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Key Points

In the coming decades, Peru will face a water crisis as chronic, unaddressed problems and environmental change combine to undermine the water security of the entire country. This trend has direct and potentially major implications for environmental security, as a number of protests and conflicts have arisen in recent years over the proposed privatization of the public water system and water pollution from mining. These clashes are a harbinger of the instability that a national water crisis could produce.

- Peru's highly populated arid Pacific coast depends on water from glacial melt to compensate for the region's lack of rainfall, but Peru's glaciers are retreating at a rapid—and increasing—rate.
- Diminished glacial water will result in decreased stocks of drinking water, water for irrigation, and water pressure to power hydroelectric facilities, as well as a loss of cultural meaning that the glaciers hold for some indigenous groups.
- Millions of Peruvians are underserved by the country's public water and sewer systems, and poor financial management of water utilities makes it unlikely that the majority will obtain these services in the near future. Despite the failure of the public sector, attempts at privatization have been met with widespread rejection and protests.
- Water pollution from mining operations threatens the stability of the country, as affected communities have clashed violently with each other and mining companies.

The Coming Crisis: Water Insecurity in Peru

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In the coming decades, Peru will face a severe water crisis as chronic, unaddressed problems and environmental change combine to undermine the water security of the entire country.

One of the most serious problems is a public water infrastructure that fails to serve, or serves inadequately, millions of poor Peruvians. Completely or partially cut off from a regular supply of public water, they are sentenced effectively to a reliance on expensive retail water vendors in urban areas and increasingly polluted rivers and streams in rural areas.

Lima's failing public water system, the Potable Water and Sanitation Service of Lima (SEDAPAL), has been unable to address this problem and many others that prevent it from running efficiently and providing reliable service. Privatization is the preferred formula of the government and the international lending community for fixing these deficiencies. But privatization is widely unpopular both with the majority of the Peruvian people and with Bolivia, whose cooperation is necessary for regional initiatives. While Peru is struggling to address these systemic problems, melting glaciers and decreased precipitation will further aggravate serious water shortages over the next 10 to 20 years if steps are not taken to mitigate their effects.

What is most significant from an environmental security perspective is the number of protests and conflicts that have arisen over water resources in recent years.[1] The situation is currently one characterized by scattered conflicts and protests, some violent, carried out by various groups protesting different aspects of the country's numerous water-related problems.

For example, indigenous groups in the Andes have fought mining companies for access to clean water, which they claim is being compromised by mining operations. Complicating the situation, indigenous groups also have fought each other, as agricultural groups object to the environmental damage caused by indigenous artisanal miners. Other conflicts have arisen over plans to privatize the country's water and sanitation services. Although these occurrences are scattered and typically confined to specific locales, they foreshadow the likely destabilizing consequences of severe water quality degradation or water shortages resulting from one or more of the

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aforementioned stresses. As water problems that now mainly affect the poor and marginalized begin to afflict the rest of the population, the security situation may deteriorate on a much larger scale.

This *Issue Brief* discusses the major factors contributing to Peru's water insecurity and the threat they pose to environmental security in the context of the water-related conflicts that the country has experienced to date. This *Issue Brief* argues that Peru must take immediate steps to ensure the water security of the country or face increasing environmental insecurity, political instability, and violence.

Factors Contributing to Water Scarcity

Location, Location, Location

Peru's impending water crisis is due in large part to the location of the country's major population and agricultural centers in relation to the location of available water resources. Seventy percent of the country's population lives on the arid Pacific coast, where less than 2 percent of the water resources are located, while 98 percent of the country's water is found on the eastern side of the Andes—home to only 25 percent of the population (Painter 2007).[2]

The situation is especially severe in Lima, the country's capital and major city. Lima is home to more than 8 million people, and is located on a desert that during most years receives very little rainfall. To compensate for the lack of rainfall, Lima must pump in water from across long distances, relying on a single tunnel to bring water from the eastern side of the Andes. This frequently results in rationing (*Economist* 2006). The situation soon may become untenable, as city water managers are concerned that water reserves in Lima will not be enough to meet demand if there are drought conditions for two consecutive years (Painter 2007). To alleviate pressure on Lima's sole water-carrying tunnel, it was proposed that the city build a second tunnel to ensure the delivery of water and possibly build water reserves for drought scenarios. However, the plan, called Marca II, has stalled as the government has found the cost to exceed its available resources.

