Growing Pains in South America

South America's recent history is a paradox of growth and decay. Governments throughout the region have begun the evolution from dictatorship to democracy. Most countries have launched successful efforts to stabilize currencies and attract investment, and incomes have risen. Infant mortality and deaths in children under age 5 have declined by about 50% over the last 15 years; life expectancy has risen by an average of 8 years. Yet national prosperity has not conquered poverty, which has, instead, increased. Continual rural-to-urban migration, political and economic restructuring, and unplanned, chaotic urban growth have seriously destabilized South America's environment, with direct consequences to human health. The state of environmental health in South America is forcing leaders, aid organizations, and communities to transform their view of human health and its relationship to the environment and national development.

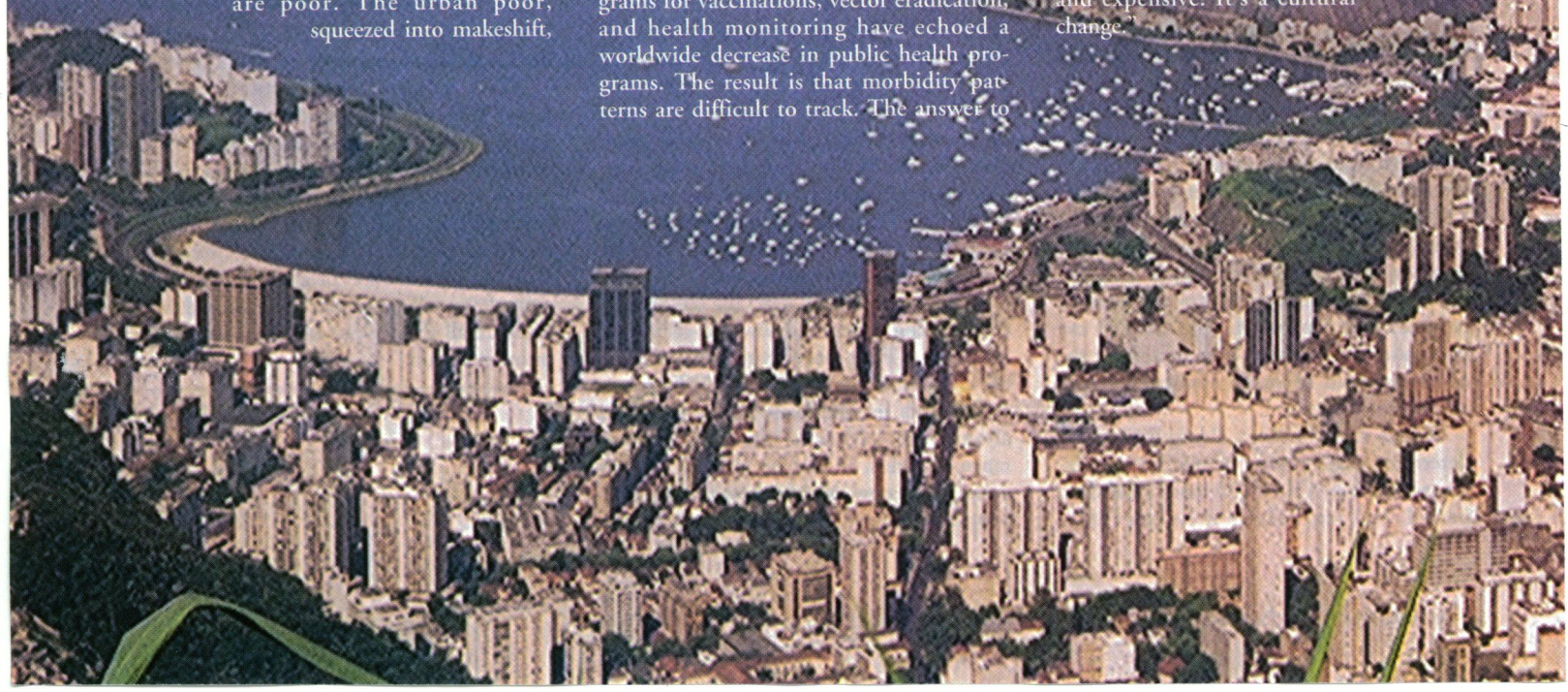
South America is no exception to the global trend towards urbanization, or to the problems that have accompanied it. Seventy-four percent rural in the 1940s, the region is now 74% urban. Some 40% of the population, or 115 million people, are poor. The urban poor, squeezed into makeshift, often illegal housing in the *ciudades jóvenes* and *favelas* (slums) surrounding the cities, are excluded from the municipal services of the monied sector. This group, while the hardest to track epidemiologically, bears the greatest burden of South America's drive to grow.

