

WINTER 2013

# ReVista

HARVARD REVIEW OF LATIN AMERICA

WATER



## Water Facets

When I'm feeling a bit blue on dark winter days, words about water flow into my head: John Masfield's "I must go down to the sea again" or the 23rd Psalm's quiet rhythms, "He leadeth me beside still waters." A walk down Riverside Drive or a stroll along the beach in Cartagena or Coney Island both calms and energizes me.

The fountains of Antigua and Oaxaca remind me of time and timelessness. Although colonial in origin, they hark to life's basic necessity: water. I've long thought this deep spiritual feeling about water was something particular to me. So it was quite a surprise when I discovered my friend Marianne Kinzer (whose photoessay is on p. 36) felt the same way:

Now, I am thinking about Oaxaca again and its water. We went to a village in the mountains, where the mythical birthplace of the Mixtec people is said to be located: Apoala. It is a village in the mountains around Oaxaca. There, a stream originates in a cave, and the first ancestors of the Mixtec people were born.... I took a few photos of the stream emerging from the cave. A brook emerges from the cave and later falls down to lower lying valleys. Above one of the two waterfalls here in Apoala—mythology tells us—the first human was born from a tree. This event is supposedly recorded in the Nutall Codex. I reflected on the importance of water especially for an agricultural society. The tree is very much related to humanity as well. I regard stories like that as ancient knowledge of the importance of water of humankind.

Like Marianne Kinzer, I'd spent months reflecting on the importance of water as I prepared this issue. Dams, hydroelectric power, water filters, territorial disputes over water, climate change, privatization, irrigation: how was I ever going to cover it all in one single issue of *ReVista*?

John Briscoe, who directs the Harvard's Water Security Initiative and has done extensive work on water management in Brazil, provided invaluable help as I shaped the magazine. He pointed me toward the future and the indispensable role of water in development.

It was not until I began reading Steven Mithen's brilliantly written *Thirst: Water and Power in the Ancient World* (Harvard University Press, 2012) that I could connect the powerful surge of water in the spiritual realm with the complicated world of water management. Mithen points out that the lowland centers of the Maya population—the predecessors of those bubbly fountains—were built in a landscape with little permanent water supply. First relying on natural accumulation of water in depressions, the Mayan people eventually used centralized planning to build complicated hydraulic systems over wide swaths of land, Mithen tells us. Water management included aqueducts, dams, channels, drains and reservoirs. Droughts and floods were a reality of every day life, and both ritual and engineering were thought necessary to control them. Likewise, in Peru's Machu Picchu, an icon of lost civilizations, the Inca gained sophisticated expertise in hydraulic engineering. "[The Inca's] military, political and cultural achievements ultimately derived from the management of water," Mithen observes.

My former visits to the monumental Mayan ruins or Machu Picchu had evoked awe and spiritual connections to a past that is only vaguely mine. Now, for me, those ruins connect ahead to a world confronted with floods, storms and climate change. This fall's Hurricane Sandy, with its flooding, brought a new aspect of water management to a city as developed as New York. It battered and damaged Santiago de Cuba—usually highly prepared for hurricanes. And only a few weeks later, torrential rains ravaged Panamá, the gateway between North and South America.

Perhaps science and spirituality are not so far apart, I thought. Water is power and water is life, and we cannot control it all.

*June C. Erlick*

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# ReVista

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### ON THE COVER

The cover of this issue on water shows a hydroelectric  
 dam in Brazil. Cover photo courtesy of Luiz Gabriel Todt  
 de Azevedo

## The Political Geography of Water

In a Changing Brazil **BY JOHN BRISCOE**

**“ONE MUST BEGIN WITH WATER,”** WROTE THE historian Fernand Braudel, because the provision of water services is one of the foundations for civilization. People and societies want protection from floods and droughts; they want water to drink, to irrigate their crops and to produce clean energy. Brazil is a case in point for how one country has used water as a platform for economic development, with its successes, failures and current challenges. A hydrological overlay corresponds closely, as Braudel might have expected, to broad economic regions.

The South and Southeast, the economic heart of modern Brazil, are blessed with abundant and consistent supplies of water. The country’s industrial development was built on the basis of cheap (and clean) hydropower, mostly at a very large scale—the Itaipu Dam on the Paraná River produces more electricity than any

Janeiro, as well as this region’s many other large and small cities.