Urban Population Growth

Lima's demand for water likely will increase in coming years, as urbanization continues unabated. Peru's urban areas are growing at 2 percent per year (UN-HABITAT 2001). By 2015, Lima's population is expected to increase to 10 million people (Magrath 2004). The added population will place greater stress on the city's water infrastructure as the demand for water connections grows. This will pose an enormous challenge, as the additional demand may not be in line with feasible water supply. According to SEDAPAL, bringing service to the 2 million people who already lack it in Lima is not possible with the city's current water reserves (Struck 2006).

This does not bode well for the growing slum population, which increases by about 3 percent per year, a rate that has been consistent since at least 1990. This perennial increase has meant that the ratio of people living in slums to those in the more affluent urban areas has risen from 60 percent in 1991 to 68 percent in 2001 (UN-HABITAT 2001). As the population of residents living in the slums swells, so too does their political clout. Despite the water shortage, calls for the government to extend water services to Lima's marginal neighborhoods are growing louder. One group, Peruvians Without Water, links 1,600 leaders of Lima's poor neighborhoods, in which 70 percent of the residents lack water service (Salazar 2006a).

The group has been agitating—with some success—for increased access to affordable, clean water for residents in the slums. Upon assuming the presidency in July 2006, President Alan García initiated the Agua para Todos (Water for All) program, which seeks to add 500,000 new water and sewerage connections between March 2007 and March 2008 (*Country Commerce Select* 2007).

Although the government is aware that the number of people without access to piped water is unacceptable and must be remedied in the near future, the task is massive. SEDAPAL estimates that it will need US$529 million for expansion projects that are not even slated to begin until 2011, and more

than US$1.5 billion to achieve the government's stated goals for potable water and sewer service expansion (*Business News Americas* 2006a). Implementing these projects will require a major investment of political capital. Whether or not the government can meet these commitments and ensure that SEDAPAL is able to expand service to most Lima residents remains to be seen. What is not in doubt is that the disenfranchised of Lima's slums have growing political clout and are not afraid to agitate for change.

Melting Glaciers

Seventy percent of Earth's tropical glaciers are located in Peru, including the Cordillera Blanca, which is the largest tropical glacier train in the world. Glaciers play a major role in Peru's hydrology and are essential for maintaining water levels, especially during the May to September dry season, when nearly all of the runoff is from glacial melt (Kaser et al. 2003). They do this by acting as natural water towers, accumulating snowfall during the cold part of the year, and then releasing some of this moisture as run-off during the warm dry months. This natural system ensures a supply of fresh water to Peru's many glacier-fed rivers, and in turn to those populations that rely on the rivers for their water supply.

The glaciers may not be able to contribute to the hydrological cycle for much longer, however. Peru's glaciers are melting at a rapid—and increasing—rate. This is primarily a function of increasing humidity and temperatures in the Andes. While the change in humidity levels is not well understood, mean temperatures have risen approximately 0.15 degrees Celsius per decade since 1950. The rate of warming also has been accelerating; the Andes warmed at a rate of 0.32–0.34 degrees Celsius per decade between 1974 and 1998, which represents a tripling in the warming trend over previous decades (Vuille et al. 2003).

Increased temperatures quicken the pace of glacial melt and lengthen the period of time during which melting occurs. These changes have had a stark effect on the size of the glaciers: a 1997 study of satellite images determined that the glacial area of the Cordillera Blanca had decreased by 15 percent over the previous 50 years (Agricultural Ministry of Peru n.d.). Other glaciers are retreating at similar rates. Quelccaya is the world's largest tropical ice cap and is located in southern Peru. According to Lonnie Thompson, a glaciologist from the University of Ohio and 2005 U.S. National Medal of Science winner, Quelccaya has been retreating at a rate of 200 feet per year—a dramatic increase from the rate of the 1960s when the ice was retreating at a rate of 20 feet per year (Josephs 2007). Quelccaya's largest outlet glacier, Qori Kalis, retreated three times faster between 1983 and 1991 than between 1963 and 1978. Between 1983 and 1991, the glacier lost seven times more volume than between 1963 and

Yanamarey Glacier. *Source:* INRENA 1987

Yanamarey Glacier. *Source:* INRENA 2004

1978 (Vuille and Bradley 2000; Vuille et al. 2003). Even more alarming is that Qori Kalis is retreating 40 times faster today than it was 2 decades ago (Thomson 2004). In all, Peru's mountains have lost more than 20 percent of their glacial area since 1970 and some experts predict that Peru's glaciers located below 5,500 meters will completely disappear by 2015 (INRENA 2005). If this happens, there will be no glacial melt during the dry season, and many of Peru's rivers could be dry for six months of the year (Magrath 2004), posing major problems for the people and agricultural areas that rely on their water.[3]

Implications of Glacial Melt

The impending lack of glacial melt has serious implications for the arid regions of Peru, specifically Lima and the coastal agricultural zones to the north of the city. Diminishing stocks of drinking and household water, decreasing water pressure to power hydroelectric facilities and irrigate agricultural lands, and the loss of cultural meaning that the glaciers hold for some indigenous groups are all strong possibilities that must be faced in the coming decades. Some of the changes, such as cultural practices, may be manageable. Others, however, such as electricity generation and irrigation, will require a nationwide effort to re-evaluate water use and development patterns, as well as develop new technical solutions.