Between 1960 and 1990, Latin America lost nearly 18% of its forest cover, mostly to agricultural production. Nearly 200 million hectares are now cultivated, and rates of deforestation for further cultivation are expected to continue climbing. With increased agriculture come ecological changes including local climate change, siltation and erosion, and runoff from agrochemicals that degrade land and water resources, endangering the health of 80 million rural poor people.

But interlinked political, economic, and cultural philosophies make it difficult to address environmental health in South America. Governments struggling with new and uneasy democracies have made economic growth a priority at the expense of health programs. Health care expenditures in the region were 3–6% of the gross domestic product, as compared to 12.7% in the United States. Cuts in programs for vaccinations, vector eradication, and health monitoring have echoed a worldwide decrease in public health programs. The result is that morbidity patterns are difficult to track. The answer to many questions about both chronic and epidemic diseases is "we don't know."

South American governments have also viewed health as an isolated issue, eschewing preventive infrastructures like water management and sanitation for short-term, treatment-based solutions. "People identify health by the absence of illness," says Carlos M. Cuneo, coordinator of the Pan American Health Organization's (PAHO) environmental quality program. "In effect, the Ministry of Health has really been a Ministry of Illness."

Nor has any serious environmental regulation accompanied booms in agriculture, transportation, and consumption of energy and fishing resources, which have nearly doubled in the past 20 years. The result has been environmental degradation severe enough to bring about a marked change in the way South Americans view their surroundings. "Latin America is very rich in natural resources—forests, biodiversity, water—and scarcity has not been an issue until recently," says Horst Otterstetter, director of the division of health and environment at PAHO. "Now, resources that historically were abundant, of good quality, and cheap are scarce, of poor quality, and expensive. It's a cultural change."



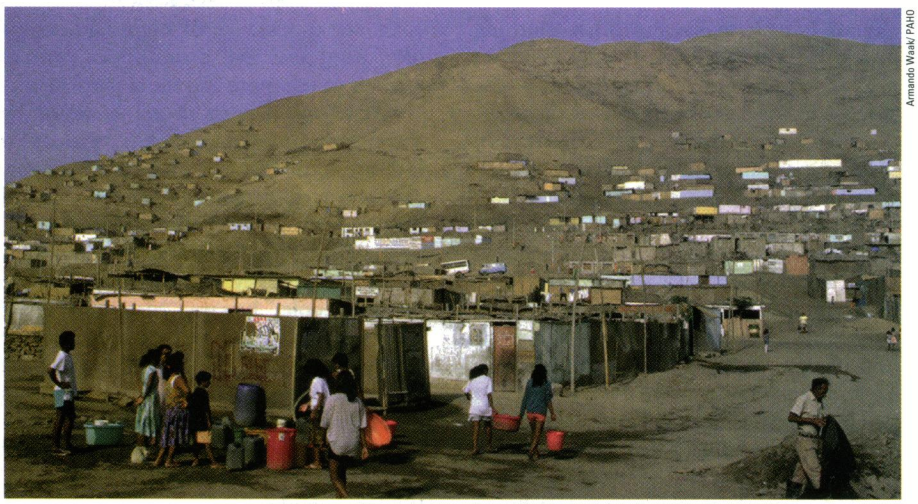
Dangerous Cities

Between 1975 and 1995, urban populations in South America increased by approximately 300%. The continent has 41 large cities (defined by the World Resources Institute as having populations over 750,000), and four of them—São Paulo, Buenos Aires, Rio de Janeiro, and Lima—rank among the world's 25 largest cities.

With urban growth came problems. Industrial emissions, fossil fuel burning, and, particularly, transportation have caused serious air pollution. A December 1996 study published in the *Journal of Environment and Development* showed that in Venezuela, the country with the highest number of cars per capita, even newborns had a blood lead level of 10 micrograms per deciliter (µg/dl). The CDC classifies this amount as an "action" level. Levels greater than this may contribute to developmental disorders and neurobehavioral effects. Automobile exhaust from leaded gasoline was identified as a major factor in air pollution—but also a problem with a feasible solution. A phase-out program, coordinated by the World Bank, is underway.

