Health

AN ECOSYSTEM APPROACH

Mining, Contamination, and Health in Ecuador

Research leads to action to improve human health

Gold has been mined for centuries in the hills of southwestern Ecuador. Today, the mining is small scale but the problems it brings are large — unsafe conditions, environmental contamination, and harm to human health. Researchers are studying the impact of mining activities in several communities along the Puyango River. They have found that the effects extend beyond the immediate area to farming families living downstream. Two communities are now taking steps to address the problems.

FUNSAD: Andre Betancourt

Dr Oscar Betancourt administers the family questionnaire about river use and health.

"Mining goes back a long way. We are the children of miners. Our grandparents were miners as well."

"We are surrounded by contamination. But we have been a little bit blind — this is the first time in the history of this town that there has been an environmental group to help solve this problem. Maybe we are a little bit late, but at least we have it now."

These are the words of Alexandra Jaramillo, a member of the newly created municipal authority formed to deal with the environmental and health problems spawned by small-scale mining in the Ecuadorian towns of Zaruma and Portovelo. This municipal authority — the first in the long history of the two towns — was formed in response to research supported by Canada's International Development Research Centre (IDRC). Working in a transdisciplinary team, researchers investigated the links between mining activities, environmental contamination, and human health. Not only are the people of Zaruma and Portovelo affected. So too are the populations living downstream of the Puyango River, which wends through the area and empties out into Peru, more than 100 kilometres away.

Mining in Zaruma and Portovelo

The hills of Zaruma and Portovelo have been mined for gold and silver for centuries — the Incas were extracting gold in the area when the Spanish founded the town of Zaruma in 1549. However, the extraction of gold went into high gear when an American mining company, the Southern American Development Company (Sadco), gained control of the district's main gold deposits in 1897. In the 53 years that followed,

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Sadco recovered some 3.5 million ounces of gold and 17 million ounces of silver from 8 million tonnes of ore.

When Sadco left the country in 1950 in the face of increasing costs and taxes, the Ecuadorian government took over the mine. But it yielded ever-diminishing returns and eventually the mine was abandoned. In 1984, poverty-stricken miners invaded the old Sadco pits and small-scale and artisanal mining has been going on in the area ever since. There are now hundreds of small gold mines in the area.

FUNSAD: Oscar Betancourt

Panning for gold: hard work for few returns, and potential health risks.

These mines are unsafe, poorly ventilated, and hot — and there is the constant threat of cave-ins.

Using simple tools and equipment, men and boys as young as 12 spend long backbreaking hours dislodging ore. They often work with family members or in informal groups, purchasing materials such as dynamite and wood to shore up the walls and ceilings to prevent cave-ins during explosions. They then split the profits derived from whatever gold they manage to find. It's a hit and miss business — some months they don't find enough to break even.

While small-scale mining is hazardous in and of itself, the processing of gold can be toxic. When miners hit a strike they can separate the gold from ore themselves or with the help of an intermediary. Alternatively, they can bring their find to one of the area's gold-processing plants.

If the miners process gold themselves or through an intermediary, they invariably use an age-old process that is inexpensive, effective, and so dangerous to health and the environment that it has been banned in many countries: mercury amalgamation. After the ore is crushed and sifted, it is combined with mercury, which bonds with the gold to form a dense amalgam or "cake." Miners then heat this cake to distil — or simply burn off — the mercury, leaving behind a gold nugget. Mercury in this form is so toxic that the amalgamation process is dangerous not just for those processing the gold, but for everyone in the vicinity. Chronic exposure to mercury is known to lead to neurological disorders that include blurred vision, tremors, malaise, memory loss, and intellectual impairment.

But this danger is not necessarily well known, explains Jaramillo. "Gold getting processed is seen as such a natural activity. I have seen little children playing with mercury." She adds, "Grandparents don't believe in changing the way things have been done. They have the opinion that precautions are not necessary."

The impact of heavy metal contamination

Increasingly, miners bring their sacks of raw gold to one of the 100 processing plants that line the Puyango River. At these plants, gold is extracted using a more efficient, mechanized process that also relies on mercury. This process leaves behind a muddy sludge of tailings containing a mix of lead, mercury, manganese, and various cyanides. These tailings are eventually flushed into the river system, poisoning the water and killing all aquatic life in the area.

Not only does this contamination affect the health of people in the immediate area, it is also harming subsistence farmers in remote communities near the Peruvian border. These are among the findings of a small, Ecuadorian nongovernmental organization known as Fundacion Salud Ambiente y Desarrollo (FUNSAD). With support from IDRC, FUNSAD's researchers studied pollution caused by heavy metals and cyanides originating from the gold-refining process, examined the impact these contaminates were having on human health, and made links to socioeconomic and cultural conditions that influence how people interact with their environment. Communities at three different points along the Puyango river system were studied: Zaruma and Portovelo, near the top of the river system, a midpoint sampling area, and several small communities at the "bottom" of the system, near Peru.

"Our research is based on the ecosystem approach to human health," says FUNSAD's director, Dr Oscar Betancourt. "We know that the problems related to mining activities are very complex. And there are many ways that human beings interact with their environment — people may depend on the river for the necessities of life — water and food, for example. Then there are economic, cultural, and technical factors that we need to understand."

The research team, composed of three medical doctors, two geologists, a sociologist, and a community development worker, aimed to help unravel the complexity of the problems facing riverside communities. Taking a transdisciplinary approach, they carried out research on three fronts. They tested the physical environment for the presence of mercury, lead, manganese, and cyanide; examined people for signs of over-exposure to heavy metals and cyanide; and undertook a survey to collect social, economic, and other data on the various ways people interact with the environment.