Lack of Drinking Water

Lima's water supply depends on the Río Rimac, and two other rivers, the Río Chillón and Río Lurín. The three rivers are fed by glacial melt year round but during the driest months of the year it is virtually their only source of water. Without the glacial melt that keeps the water flowing, Lima's water supply will be severely reduced. This reality has not gone unnoticed by the government, and several plans have been proposed to remedy the situation. Among them is Marca II, which until recently was being considered as a way to increase Lima's water supply by constructing one or more additional tunnels through the Andes to bring water from the mountains to several reservoirs near Lima. The plan, which was to cost an estimated US$98 million, apparently has been ruled out as the government says it is unable to fund its construction (*Business News America* 2007a). Instead, the government is considering constructing desalination plants to provide potable water service in Lima. According to the country's deputy construction and sanitation minister, Juan Sarmiento, the plants would be made possible through private investment—thus freeing the government from the huge financial investment necessary to secure water for Lima (*Business News America* 2007a). The plan does have a catch. Even if these plants are built, desalination facilities are very expensive to operate and maintain. Depending on these costs, the water produced by these facilities may be too expensive to use for drinking water.

Diminishing Energy Resources

Eighty percent of Peru's electricity, approximately 6000MW, is supplied by hydropower. Until recently, Peru's rivers have been seen as an inexpensive, renewable, and clean energy source, and indeed, President Alan García is keen to expand the use of hydropower. This may be feasible in the coming 10 to 20 years as increased glacial melt from the last of the country's glaciers flow at a rapid rate, increasing the water supply and potentially making more water available for power generation. However, this is not a viable long-term strategy. Experts predict that Peru will become water scarce by 2050, and possibly as early as 2030. Once this happens, hydropower operations that rely on glacier melt will be increasingly unreliable. Additionally, hydropower facilities also are vulnerable to fluctuations in rainfall. Without consistent water flow from glacial melt and rainfall, hydropower facilities may lack the water pressure necessary for consistent electricity generation (*Economist* 2007; Economist Intelligence Unit 2007a). As Peru's water shortage also is likely to become an energy security issue, the government must make immediate plans that accommodate this future scenario, taking into consideration what is likely to be an irreversible decline in glacial runoff.

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The government also must tackle structural inefficiencies and water loss. SEDAPAL estimates that 8 million cubic meters of water are lost every year because of poor coordination between hydropower facilities and SEDAPAL (*Business News America* 2005a). Although this amount pales in comparison to the amount of water generated from glacial melt, the government must nevertheless control water loss wherever possible.

Agricultural Practices

The arid coastal region of Peru produces 50 percent of the country's agricultural products, most of which are intended for export. Although the share of agriculture as a percentage of GDP decreased slightly from 2000 to 2005, in absolute terms the monetary value of agricultural products has grown (World Bank 2005a). In 2007, agricultural exports were expected to earn the country US$2.06 billion (*Latin American News Digest* 2006a), an increase of 14.8 percent from 2006.

The increasing importance of agriculture is being driven by a number of factors, including the Andean Trade Promotion and Drug Eradication Act (ATPDEA). ATPDEA, which was introduced in October 2002, gives preferential trade status in the U.S. market to 6,000 exports from Peru, Bolivia, Colombia, and Ecuador. Additionally, Peru and the United States currently are in talks to replace ATPDEA with a permanent free-trade agreement (FTA). If the pact is approved, the U.S. immediately will become a tariff-free market for several of Peru's agricultural products, including beef, cotton, soybeans, fruits, and vegetables (*Country Profile Select* 2007a). The tariffs for corn and rice would be reduced over a period of 12 and 17 years, respectively. If Peru and the United States enter into a FTA that includes agricultural products, the industry could take on even greater significance in the Peruvian economy.

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The expansion of the agricultural sector likely will mean increased export earnings and more jobs; in fact, job growth in the coastal agricultural areas north of Lima has been higher than in Lima in recent years (*Country Profile Select* 2007b). In a country with 10 percent unemployment (Economist Intelligence Unit 2007b) and a 50 percent poverty rate (Economist Intelligence Unit 2007c), it is clear why economic expansion is a top priority.[4] However, the export agricultural sector is under major threat due to glacial retreat because it relies on irrigation from glacier-fed rivers (Magrath 2004). The irrigation systems demand massive amounts of water—agriculture accounts for 82 percent of Peru's water withdrawals (FAO 2000). Although the effects will be varied depending on local rainfall conditions, a large percentage of the water upon which agricultural areas rely will no longer be available once the glaciers have fully melted.