But populations in large cities like Bogotá, São Paulo, Rio de Janeiro, Santiago, Lima, and Caracas are still exposed to potentially toxic emissions such as carbon dioxide, sulfur dioxide, nitrogen oxides, and suspended particulate matter. These substances are associated with increased mortality and increased incidence of cardiovascular and neurobehavioral disorders. Air monitoring is generally poor in Latin America. However, PAHO figures for 1994 show that in large cities like São Paulo and Santiago, suspended particle matter was between 100 and 400 $\mu g/m^3$, well over WHO guidelines of 60–90 $\mu g/m^3$. Acute respiratory infections are easily transmitted through migration and overcrowding, and complicated by indoor pollution from fossil fuel burning in homes. A 1990 study, "Urban Air Pollution in Latin America and the Caribbean," published in *World Health Statistics*, shows that over 2 million city children suffer from chronic coughs, and 65 million person-days of work are lost throughout the region because of air pollution. Many South American countries have requested help from donor organizations such as the World Bank to increase the sophistication of their air quality monitoring programs.

Continuing migration and deterioration of epidemiological and vector control programs have contributed to the reemergence of mosquito-borne dengue fever, including its most virulent manifestation, dengue hemorrhagic fever. Traditionally an urban disease, dengue is now occurring in rural areas, and dengue hemorrhagic fever, unknown in Latin America before 1981, has appeared in 18 countries, with 140,000 cases, reported in the 17 January 1996 issue of *JAMA*. "We're seeing epidemics in continental South America for the first time in 50 to 100 years, and there are several factors," says Duane Gubler, director of the division of vector-borne infectious diseases at the CDC. "The most important is reinfection by the *Aedes aegypti* mosquito, following the elimination of a continent-wide eradication program in the 1970s. Then there's unplanned urbanization, which allows the mosquito to breed in stored water and nonbiodegradable trash, like automobile tires. And finally there's the jet airplane, which moves viruses back and forth. The constant movement into and within the region helps spread the disease."



Armando Waak/PAHO

Clinging to the edge. Slums such as this one outside Lima, Peru have sprung up throughout South America as a result of mass migration to urban areas.

Pesticides and Profit

The push to expand agriculture, both for urban markets and for Latin America's growing export market, has driven a corresponding expansion in the market of various kinds of agrochemicals, including pesticides. The dollar value of Latin America's pesticide market has grown at twice the world average. According to a 1996 report by the World Resources Institute, *Pesticides and the Immune System: The Public Health Risks*, Brazil and Colombia are the continent's heaviest consumers, applying pesticides at the rates of 1.1 and 3.7 metric tons annually per 1,000 hectares, though no South American country approaches Costa Rica's application rate of 18.0 metric tons annually per 1,000 hectares. Latin American countries both import and produce pesticides including DDT, paraquat, and heptachlor. Environmental and health hazards associated with these chemicals have spurred the United States and many European nations to ban their use. In spite of such dangers, though, DDT remains one of the most effective means of combating the mosquitos that carry malaria, justifying the risk according to Latin American health officials. Customs officials in many countries also often treat products entering the country with methyl bromide, a dangerously toxic post-harvest treatment that is also used in the United States as a soil fumigant. Methyl bromide is a potent ozone destroyer, and its use will be phased out in the United States in the year 2001; in developing countries, its use will be frozen under the Montreal Protocol in 2002.

Exposure can also take place during crop harvest or transport, as well as through forestry, livestock farming, and vector control activities. South American agriculture commonly employs some organochlorines, such as DDT. Organochlorines are persistent in the environment and in human tissues, but are not acutely toxic. But the most commonly used pesticides in South America, representing 40% of use, are organophosphates and carbamates. While these chemicals degrade quickly, some are extremely toxic. Exposure to small amounts of these pesticides can severely inhibit the action of acetylcholinesterase, an enzyme necessary for neurological function, according to Douglas Murray, associate professor of sociology at Colorado State University in Fort Collins. Two or three applications within several days can cause convulsions and death. Prolonged exposure can lead to permanent neurological impairment. Numerous local conditions make safe use of pesticides nearly impossible—the hot

climate (which makes protective clothing uncomfortable), a lack of education on proper application, and, frequently, the absence of water to wash exposed skin.