The survey was particularly critical for filling out researchers' understanding of precisely how and why people's health was being affected by environmental contamination. Were people

drinking water straight from the river? Did they know about the risks of burning mercury amalgam? Were women and men exposed to contamination in the same way or to the same extent? By uncovering answers to these sorts of questions, the researchers aimed to lay the groundwork for finding concrete ways to make lasting improvements in human health.

A transdisciplinary approach

In each of the three ecosystems, the research team tested river water, solids in suspension, and river sediment. In the lower zones, they also examined fish and other food sources. They hypothesized that they would find the water and food was contaminated primarily with mercury — and, in fact, mercury was present in the water, particularly near the processing plants. However, says Betancourt, "the surprising result was that the water was most contaminated with lead." Measurements taken at the processing plants were extremely high, and downstream the concentrations of lead were 16 times higher than at the river's source.

Health Effects of Lead Exposure

A human body cannot tell the difference between lead and calcium, which means that lead is absorbed into the bones where it can collect for a lifetime. Chronic effects are often attributed to low exposures over a long period of time. Symptoms include excessive tiredness, nervous irritability, fine tremors, and numbness. Because these symptoms are common to a variety of health problems, they can easily be overlooked.

Moreover, children under 6 face special hazards. Because their bodies are developing rapidly, even exposure to low levels of lead can have permanent effects, including nervous system and kidney damage, and decreased muscle and bone growth. Overexposure to lead can cause learning disabilities.

To understand the extent to which this affected people's health, the research team used a range of medical procedures. They carried out clinical exams; tested blood, urine, and hair samples; and administered a battery of neurobehavioural tests. These quick and straightforward tests can reveal subtle signs of chronic exposure to heavy metals. Key among FUNSAD's findings was that people in the lower basin communities and in Zaruma and Portovelo had elevated levels of lead in their bodies. People living near the lower basin also showed unsettling signs of neurobehavioural problems related to fine motor skills, attention span, and memory.

The questionnaire the team designed helped to illuminate why this was happening. Working with a team from the local community, researchers gathered a broad range of information about how people lived and worked. They collected basic

FUNSAD: Oscar Betancourt

A researcher draws blood samples to test for exposure to heavy metals.

information about people's level of education, income, and the length of time they had lived in the area. They asked questions about how people used the river and whether they considered it polluted. Because people all along the Puyango River system occasionally pan for gold as a sideline, the researchers also asked questions about their exposure to mercury amalgams. They also wanted to know people's views about contamination, prevention, and protection — and the extent to which they had been informed about these issues. Women were interviewed separately from men and asked questions about their specific roles and responsibilities. In all, some 1800 people were surveyed.

Researchers worked with a team of 12 people from the local community. Becoming involved in the research project was an eye-opening experience for many of them. "I learned about environmental and health problems that I never knew about," says Nelson Aguilar, a young man who administered the questionnaire. His sentiments are echoed by Cumandá Lucero, who adds, "What I appreciate most about being in this project is that I feel I am part of the community and that maybe I can do something to solve the problems here."

The results of the questionnaire revealed that people in the lower zone relied heavily on the river, particularly during the dry season. As Betancourt explains: "The people living downstream drink the water from the river all the time without any treatment. And they eat the fish — it is their main food because it has no cost." He adds that people also believe that the fast-running water of the river means that they are protected from pollution.

In Portovelo and Zaruma, however, people knew the river was contaminated — they could see it was lifeless. They don't drink untreated water or rely on the river for food. Yet FUNSAD's research revealed that most people in the area had dangerous levels of lead in their bloodstream. The research team plans to investigate the possible causes of this finding. Their hypothesis is that it is caused by air pollution and other sources.

FUNSAD: Nick Mainville

Mine tailings contaminate the Puyango River, endangering aquatic life and human health.

Forging links with local government

The research team then brought the work to the attention of local authorities in both Zaruma and Portovelo. "We can do a study of the problem, but studies are only studies," says Betancourt. "This is the reason why we are working with the local authorities, miners, and the population — to work with them to find solutions."

Toward this end, a new municipal environmental group has been formed — a joint effort between the communities of Zaruma and Portovelo. Given the complexity of the problems related to mining, the tasks facing this group are daunting. But they are planning to work with teachers to help educate children about the risks of mercury, and to work with miners to ensure they understand how to protect themselves and the environment. The team will also be looking at developing a new regional environmental code that will be enforced by municipalities.

"We want to finish with the contamination once and for all," says Jaramillo. "But if we can't do it 100 percent, then at least we can do something to make things better."

As the mayor of Portovelo, Segundo Orellana, says: "We know the degree of contamination that exists in the watershed. Definitely these results furthered our understanding. With the presence of FUNSAD, I think we can succeed in finding solutions that will benefit the community. We have to start increasing our effort because the alternative is more contamination — and the impact that this could have on us all."

This *Case Study* was written by Lisa Waldick, a writer in IDRC's Communications Division.

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Ecosystem Approaches to Human Health

Human health and well-being are intimately tied to the health of the ecosystems that sustain life. Yet the potential for improving health by better managing the local environment is an avenue rarely explored in mainstream health programing. Through its Ecosystem Approaches to Human Health (Ecohealth) Program Initiative, IDRC aims to identify the web of economic, social, and environmental factors that influence human health. Communities can then use this knowledge to better manage ecosystems and improve the health of both people and the ecosystem.

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