In the coming decades, this scenario could be especially problematic for the Río Santa valley, located north of Lima, along the western coast. According to Gabriela Rosas, a member of a research team modeling water availability in Peru, glacial runoff is estimated to contribute 10 to 20 percent of the total annual water runoff in the Río Santa valley, but it accounts for as much as 40 percent of the flow during the dry season (Bradley et al. 2006). As glacial runoff subsides, and demands for the remaining water increase, the coastal agricultural sector will be forced to look to other sources for irrigation. Accepting the alternative and ceasing crop production in the desert coastal region of country is likely to be politically unpopular, as the industry raises export earnings and employs many people. Nevertheless, the impending water shortage will stress the industry heavily. If a consistent source of water to ensure production is not developed, the resulting economic losses may have destabilizing effects on the economy, which in turn may threaten the stability of the country.

Loss of Culture

In addition to the economic and environmental benefits of healthy rivers, Peru's indigenous groups see the glaciers in spiritual terms. The quickly receding glaciers therefore are having unsettling cultural impacts on those communities that are closest to them. In years past, important ceremonies were conducted on Peru's glaciers, including one ritual practiced by the Pablitos,

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who live near the Sinakara glacier. Their festival, called Qoyllur Rit'i, brings thousands of pilgrims from all over the Andes region to the area to obtain a piece of the glacier, which many believe has healing properties. The practice was halted in 2003 in order to protect the already shrunken glacier, a decision that upset many pilgrims. Although this issue is perhaps not as serious as the impending lack of drinking water, loss of reliable energy, and the negative economic consequences of glacial melt, recent research on the causes of civil conflict states that unrest is likeliest to occur in places where groups feel their entire way of life is threatened (Leuprehct 2007). Considered in concert with the pressure that communities are already under with respect to their drinking water, agricultural water, and sanitation facilities, the impact of rapid cultural change may exacerbate the impact of the other changes and make conflict more likely.

Previous Water Conflicts

The potential consequences of the environmental insecurity that Peru will face in the coming decades must be viewed in the context of the country's previous experiences with water-related problems. Although protests are common in Peru—it has been said that Peruvians view street protests as a national pastime—conflicts over water have become especially heated. Two recent issues, the proposed privatization of SEDAPAL and mining pollution, provide a glimpse of the insecurity that a national water crisis could produce. Both are important case studies on how the use and distribution of a vital resource such as water quickly can become politicized and a major source of tension in affected communities. Although it is impossible to predict the exact trajectory of future conflicts, the previous violence foreshadows the possible security consequences of a massive water shortage in a major Peruvian population center.

Privatization

Lima's public water and sewer utility, SEDAPAL, suffers from a number of problems, including inadequate funding, mismanagement, and inappropriate pricing schemes. These problems were especially acute at the time former President Alberto Fujimori took office in 1990, when the utility was in a "state of near collapse" (Alcázar et al. 2002). During this time, the government embarked on a program to privatize as many as 200 state-owned enterprises as a part of a major economic structural reform package. Included in the scheme was Lima's much-maligned water utility, which, after a series of delays, was to be concessioned after the 1995 elections. However, privatizing SEDAPAL proved to be politically hazardous, and was eventually cancelled.

Prior to the proposed privatization, SEDAPAL was struggling with nearly every aspect of service provision and utility management. Twenty-five percent of Lima's population did not have access to water services, and a third of the population was not connected to the public sewer system (Alcázar et al. 2002). The result was a public health disaster, with raw sewage being dumped into the ocean at the rate of 17 to 18 cubic meters per second (Alcázar et al. 2002). In 1991, poor hygiene and lack of proper sanitation led to a major cholera outbreak that began in Peru and spread to every country in South and Central America (except Uruguay), eventually causing 1 million reported cases and 9,000 deaths (McDevitt 2000).

Poor management and billing practices were undermining the utility's financial solvency. According to Alcázar et al., 43 percent of the water produced was unaccounted for, two thirds of it due to leakage and the remainder consumed but not billed (2002). The utility did not have the ability to cut off service to those receiving water but not paying for it. These problems meant that SEDAPAL not only did not have the financial resources to bring service to the millions lacking it in Lima, but also did not have the incentive to try. Unable to bill for all services and absorbing a loss, the utility ceased making debt payments and let maintenance fall by the wayside.