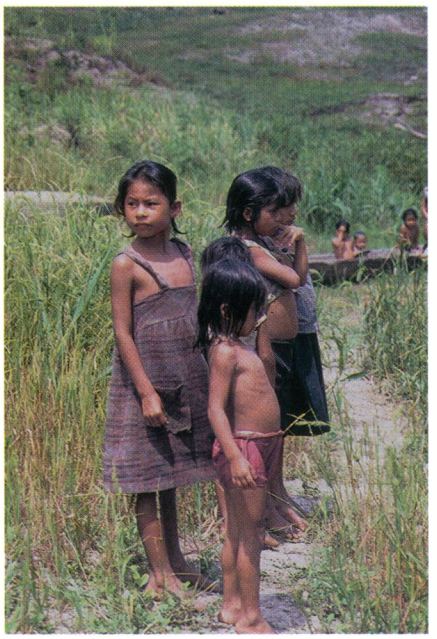
Pesticide residues are common in South American wells and rivers, but their effects, as well as those of various levels of exposure, are not well documented. The only solid data available are from medical reports of acute pesticide poisonings. Colombia, for example, reported 5,618 poisonings between 1978 and 1989, with 660 deaths, 80% of which were due to organophosphates, according to a 1994 PAHO report, *Health Conditions in the Americas*. "And that's just the tip of the iceberg," says Murray. "Many of the symptoms of pesticide poisoning are like flu or food poisoning—nausea, dizziness, blurred vision. Farmers treat themselves; that's a significant factor in underreporting." An additional factor is that health care providers often do not recognize the symptoms of chemical poisoning.

The emphasis on cultivating export crops to boost the South American economy, a strategy of international development organizations, has forced producers to employ large amounts of pesticides, often in an unsafe manner. "In Colombia, cut flowers are produced intensively," says Antonio Bravo, a biochemist with the office of pesticide programs at the U.S. EPA. "Intensified production of flowers requires very, very high levels of pesticides, including insecticides and fungicides. Wanton use of pesticides has led to resistance in mites, which threaten Brazil's orange industry. The cotton monoculture in Paraguay and Argentina has led to boll weevil infestations, and growers there are using a slew of [chemicals] to control them. Importing-country standards on the cosmetic appearance of high-value crops like snow peas and cantaloupes compel growers to use more and more pesticides."

Bravo says the export-crop emphasis by development organizations, meant to increase local incomes and generate jobs, can backfire, creating further cycles of dependence and continuing pesticide exposure. "Some critics argue that research shows little money trickling down to the poorest people," he says. "Many high-value crops are now grown on land once used for subsistence crops. So poor farmers have lost a lot of the productive land that was once used to grow household food. They remain dependent on loans, and many loan programs require the use of pesticides. It's very complex."

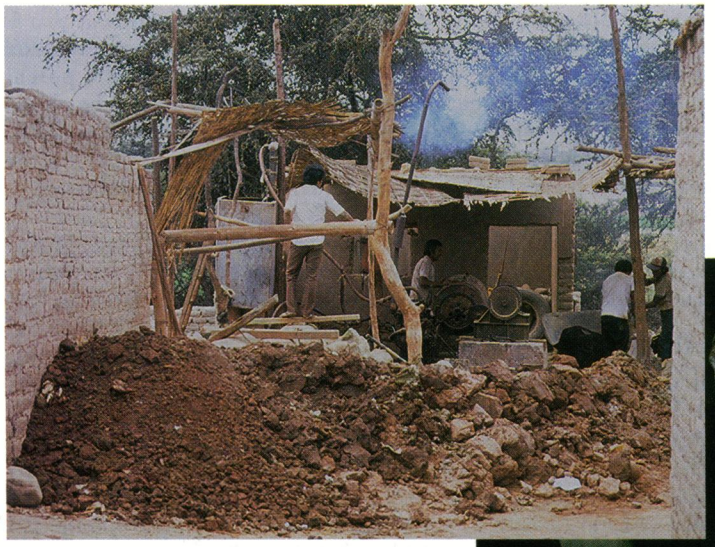
Labor: Hazardous to Your Health

Pesticide poisoning is a major risk for the estimated 40 million-plus agricultural workers in Latin America and the Caribbean. It is estimated that 1,000–2,000 pesticide poisonings occur annually in each of the small countries, and proportionately more in larger countries. Occupational hazards in general are now being viewed as a serious social and economic problem. Experts estimate that only 1% of occupational diseases (which include hearing loss, poisoning by metals, chemicals, and solvents, mining accidents, and skin and osteomuscular disease) are reported.