The availability of abundant water is, however, just one part of a supply chain needed for a healthy urban life. Surveys in São Paulo have shown the dynamic of challenge and response and the hierarchy of demands for a growing economy. Fifty years ago, “clean water” was the highest priority for the burgeoning *favelas*. This need was met both through economic growth and political voice, only to be followed by a demand for getting wastewater out of the house and neighborhood. This challenge, too, has largely been met, and the challenge for the cities is now the drainage of storm water, treatment of wastewater and improvement in the quality of rivers and estuaries. Accompanying these efforts have been gradual changes in the institutions for managing

institution, half-public, half-private, that is charting a new and promising path for reconciling social accountability and efficiency in Brazil and elsewhere. The consistent and moderate rainfall in this region has also underpinned the development of Brazilian biofuels, with entrepreneurial farmers and quality scientific research meaning that Brazil can rely on ethanol as the primary source of energy for its transportation network.

At the other end of the hydrological and economic spectrum is the Northeast, where water has always been both scarce and unreliable, giving rise to endemic poverty and a paternalistic “culture of drought.” The great response in this region—one followed, amongst others, by President Lula—was migration away from hydrological-induced suffering to the *favelas* of the Southeast. But attempts have also been made to use the ample waters of the São Francisco, the one great perennial river of the region, to build a water platform for growth both within the São Francisco Valley and in the arid hinterland. Again the dominant feature has been the capture of the large hydroelectric potential of the São Francisco, providing cheap and clean power to the regional economy. Efforts to use the waters of the river for agriculture within the valley have been persistent, but of limited benefit. Some successes with private farmers irrigating high-value crops have been offset by persistent failures of large public irrigation projects to kick-start the regional economy. Learning from these successes and failures, Brazil is now experimenting with new models of public-private irrigation partnerships, which, it is hoped, will bring dynamism

**Provision of water services is one of the foundations for civilization. Brazil is a case in point for how one country has used water as a platform for economic development, a great achievement. Yet, as is always the case with water, many challenges remain.**

other dam in the world. Over the latter half of the 20th century, most of the economically viable hydropower in this area has been tapped. Hydropower does not, of course, consume water, but rather takes advantage of its flow. Thus, the regulated rivers of the South and Southeast also provided a reliable and abundant supply of water for the growing megalopolises of São Paulo and Rio de

water. In the days of the 1950s “Brazilian miracle,” the approach was state-driven and centralized. Much was accomplished, but the water institutions were largely unaccountable and inefficient. Within the context of the maturing of the Brazilian economy, water institutions too have changed. The Brazilian water utility SABESP, the fifth largest in the world, has evolved into a hybrid



The map shows Brazil's many rivers and regions, including the Amazon, home to the world's biggest river.

but also a broad-based distribution of benefits. Beyond the basin, the great temptation has always been to see a pipeline from the São Francisco as the solution to the endemic water insecurity of the arid areas of the Northeast. After decades of discussion, such a pipeline is now being built, in an effort to find a new security equilibrium for the “drought polygon” to the north. Necessary as the infrastructure is, the great challenge—yet to be squarely faced—is what software (allocation and management instruments) will be put into place to realize the promise of a very large investment.

The third great hydrological region is the Center-West, a savannah once considered impossible to cultivate but now the heartland for the world's largest production of soybeans. Brazil's decades-long investment in agricultural research has been the key, but so too is

the relatively even and consistent rainfall that waters these vast plains.

The fourth great hydrological region of Brazil is the Amazon, home to the world's biggest river and largest forest. Until recently, the Amazon and its tributaries were primarily a barrier to development. But this is changing, because of two big national drivers. The first is the massive hydropower potential of the Amazon and its tributaries. Large as the installed hydropower capacity of Brazil is, twice this potential still exists in the Amazon. Some early attempts to develop this power were disasters, with huge areas submerged for little energy return. As environmental concerns have risen in Brazil, so designers have innovated, with current-generation projects having a footprint per unit of energy just 1/100th that of earlier projects (albeit at the cost of lower reliability of energy supply). The second driver is the need

for cheap, environmentally friendly transport of grains. Despite having two of the great river systems of the world (the Amazon and Paraná), Brazil ships only about 15 percent of its grains by river transport (in comparison to 60 percent for the United States). River transport, unlike roads, does not lead to deforestation and thus developing Brazil's internal waterways is a high priority for the country.