This situation was the most serious for Lima's poorest residents, as the lack of access to piped water in their neighborhoods meant that the residents had to purchase all of their household water from tanker trucks, which are operated by private vendors. Water from retail vendors is very expensive; in

today's dollars, a 100 liter container of privately vended water costs between US$2.50 and US$3 (Anthony 2007). How long the supply lasts depends on household usage, but for a family of four, 100 liters is enough to last two days (Lama 2005). To put this in perspective, approximately 32 percent of Peruvians earn less than two dollars per day, and many of Lima's poorest residents fall into this category (UNDP 2007).

Despite these problems and their associated social and economic costs, when the government introduced plans to privatize SEDAPAL, it was met with fierce opposition from citizens fearing that their water bills would increase dramatically, as well as from union leaders who feared job and salary cuts. As Lima's poor were the primary political base of President Fujimori, and he did not wish to inflame them, he decided against privatizing SEDAPAL, which was a politically savvy move. In 1991, when the privatization of SEDAPAL first was discussed, 52 percent of Lima's residents supported privatization. By 1997, when the government would have been ready to proceed with the plan, only 28 percent of residents agreed with it, and among Lima's poor communities, only 19 percent of residents were supportive (Alcázar et al. 2002).

Although the original privatization efforts were rejected before reaching the point of public demonstrations or social unrest, conflict was not avoided in 2001 when farmers went on strike and barricaded roads in protest over government attempts to give SEDAPAL the authority to set water prices and collect payment from water garnered from the Río Rimac. As this was their primary source of irrigation water, the farmers vigorously objected. The protests had a strongly anti-privatization component as well; the farmers saw this as the "last step before privatizing the system" (Lama 2001).

Other protests followed:

- In 2005, employees of SEDALIB (a union of utility workers) protested the decision to put their water and sewer utility up for private concession. The workers called for a reversal of the decision, threatening to declare an indefinite strike if their demands were not met (*Business News Americas* 2005b).
- Also in 2005, a citizen group, the National Commission in Defense of Water and Life, scheduled mass protests to oppose a government bill that would have allowed multiple water utilities to be concessioned across the country (*Business News Americas* 2005c).
- Protests against the proposal also took place later that year in Piura, Lambayeque, La Libertad, Chimbote, Huancayo, and Pucallpa Huancayo (*Business News Americas* 2005d).
- Unions threatened an escalation of ongoing strikes and protests if privatization plans were carried out. The fear of privatization was brought on by new regulations that would require water and sewer utilities to raise rates, bringing them closer to the actual cost of service. Union leaders assumed this was to make the utility more desirable to private investors (*Business News Americas* 2005d).

Despite public opposition, privatization and concession plans are frequently under discussion, notwithstanding promises by politicians that they will not consider selling SEDAPAL. Currently, there are conflicting reports about the government's plans. In September 2006, President García's ruling party proposed legislation that would exclude the water utility from privatization efforts (*Country Commerce Select* 2007). As of April 2007, the proposal was under consideration by two separate congressional committees. However, the discussions that the government has had on the international level play into the speculation that privatizing SEDAPAL is still possible. In June 2007, Bolivian president Evo Morales withdrew

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from trade negotiations between the Andean Community and the European Union because Colombia, Ecuador, and Peru were willing to discuss water privatization (*Business News Americas* 2007b). While there is no firm evidence of a government plan to restart efforts to privatize SEDAPAL, it has never been taken fully out of consideration, and public concerns about the government's plans persist.

The gap between the government's repeated attempts to privatize SEDAPAL and the demonstrated rejection of the plans by the public does not bode well for the security of the country, especially since all attempts to increase the financial solvency of the utilities are seen as attempts to make them more favorable to investors. Yet, without further reforms, it is difficult to see how SEDAPAL will manage to increase connections to new households and increase the quality and reliability of its service, which is itself a source of tension.

Mining Pollution and Popular Protests

Like many places in the world with an abundance of natural resources, Peru has had a mixed experience with its mineral wealth. The benefits to the country are numerous, including the export earnings that the mining sector generates. Although mining revenues account for only 4 percent of the country's GDP, they account for more than 50 percent of the country's export earnings (EITI 2006). Peru is the world's second-largest producer of silver, third-largest producer of zinc, and sixth-largest producer of copper. The country also has some of the world's most valuable gold mines, ranking sixth in the world for production. The number of people employed in mining is debated. However, based on data from the Economic Commission for Latin America and the Caribbean (ECLAC), it can be estimated that mining employs approximately 250,000 people (ECLAC 2006).[5] Despite the economic benefits of mining, in recent years pollution caused by poor mining practices and accidents have harmed the environment and inspired numerous incidences of conflict. At the center of many of the conflicts is water, as communities near mining operations claim that their water resources are being depleted and polluted.