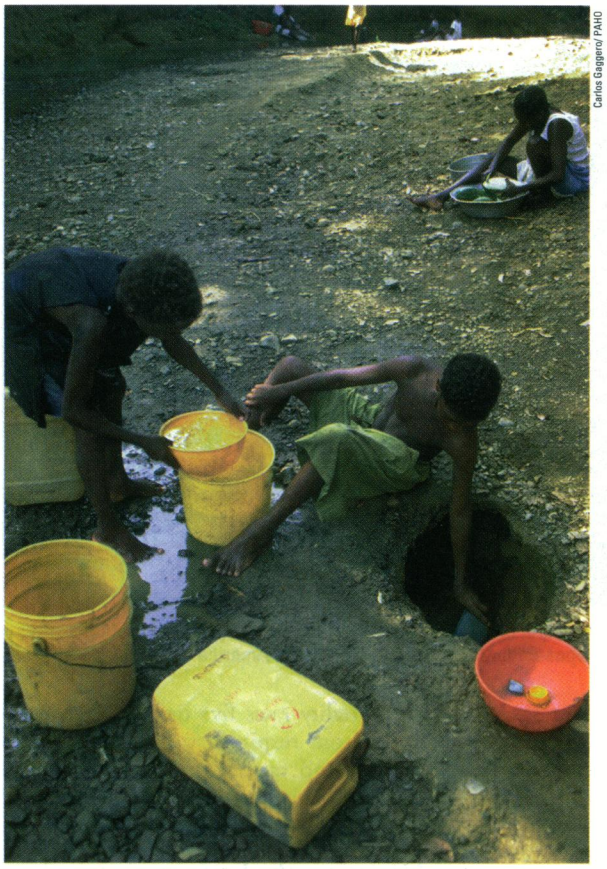
Wee workforce. Children employed as garbage collectors, and agricultural and construction workers are exposed to environmental hazards.

Miners face special risks. Silicosis, a chronic lung disease caused by breathing silica dust, was found in 3–37% of miners and metalworkers in Colombia, Peru, and Venezuela according to *Health Conditions in the Americas*. Gold mining in the Amazon Basin has exposed some 400,000–500,000 miners to the mercury vaporized during smelting, and the environmental damage resulting from mine construction has led to increased transmission of malaria due to an increased number and



Carlos Gaggero/PAHO

Dangerous work. Workers throughout South America are exposed to a variety of occupational health hazards, including injuries, dusts, and toxic chemicals, with little protection.



Carlos Gaggero/ PAHO

For want of a well. Untreated water drawn from suspect sources has become a health liability throughout South America.

concentration of human hosts, and a reduction of animal hosts when their habitat is destroyed. Adjacent ecosystems and human populations are also exposed to mercury released into rivers, although studies show inconsistent levels of contamination.

South America follows the global demographic pattern in which men migrate for work, leaving women and children to take their place as wage earners. More than 35% of urban South American households are headed by women, who frequently replace absent husbands in agriculture. With them come children, also working in the father's place or accompanying the mother rather than being left home alone. Pesticide poisonings among minors are growing: 1994 PAHO figures for Latin America showed that 10–20% of cases involved children under 18.

Children who work receive even greater exposure to environmental risks such as noise pollution and chemical poisoning. A 1992 projection by UNICEF stated that throughout Latin America nearly 20% of children aged 10–14 are employed as shoeshiners, garbage collectors, water haulers, construction workers, or agricultural workers.

Although ignored in official statistics, informal workers, those who earn money outside conventional salaried jobs, comprise a large, important sector of South America's workforce. More than 25% of workers in Brazil and Venezuela, over 30% in Chile and Colombia, and over 40% in Peru are informal-sector workers, mostly manual laborers, domestic workers, and paid or unpaid employees in family businesses. An increasing number of informal workers, estimated at over 100,000, live by scavenging in waste disposal facilities. No definitive studies have been done on these workers, whose vulnerability to health risks is increased by the poverty in which they live.

