining industry has been reduced by more than five tons per year through these measures. Air, soil and water contamination have been reduced. There has also been a 10 to 20 per cent increase in gold recovery.

Measures introduced by MEDMIN in primary gold mines have led to a reduction in the emission of sulphides by about 300 tons per year. The construction of several tailing ponds has prevented ground solids (sand) being released into the rivers and the addition of mud into the rivers has also been reduced by the installation of the first water clarifying system.

In addition to these practical environmental measures, MEDMIN has produced a series of socio-economic and health studies which provide information on the effects of pollution on miners and local people and also provide other social and economic information relating to small-scale miners.

MEDMIN has based its understanding of the problems and potential solutions relating to small-scale mining and the environment on seven detailed research studies carried out in the most important gold-producing regions in Bolivia. Its aim is to reduce environmental destruction in all regions where there is small-scale mining within a medium-term time period. It is successful so far because it has identified, developed and provided successful alternative technological solutions which small-scale miners can afford and that improve both the quality of the environment and living standards for the miners.

Relationship between Small-scale Miners and Medium-scale Exploration Companies

Small-scale mining companies and cooperatives can sometimes have difficult relations with the larger companies when both work in the same concession area.

Agreements can be negotiated to overcome some of these difficulties. For example, in San Simon an exploration company has signed an agreement with a company of small-scale miners. As a result of negotiations, the company agreed: to suspend all legal action against the small-scale miners; to grant the small-scale miners the right to exploitation and purification of the ore under certain conditions (defined zones, maximum daily production, no heavy equipment); and to assist the small-scale miners in acquiring another mine concessions.

The small-scale miners, on the other hand, agreed: to legalize their corporate status with the assistance of the company; not to jeopardise the exploration activities of the larger company; not to increase the number of their members; and not to sign any agreements with third parties.

By mid-1998, the larger company had complied with its part of the bargain and although the small-scale miners had not been able to comply fully with their side, there were good relations between the two sides. The company would certainly not initiate legal action for fear of the social problems this could produce.

Laws and Regulations Governing the Mining Industry

In Bolivia, the most important laws governing the mining industry are:

- Article 171 of the Political Constitution of the State.
- Relevant provisions laid down by the International Labour Organization and ratified by Law 1257 of 11 July 1991.
- The General Environmental Law, passed as Law 1333 in April 1992.
- The Mining Code passed as Law 1777 in March 1997.
- Environmental Regulations for Mining Activities approved by Supreme Decree No. 24176 in December 1995.

In addition to these laws, there are also further regulations:

- General Regulations for Environmental Measures.
- Regulations for Environmental Prevention and Control.
- Regulations for Atmospheric Contamination.
- Regulations for Water Contamination.
- Regulations for Activities with Dangerous Substances.
- Regulatory Decrees of Law 1606 (Supreme Decrees 24049-24051 relating to VAT and company profits tax, passed 29 June 1995).
- Supreme Decree 24780: observance of the payment of mine patents and tax obligations (31 July 1997).
- Supreme Decree 24785: validating the National Policy on Co-financing.
- Supreme Decree 25419: the first series of deadlines for the mining sector to present Environmental certificate (document required before obtaining environmental licence (11 June 1999).
- Supreme Decree 25877: second series of deadlines for the mining sector to present Environmental certificates (24 August 2000)
- Law 1129-World Bank Credit 2013-BO: established \$26,000,000 credit with special rotational rights under concessional conditions over a 40-year period (with a 10-year grace period) and 0.75 per cent annual interest. The credit must be used for the rehabilitation of the mining sector.

Policy Changes Affecting the Mining Industry in the Last Ten Years

The monopoly over commercial minerals and metals was held by the Banco Minero de Bolivia (Bolivian Mining Bank), which acted as a retention agent until 1985 when the market was opened to imports and exports. This was confirmed by the new Mining Code (1997) which declares ‘free and unrestricted the possession and commercialisation of minerals and metals by any individual or collective group of persons, national or foreign’.

The Investment Law, enacted by Jaime Paz Zamora’s government (1989–93), grants the same rights and obligations to foreign investors as to nationals and guarantees freedom to contract services and protect investments. With respect to small-scale mining, no form of private monopoly is to be accepted and a legal framework was to be established for joint venture contracts.

President Gonzalo Sanchez de Lozada (1993–7) created the Ministry of Sustainable Development and Environment in November 1994. The current president changed this to Ministry of Sustainable Development and Planning and has granted environmental licences for mining operations through the ‘General Administration of Impact Quality and Environmental Supervision’, which comes under the Vice-ministry of the Environment, Natural Resources and Forestry Development.

During the presidency of Gonzalo Sanchez de Lozada the Ministry of Mines and Metallurgy became the Vice-ministry of Mines and Metallurgy within the Ministry of Economic Development. Law 1606 (December 1994) created a universal tax system for mining activities and established a minimum mine patent.