Water depletion is typically associated with gold mining. The process of cyanide leaching, the most efficient and economical method of separating gold from less valuable minerals, uses massive amounts of water to dilute cyanide. The mixture is then poured over heaps of ore and gold (*AFX International Focus* 2006). A hydrological study completed in 1992, just prior to the opening by Newmont Mines of the Yanacocha gold mining site, estimated that the operation would entail water requirements of 11.6 liters per second, or 1,000 cubic meters per day. Using that rate, it is estimated that the company used 125 million cubic meters of water between 1993 and 2004. According to Milagros Salazar, who writes frequently about water issues in Peru, that amount of water would be sufficient to supply 6.5 million people with a one-time allotment of 50 liters of water (Salazar 2006a). The effect of this water use has not gone unnoticed. In Combayo, which takes several hours to reach by car on poor roads, wells have gone dry because of the amount of water required at the Yanacocha site. Newmont Mines, which operates the Yanacocha concession, does not dispute this fact, only claiming the government has not set limits on the amount of water that it is allowed to draw (Salazar 2006b).

Pollution also is a major concern for the communities living in and around mining operations. Air pollution and chemical spills both are serious problems and have attracted international media attention. But more than any other issue, water pollution has become the rallying point for affected communities. Residents resent the contamination of water resources by the cyanide and arsenic that are used by many mining operations, and the mercury used by alluvial miners. Tensions between communities and mining companies are numerous and ongoing and have destabilized both the industry and the surrounding communities. These communities generally are very poor and economically marginalized; most community members try to eke out a living in subsistence agriculture. They depend heavily on rivers to provide drinking water, irrigation, and water for their livestock. The degradation of this vital resource has pitted affected communities against large mining companies, and also against other

communities that are engaging in artisanal mining upstream (Salazar 2007).

A good example of the escalating struggle between mining companies, artisanal miners, and farming communities is the situation in Algamarca Hill in the province of Cajamarca. There, two private mining companies, Sulliden Exploration and Las Algamarcas, are fighting each other for control of 26 concession areas where both companies wish to mine gold. Both companies also are fighting the artisanal miners who, unable to make a living as subsistence farmers, sneak into the concession area to mine. Both sides are armed, and conflict has occurred already; in the spring of 2007, artisanal miners burned down a guard house erected by Las Algamarcas.

The miners, too, are divided. One miner was killed by members of an opposing group of miners after being tortured. Shortly thereafter, one group of miners drove the other group out of the area (Salazar 2007).

Adding to the tension, both companies and the artisanal miners are fighting the local communities for the right to mine. Farmers living two hours downstream from the operations in the district of Chuquibamba are seeking to have all mining—large scale and small scale alike—banned, as they complain that the operations are polluting their water. One study found that the Chupalla River, which is used in irrigation in Chuquibamba, has twice the legal limit of arsenic that is allowed by Peruvian law (Salazar 2007). To combat the pollution of their water source, the farmers formed a group intent on protecting the community's assets. Unlike the other groups, however, they have so far remained unarmed. Even so, in early 2007, tensions simmered over, and downstream farmers' groups opposed to mining pollution stormed Algamarcas Hill and destroyed 36 cyanide and mercury tanks and captured 7 miners, who were later turned over to the police (Salazar 2007; Inter Press Service 2007).

The constant tension and conflict in the country's mining regions are destabilizing a mining industry that brings in billions of dollars per year in export earnings. Many mines have been forced to close due to community protests centering on water pollution. Newmont Mines was forced to reconsider plans to exploit part of its concession in Yanacocha after thousands of farmers blocked the entrance to the mine. The protest cost the company US$1.8 million per day over the course of 6 days. The state lost US$615,000 per day in tax revenues (Salazar 2006b). Another major company, BHP Billiton, had to close its copper mining operation for a month in May 2005 when farmers broke into their facilities and vandalized equipment (Lozano 2005).

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Many other mining-related protests have been carried out:

- In 2004, Newmont Mines canceled plans to mine gold on Carro Quilish Mountain when farmers concerned about their water supply protested violently.
- On August 2, 2006, citizens protesting against Newmont Mines clashed with the police and mine security, resulting in the death of a local farmer. He was killed at the Chaquicocha River, which is a main source of water for Combayo (Salazar 2006b).
- Two people were killed by police during protests against a British mining company, Monterrico Metals. The community opposes mining planned along the border with Ecuador, fearing water contamination (O'Shaughnessy 2007).