Water, Waste, and Garbage

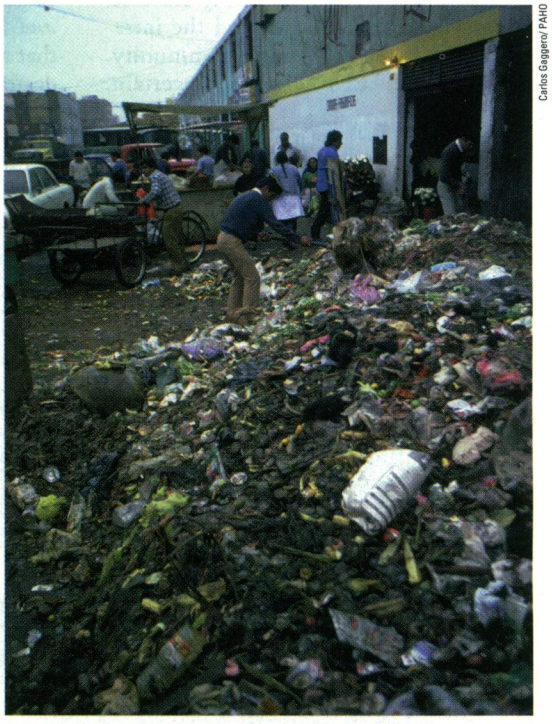
Poor environmental controls have turned South America's abundant water supply, so vital to economic growth, into a health liability. "Eighty percent of Latin America's water is used for agriculture," says Otterstetter. "Since agriculture defines who uses water and its overall quality, the supply for human consumers suffers."

South American rivers receive unregulated, untreated pollutants throughout their course. Considering untreated wastewater in 60% of rural communities, runoff from pesticides and fertilizers, industrial effluents, and urban waste, South America pollutes almost 11 times more fresh water per capita than Europe. Increasing quantities of domestic waste, generated at 0.5–1.0 kg/person/day, are increasingly becoming a disposal and environmental problem, according to Francisco Zepeda, head of PAHO's basic sanitation program. Improper disposal of waste from pollution-producing industries such as tanneries, paper mills, and metal finishers—which produce 0.3 tons of sludge and solids per person annually in Uruguay, for example—pose even more serious hazards. Most countries are just beginning to develop regulations for hazardous waste classification and regulation.

South American governments have sought to improve basic services in urban communities. A universal policy of decentralizing water, sanitation, and solid waste services has shifted responsibility to municipalities and private companies. But service providers and their customers are still in a learning curve, and most operate at a deficit.

Over 60% of large cities, for example, have privatized the disposal of municipal wastes. "The results are mixed," says Zepeda. "Many municipalities are not prepared to pay for the costs of waste disposal. There are problems with inexperienced contractors. Some cities have worked things out. In Bogotá, at first, the contractor was paid according to weight. So the heaviest garbage in the world was Colombian. But now [Bogotá's] system is working very well, as it is in Buenos Aires and São Paulo."

About 70% of domestic garbage is collected, and about 30% is disposed of correctly in South America, according to Zepeda. Only about half is collected in smaller cities (population under 750,000), where garbage is often put in open or semicontrolled dumps, sometimes alongside illegally deposited hospital or industrial waste. In poorly contained facilities, leaching can contaminate the water supply. Because most watersheds that supply South America's cities are heavily polluted with nitrates, pesticide residues, and microorganisms, treatment of the water supply is critical.



Carlos Gaggero/ PAHO

The dark side of cities. Garbage and other waste disposal presents a huge sanitation problem for cities unprepared to cope with continued migration.