The new Mining Code of March 1997 changed the law regarding domain and mine concessions. Whereas property had previously been measured by the hectare, the new unit of measurement became the 'grid' or 'square', each composed of 25 hectares. The new system helps to avoid the frequent legal disputes caused by overlapping concession areas.

Article 45 of the new Mining Code states that concession holders and those engaged in mining activities should use systems and technology compatible with the protection of the environment. Chapter I of Title VII of the code develops this concept further and lays the foundations for the development of the Environmental Regulations for Mining Activities of July 1997.

Supreme Decree 25419 was passed in June 1999 in an attempt to enforce the 'Regulations for Environmental Prevention and Control'. This decree established time periods within which those involved in various mining activities should be able to present their environmental certificate (document required before being granted an environmental licence): gravel exploitation by August 1999; open-pit and alluvial exploitation by October 1999; and traditional mineral exploitation by December 1999. Although this decree was widely publicized, it was not a success. Most mining operations — small-scale operations in particular — continue to function without an environmental licence. In August 2000, Supreme Decree 25877 was therefore passed stating that August 2001 was the new deadline within which the environmental statements should be presented. However, the measure had by now lost its force and most members of the small-scale mining community were unaware of this latest extension.

Due to these failures the government is now looking into other strategies to help promote mining (and small-scale mining in particular) in accordance with the principles of sustainable development. Alternative strategies are being jointly reviewed by the Vice-ministry of Mining and Metallurgy and the Vice-ministry for the Environment, Natural Resources and Forestry Development. At the time of writing, however, no specific details were available to publicize.

Article 22 of the Mining Code declares that the state will establish mechanisms to help develop the small-scale and cooperative mining sector through technical and developmental assistance and through financial support. It also states that it will establish incentives for the mining industry to promote the protection of the environment. However, the fact that by May 2001 there were still no effective policies in place to achieve these aims led to serious social unrest. On 8 June 2001, thousands of miners arrived in La Paz demanding that the government comply with Article 22. As a result of the violent demonstrations that left five people seriously wounded, the government signed a 16-page agreement with the Federation of Mining Cooperatives.

The government's commitments included:

- An allocation of \$23 million for the regeneration of the small-scale mining sector.
- The provision of new concession areas for mining.
- To grant the miners ex-COMIBOL machinery.
- To incorporate miners in the ‘Law of the Dialogue’.
- To provide machinery that miners could pay for over a longer period of time.
- The formation of 7 teams with 25 technical experts to provide permanent support to the small-scale mining industry (with an emphasis on environmental and industrial safety projects).
- The construction of more roads through the National Highways Service.
- Interest and fines to be waived on all short-term insurance contributions in arrears.
- More homes provided through a special commission.
- Cooperatives to have to pay the Complementary Mining Tax at only 0.6 per cent of product value.

It was agreed that there would be a further meeting in 90 days to evaluate progress.

Appendix I

Official Definition of Small-scale and Artisanal Mining

Neither the Mining Code nor the ‘Environmental Regulations for Mining Activities’ take different types of small-scale mining into account. They make reference to concession owners and mine operators but do not classify the scale of mining operations in relation to the type of technology employed. The only distinction made by the Environmental Regulations is that operations that extract less than 300 tons per month have fewer environmental requirements.

The ‘Mining Strategy for Latin America and the Caribbean’ defines medium-scale mining as those operations that reach between 1,000 and 5,000 tons per day and that have annual sales worth between \$10 million and \$100 million. While there are some small-scale mining operations that extract over 1,000 tons per day, none has annual sales above \$10 million. Artisanal miners are considered to be small-scale miners with little or no mechanization.

Although mining in Chile and Peru generally fits into the categories described above, the situation in Bolivia is slightly more complex. This is due to the fact that until the mid-1980s, large-scale mining was synonymous with the state-owned (COMIBOL) operations. All large private operations were considered to be medium-scale mines.

This is still the case even though the COMIBOL mines are no longer in operation. It is therefore considered that there is no large-scale mining in Bolivia; rather, there are three important mining associations: The National Association of Medium-Scale Miners, The National Association of Small-Scale Miners and the National Federation of Mining Cooperatives.

The medium-scale mining sector in Bolivia includes all operations exploiting over 500 tons per day. Within this sector the largest operations are two new joint ventures: Inti Raymi (an open-pit operation) and COMSUR (underground and open-pit mining). Although these two companies would be defined as large-scale mines according to the Mining Strategy for Latin America and the Caribbean definition, in Bolivia they are categorized as medium-scale mining.

In Bolivia, small-scale mines are considered to be operations that exploit less than 500 tons per day. A fundamental part of the economic movement generated by small-scale mining is cooperative mining. The Mining Code takes this into account in articles 20 and 21, where the terms 'societies', 'mining companies' and 'cooperative mining societies' are used. The Mining Code specifies that mining cooperatives must be legally constituted and have the same obligations and rights as those laid out in the General Cooperative Law.