Attempts to integrate water issues into corporate-sponsored community outreach packages have had mixed results. The case of Doe Run, a U.S. lead producer, illustrates this well. According to the company, Doe Run has more than met its environmental obligations. By 2009, the company estimates that it will have spent US$254 million on environmental improvements, which is 2.4 times higher than required by their initial agreement with the Peruvian government. They also claim to have made advances in air quality, bringing the operation into compliance with Peruvian law for the first time since production began at the site in 1922 (PR Newswire U.S. 2007). As for water programs, in April 2006, the company opened a sewerage treatment plant that treats not only the effluent from one of their operations, but also the

Doe Run Peru Processing Operation, La Oroya, Peru. *Source:* Matthew Burpee n.d.

wastewater generated by the homes of as many as 10,000 people (*Business News America* 2006c). The plant was the first of three wastewater treatment plants built by the company. The second and third plants were completed in June 2006 and December 2006 (*Latin America News Digest* 2006b). All three plants treat water to a standard high enough to be used for animals and agricultural use but not for human consumption.

However, in May 2006, the Peruvian government granted the company a three-year extension on the completion of two sulfuric acid treatment plants that are necessary to control the toxic heavy metal emissions from their smelting operations (Wittenaur 2007). In exchange for the extension, Doe Run began offering healthcare to the children and pregnant women of the surrounding areas, as they are most at risk from water and air contaminated with heavy metals. In La Oroya, almost 75 percent of the town's 18,000 children have lead levels in their bodies that are 2 to 4 times greater than what is considered poisonous (*St. Louis Post-Dispatch* 2006). While these children will benefit from access to healthcare, they would undoubtedly benefit more from clean, safe water and air, which also would benefit the rest of the community.

The mining-related water pollution also is causing instability in the agricultural sector. Peru's agricultural industry relies on rivers for irrigation, but these water sources are increasingly polluted by heavy metals from the mining industry. In fact, 75 percent of Peru's rivers are contaminated with metals and wastewater. The mayor of Algamarca, a center for informal mining, believes that in current circumstances, i.e. as long as there is artisanal mining, pollution is inevitable (Inter Press Service 2007).

As Peru builds its export agricultural sector, contaminated water may seriously stunt its growth and potential. Farmers in Chuquibama, an area not far from Algamarca, annually export between 120 and 200 tons of paprika, which brings in up to US$3,800 dollars per hectare. The farmers also produce avocados for export to the United Kingdom. However, the water used to irrigate these crops contains twice the legal limit of arsenic (Inter Press Service 2007). If this situation continues, farmers may not be able to find countries willing to take their exports. In September 2006, Japan turned away Peruvian vegetables amid concerns about the health implications (*Business News Americas* 2006b). Given the instability in the mining sector, and the growing importance of agricultural exports, the Peruvian economy cannot afford further threats to crop production and export capacity.

Conclusion

Peru is facing a multitude of water-related problems, including basic access to adequate water and sanitation, tense competition for scarce water resources, conflict surrounding the privatization of SEDAPAL, and mining-related water pollution. Any of these problems could be destabilizing in the near future; in fact, the latter two have already caused serious social unrest and undermined the public's confidence in private companies and the government. Problems in the water sector also threaten the economy, partly because of protests and violence, and partly because environmental damage harms export agriculture. Adding to this already volatile situation is the strong likelihood that glacial melt will cause severe water shortages in the near future, exacerbating pre-existing tensions.

What is perhaps most troubling about the situation is the growing

number of people who are about to feel the effects of Peru's water crisis for the first time. In the past, the poor and marginalized have been most affected by water insecurity, which has kept the struggle for equal access and clean water limited to the affected communities. Lima's urban poor formed organizations to demand water and sanitation, and farming communities in the Andes formed groups to fight mining pollution. But the lack of coordination among groups has meant that any disturbances, even violent protests, have been contained in the areas that are directly affected. This has prevented a rapid downward spiral in the security situation, but it also has meant that the middle and upper classes have remained largely insulated from the full scope of the problem. While even those with access to clean, piped water face periodic service interruptions, their water remains inexpensive and mostly safe. This may change, however, as severe water shortages and increasing pollution impact a much greater percentage of the population. While citizen complaints may incite the government to act more quickly or effectively to mitigate the effects, there also is the possibility that these problems could overwhelm the government's capacity to respond, resulting in a much more serious breakdown in security.