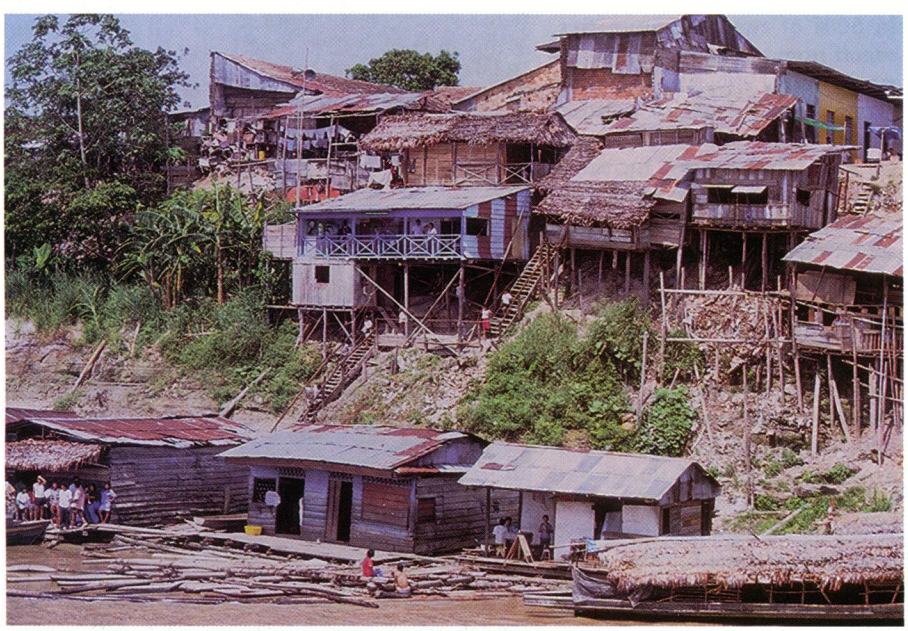
Overall, an average of 70–80% of urban residents receive water and sanitation services, but only 10% of wastewater is treated. PAHO estimated that in 1990 a total of 350 m^3/sec of improperly treated industrial and domestic wastewater was discharged into lakes, estuaries, waterways, and the ocean. And figures for municipal water and wastewater service reflect only erratic service to the peri-urban communities. Peri-urban communities are the informal "squatter" communities that arise around cities. These informal communities often are not connected to urban services such as electricity and water, and are generally crowded and poor. This is partly because cities cannot afford the $218 billion judged necessary to provide full service, and partly because of a somewhat institutionalized policy of neglect. "The data [are] not too bad for giving a rough estimate of services. But populations that aren't in formal areas are often not counted," says Ellis Turner, vice president of the consulting firm Camp Dresser & McKee International and project director of the U.S. Agency for International Development's environmental health project. Says Turner, "There's very little commitment to the informal sector, and data gathering is hard to do. There are difficult physical conditions, with buildings on the sides of hills. There's crime. A lot of municipalities try to avoid the issue, until the problems become so great that they affect the formal community."

Private and municipal water and wastewater providers, often financially unstable, have little incentive to extend the infrastructure to the peri-urban community, where investment returns are uncertain.

Armando Waak/ PAHO

Resurging epidemics. A child in Peru is one more victim of the resurgence of cholera which has spread quickly through poor populations in repeated outbreaks throughout South America.

Without access to clean water or sanitation, shantytown residents risk numerous waterborne diseases such as amebiasis, cholera, hepatitis, and typhoid. Because such populations are poor, frequently undernourished, and have little access to health care, they are extremely vulnerable to health problems. A 1990 comparison by J.E. Hardoy and colleagues of poor and nonpoor mortality rates in Pôrto Alegre, Brazil, titled *The Poor Die Young: Housing and Health in Third World Cities*, showed that among shantytown residents, neonatal deaths were two times higher, post-neonatal mortality rates five times higher, mortality from respiratory disease six times higher, and mortality from septicemia eight times higher than the formal sector of workers.



On the water's edge. Poor communities are often built along rivers that are constantly polluted by urban waste, agricultural runoff, and chemical effluents.

Migration, the Environment, and Endemic Disease

Human interactions with the environment create synergies that affect human and environmental health, according to Paul R. Epstein, assistant director of the center for health and the global environment at Harvard Medical School. As an example, he cites the multiple factors that contributed to the 1991 cholera pandemic that struck Latin America in January 1991. "Excess nutrients enter water systems from sewage, fertilizers, and nitrogen deposits from coal and fossil fuel burning," he says. "The removal of the coastal wetlands, which serve as nature's 'kidneys,' means they can no longer filter and absorb nutrients. Then, because of overfishing, there is diminished predation. Finally, warming enhances plankton and bacterial growth." The cholera was first observed in the Peruvian coastal town of Chancay, some 60 km north of Lima, possibly deposited in ballast water released from an Asian ship. The disease, almost exclusively confined to poor populations, spread north from Peru to Colombia and Ecuador within months. By the end of the year it had crossed the continent and 350,000 cases had been reported. Total cases have exceeded 1 million, with over 8,000 deaths. Outbreaks were reported in 17 countries, with significant resurgences occurring as recently as last year in Argentina, Bolivia, Colombia, and Venezuela.