Panglossian as this picture is, two great unknowns and potential threats endanger Brazil's water security. The first of these is the effect of land-use and vegetative changes. A big mystery is why the runoff of the Paraná River has increased by almost a third in recent decades. It is generally assumed that this must be due to land-use changes in its catchment, but there is little science to support this thesis. Looming larger still are questions about the potential impact on the hydrology of the plains of changes in the Amazon forest because of both climate change and deforestation. Every year about 12 trillion cubic meters of water fall on the Amazon forest. About half of this runs back to the ocean in the rivers, but the great forest re-evaporates half, and 6 billion cubic meters (10 times the flow of the Mississippi) gets blown onto the Andes, with the clouds then sweeping down and raining on the plains of Brazil and Argentina. Whereas rain in the United States and Europe comes almost entirely directly from ocean-based evaporation, in South America it is this land-based evaporation which drives the hydrological cycle. Whence a great question: what will happen to the hydrological cycle when, due to climate change and deforestation, the vegetation of the Amazon region changes?





Above: Bathers enjoy the water in Olinda-Pernambuco in northeastern Brazil; a young man gazes out at the water in Salvador da Bahia, also in northeastern Brazil.

What will be the impact on the great green sources of electricity (hydro and ethanol)? What will be the effect on Brazilian agriculture and even on the water-dependent cities?

Last, of course, is politics. People looking from the banks of the Charles River in Boston may raise eyebrows at the “sustainability” of all of these achievements. And indeed the usual celebrities—from James Cameron to Bill Clinton—make the usual lofty statements about their opposition to dams in the Amazon, and the U.S. government finances international and local NGOs to build opposition to these priorities of a democratic government. But Brazil, like China and India and a growing group of middle-income countries, no longer have to bow at these altars—the Brazilian Development Bank is three times the size of the World Bank. At the end of eight years in office, President Lula had presided over extraordinary changes in his country, both in making (in his words) Brazil into “a normal country,” no longer subject to populist politics, and in consistent growth, especially for the poor. President Obama described him as “the world’s most popular politician.” And what was Lula most proud of? The first items in his farewell speech to the nation had to do with infrastructure, especially the hydro plants of the Amazon and the São Francisco inter-basin transfer. Building a water platform for growth and securing Brazil’s water-related security is indeed a great achievement, but as is always the way with water, successes give rise to new challenges which will test the ingenuity of the next generation of Brazilian political and scientific leaders.

**John Briscoe** is Gordon McKay Professor of the Practice of Environmental Engineering and Environmental Health at Harvard University, where he directs the Harvard Water Security Initiative. He teaches undergraduate and graduate courses on water management and development.



# The Struggle for Clean Drinking Water in Latin America

BY JOSEPH B. TREASTER

**FOR THE LAST FEW YEARS I'VE BEEN TAKING** students from the University of Miami to the Galápagos Islands off the coast of Ecuador. We study the environment and the culture. We record the squeaky, hissy conversations of giant land tortoises and the volcanic-black marine iguanas that are found nowhere else. We swim with sea lions and penguins.

One thing we do not do is drink the water.

The people on the island of Isabela, which serves as our headquarters, live in a kind of environmental paradise. Blue-footed boobies and pink flamingos soar over the main village of Puerto Villamil, and little stubby, brown finches dart through the mangroves and shrubs.

But all too often the people in Puerto Villamil and the hamlets in the highlands wake up with a serious stomach ache. It is because of the water. As far as I know, there's been no conclusive analysis of pre-

cisely what parasites, bacteria and viruses are in the water. It runs nicely through pipes into many homes and businesses. But it needs to be boiled to be safe to drink.

The unsafe drinking water there is part of a global problem. Throughout Latin America and the world, nearly 800 million people live without safe, clean drinking water, according to United Nations agencies. More than three times more people—2.5 billion—manage to survive without a decent toilet, day in and day out. People suffering from water-borne diseases take up about half of all the hospital beds in the world. And each year the diseases carried in water kill nearly two million people, mostly children under five years of age.

Economies suffer. Women and girls spend hours each day lugging water from streams and lakes. People miss days at work. Children don't go to school.

In Latin America and elsewhere in the world, climate change and increasing

population are going to make access to clean drinking water even more difficult. More people will have to share the earth's finite water. The higher temperatures of climate change are expected to bring longer dry stretches and more evaporation, alternating with heavy rains and floods. Most places have not developed ways to capture and store the rains and the flooding churns all sorts of harmful things into drinking water.