There are a number of strategies that Peru can employ to mitigate these challenges, but none is a panacea. For instance, it is clear that Peru must start conserving water. In urban settings, this means reducing the amount of water that is lost to inefficiencies between SEDAPAL and hydroelectric facilities. In the rural areas, where the water-intensive industries of agriculture and mining are located, this will mean increasing efficiency. Employing more efficient, less wasteful irrigation methods, and moving away from cyanide leaching in the mining sector are necessary, if costly, changes. One company, Minera Milpo, is using only desalinized water to process zinc, copper, and lead at its site in Cerro Lindo, the first company to do so (*Business News America* 2007c). However, these changes may be difficult to implement on a nationwide basis, as installing new irrigation systems and changing industrial operations both require significant capital investments. Finding either the funds to subsidize these changes or the political will to mandate them may exceed the government's capacity.

"...there is the possibility that these problems could overwhelm the government's capacity to respond, resulting in a much more serious breakdown in security."

In Lima, SEDAPAL must reform its pricing structures to reflect more accurately the cost of providing water and sanitation services in a desert. This is likely to be a complicated endeavor, especially considering the public's deep distrust of privatization programs, but it is nevertheless necessary. While water remains under-priced, and the utility does not have a viable method of collecting compensation for services rendered, waste and misuse will abound. Subsidies for the poor can help cushion the impact of some of the price increases, as can an incremental application of tariff changes. Peru must find a balance between maintaining service for the poor and providing an incentive to conserve water.

Experts from the Peruvian government's Natural Resources Institute, INRENA, predict that Peru's glaciers will be completely melted by 2050, with some predicting a date as early as 2030 (*BBC News* 2003). They also predict that halting or reversing glacial melt is unlikely. Therefore, it is clear that Peru will have to find alternate sources of water for drinking, agriculture, and industry. The government is currently looking at desalination technologies, which they expect to be privately financed. However, desalination is very expensive, and may not be a viable method of providing drinking water to Lima, though it may potentially provide water for irrigation if costs can be kept low enough.

One interesting solution, proposed by former Uruguayan Minister of Foreign Affairs Didier Opertti, is the creation of a regional energy bank among South American countries (*Latin American News Digest* 2004). An element of the plan would take advantage of the opposite timing of Peru's and Ecuador's rainy and dry seasons. For instance, if Peru and Ecuador were to join forces, during Ecuador's rainy season, Ecuador would produce enough hydroelectric power for both its needs and that of Peru. The arrangement would allow water formerly used for electricity generation in Peru during the dry season to be redirected, and thus made available for other uses.

Then, during Peru's rainy season, the situation would be reversed. Aside from the politics of such an arrangement, whether this is feasible depends on how much energy each country can be relied on to produce and the careful management of water and energy resources. Although this plan has not moved forward, international cooperation still may be key to solving Peru's water needs.

Whatever the solutions may be, the time has come for Peru to make the difficult decisions that are necessary to protect the country's water security. Given the cost associated with a number of possible solutions, the government must start acting now, before water problems become unmanageable or prohibitively expensive. The case for action can hardly be overstated: the lives and livelihoods of nearly all of the country's population will be affected in a relatively short time span. Adding to the urgency is Peru's recent history of civil strife and violent conflict over water resources. Although limited in scope, there already has been unnecessary loss of life, property, and damage to the economy from these events. The government must address these issues now before insecurity spreads to a larger proportion of the population.■

Endnotes

1. FESS defines environmental security as a condition in which a nation or region, through sound governance, capable management, and sustainable utilization of its natural resources and environment, takes effective steps toward creating social, economic, and political stability and ensuring the welfare of its population.

2. This disparity primarily is the result of Lima's location on the coast of the Pacific Ocean, which although beneficial for trade and shipping routes, leaves the city lacking in potable water supplies.

3. Peru's glaciers also may not be recharging themselves at the rate at which they once did. Although meteorological studies have shown differing results (Vuille et al. 2003), anecdotal evidence suggests that over the last few decades, precipitation has been decreasing in the Andes, meaning that there is less available snow pack to be added to the bodies of the glaciers. Farmers who once counted on reliable annual rains to grow their crops say they now wait helplessly as their land turns to dust and their crops dry out before the rains arrive. When the rain does come, farmers say it is lighter than it was before (Carroll 2007). If this phenomenon is indeed occurring, then scant, erratic precipitation is working to decrease glacial accumulation while the lengthening of the warm season and increasing temperatures are speeding their melt. In any case, these latter factors have ensured the rapid retreat of Andean glaciers.

4. There is some debate surrounding the accuracy of Peru's poverty rate. The current García administration ordered that a new census be taken, as President García does not believe that the 45 percent poverty rate cited by the previous administration, which represents a decline, is accurate.

5. This figure was obtained by multiplying Peru's total 2005 population, by the 2005 rate of employment in mining. All data was obtained from ECLAC.

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