Poverty and insecure land tenure in cities have also driven urban residents back to the countryside to farm, log, or mine. This migration is clearly linked to outbreaks of diseases—typically not new organisms, but vector-borne endemic pathogens that find new pathways in humans. "We've seen many man-made malarial outbreaks, especially with the colonization of the Amazon. There was deforestation, dam construction, agriculture. The deforestation reduced the natural blood sources of mosquitoes and offered a new, [more easily available], and more concentrated human blood source," says Renato Gusmão, regional advisor of the communicable diseases program at PAHO. "Population dynamics under these conditions are poorly understood. But we see an unbelievable increase of transmissions in humans. We also see some very pernicious strains of resistant parasites."

Making a living. South Americans are learning that a commitment to the economy must go hand-in-hand with a commitment to health.

Malarial incidence in Latin America has remained stable at about 1 million cases per year. But in some gold-mining regions of Brazil, the annual parasite index (API) (infection rate per 1,000 population) is over 100, or 20 times the API of 5.8 for the whole region of Latin America. Colonization of forests and plains has led to numerous outbreaks of bacterial, parasitic, and viral diseases, including oropoche fever, a viral disease that has infected over 300,000 people in northeastern Brazil, and various types of rodent-borne hantaviruses that have caused epidemics in Colombia, Argentina, and Venezuela. Chagas disease, which can cause heart inflammation and enlargement of internal organs, is estimated to have affected over 16 million rural people and has been spread through blood transfusions, as have hepatitis, HIV, and syphilis. Public health centers are improving their screening of blood donors, but not all blood is screened.

Solutions

In Miami in 1994, and in Bolivia in 1996, heads of state for the American countries identified 65 initiatives in health, agriculture, urban and community life, water management, and energy use as part of an overall action plan for sustainable development. Long-term sustainability, experts say, will require a commitment to environmental health by all stakeholder communities including politicians, financial donors, the scientific community, and the public.

Nongovernmental organizations and international aid agencies are increasingly placing their hopes in community-based programs to help poor populations gain access to formal-sector services. Peri-urban communities in Lima have organized trash pickup teams, which pedal tricycle-like carts along fixed routes in the city's spreading slums. These enterprises, funded by the municipalities or directly by residents, serve as many as 250,000 people. In Belo Horizonte, Brazil, the PROFAVELA project helped squatter communities obtain land tenure and, thus, connection to municipal service networks.

Advances in many scientific disciplines also offer hope of improved prediction of disease and disaster outbreaks. An article by Rita R. Colwell published in the 20 December 1996 issue of *Science* described the way in which the warming of ocean surfaces, as in the El Niño phenomenon, can be a factor in cholera outbreaks. This knowledge could be combined with remote sensing techniques to help predict future outbreaks of cholera. International organizations, U.S. government agencies, and universities have embarked on a number of projects to design early warning systems for environmental health effects. "The rise in epidemics can be attributed to a set of factors—local, ecological, social, and global changes," Epstein says. "When factors act synergistically, one may see surprise upsurges in vector populations. We can use remote sensing to better understand habitat and climate forecasting to improve prediction of floods or droughts that provide conditions conducive to outbreaks. Ecological monitoring can help improve surveillance and response capability."

International financial and aid institutions are also focusing on multi-sector efforts. Working with laborers, industry, and the government, PAHO is helping to devise a regional strategy for workers' health. PAHO also promotes the use of inter-ministerial teams in health planning, in an effort to move beyond the strictly medical treatment aspects of health and seek more sustainable preventive solutions. "If [all the stakeholders] involved in mining work together on a plan for miners' health, for example, that's more effective than building a hospital," Cuneo says. He adds that in Latin America's new democracies, community involvement in political decision making, a necessary element for sustainability, has been slow in coming. "It's a long-term project, and it involves a learning process," he says.

Ultimately, addressing South America's environmental health problems may require a rethinking of the opinion that development should be viewed as it has been: in mostly economic terms, and through a short-term perspective. Latin Americans are beginning to realize that environmental sustainability, human health, and economic growth are not separate, but interlinked factors. Decisions made today on how to safeguard these factors will affect the well-being of Latin America's human capital for generations to come.

Stephanie Joyce

Note: Special thanks to the Pan American Health Organization and to Armando Waak for his help in preparing this article.

Corrections and Clarifications

In the **Focus** article on alternative vehicles and fuels that appeared in the June issue of *EHP* ("A Driving Force," 105:582–587), two of the vehicles pictured on the first two pages were misidentified in the caption. The vehicle on the far left is the General Motors EV1, while the third vehicle from the left is the Chrysler PNGV.