To deal with climate change, water experts say everyone needs to use less water, especially the farmers in Latin America and elsewhere. Experts estimate that at least 70 percent of the world's water goes to irrigate farm crops and nourish livestock. Much of that water could be saved through the use of drip irrigation, which takes water directly to

**Water quality sampling is an important part of making sure that water is safe for drinking. This image is from Brazil.**

WATER AND SANITATION COVERAGE IN LATIN AMERICA AND THE CARIBBEAN  
 From “Progress in Drinking Water and Sanitation: 2012 Update” Joint Report by UNICEF and WHO

NO.	COUNTRY	POPULATION (2010)  (X 1,000 HAB.)	POPULATION DISTRIBUTION (2010)		WATER SERVICE COVERAGE			
			Urban	Rural	Urban Population		Rural Population	
					Improved Sources	Static Sources	Improved Sources	Static Sources
1	Argentina	40,412	92%	8%	98%	2%	NA	NA
2	Belize	312	52%	48%	98%	2%	99%	1%
3	Bolivia	9,930	67%	33%	96%	4%	71%	29%
4	Brazil	194,946	87%	13%	100%	0%	85%	15%
5	Chile	17,114	89%	11%	99%	1%	75%	25%
6	Colombia	46,295	75%	25%	99%	1%	72%	28%
7	Costa Rica	4,659	64%	36%	100%	0%	91%	9%
8	Cuba	11,258	75%	25%	96%	4%	89%	11%
9	Ecuador	14,465	67%	33%	96%	4%	89%	11%
10	El Salvador	6,193	64%	36%	94%	6%	76%	24%
11	Guatemala	14,389	49%	51%	98%	2%	87%	13%
12	Honduras	7,601	52%	48%	95%	5%	79%	21%
13	Mexico	113,423	78%	22%	97%	3%	91%	9%
14	Nicaragua	5,788	57%	43%	98%	2%	68%	32%
15	Panama	3,517	75%	25%	97%	3%	NA	NA
16	Paraguay	6,455	61%	39%	99%	1%	66%	34%
17	Peru	29,077	77%	23%	91%	9%	65%	35%
18	Puerto Rico	3,749	99%	1%	NA	NA	NA	NA
19	Haiti	9,993	52%	48%	85%	15%	51%	49%
20	Dominican Republic	9,927	69%	31%	87%	13%	84%	16%
21	Uruguay	3,369	92%	8%	100%	0%	100%	0%
22	Venezuela	28,980	93%	7%	NA	NA	NA	NA
	<b>Latin America and the Caribbean</b>	<b>581,852</b>	<b>80%</b>	<b>20%</b>	<b>98%</b>	<b>2%</b>	<b>82%</b>	<b>18%</b>

the roots of plants. But drip irrigation is expensive, and farmers would probably need subsidies to convert from their widespread use of sprinklers. Indeed, much of Latin America’s water is consumed by soy farmers and cattle ranchers in Brazil.

The situation in Latin America and the Caribbean is not as bad as in Africa and India. But the United Nations reports that about 36 million people—more than all the people in Mexico City, Bogotá, Lima and Buenos Aires combined—are living without clean, safe drinking water.

It’s hard to say when things will get better for these people. The water problem in Latin America, as in Africa and India, is mostly a matter of poverty. It is not, as one United Nations agency pointed out a few years ago, that there is not enough water to go around. That is especially true in Latin America, which has some of the most bountiful water resources in the world.

Manuel Rodriguez Becerra served as Colombia’s first Minister of the Environment years ago and has worked on environmental projects for the United Nations. One of the first things he mentioned in an interview with me was the inequality in Latin America: “it is the poorest of the poor who don’t have access to clean drinking water,” he said by telephone from Bogotá.

Around the world, a lack of sanitary facilities—toilets—is a big factor in the unhealthiness of the drinking water. Some people simply wade into rivers and streams where others get their drinking water. Cattle defecate in the same water. In Latin America, as in other parts of the developing world, many rivers are choked with chemical and industrial waste. The Rio de la Plata, which sweeps past Buenos Aires, is one of the most polluted.

The poor often lack the ability to bring pressure on political leaders. They are invisible from the steel and glass skyscrapers of São Paulo and Buenos Aires. And even when governments and humanitarian agencies try to help get water to the poor, they struggle with logistics and coordination and with providing solutions that fit in with the lives of the people they are trying to help.

Lots of people are working on the water problem in Latin America from many perspectives, as you will see in this issue of *ReVista*. But often they are working at cross-purposes. Some governments and humanitarian organizations dig wells. Some distribute purification tablets. Some install pumps. Still others believe the answer is to build big water treatment plants and lay down miles of water pipes. There are many kinds of projects, all useful. But for one reason or



SANITATION COVERAGE				NATIONAL WATER SERVICES AND SANITATION COVERAGE			
Urban Population		Rural Population		Water Services		Sanitation	
Improved Sources	Static Sources	Improved Sources	Static Sources	Improved Sources	Static Sources	Improved Installations	Non-Improved Installations
NA	NA	NA	NA	NA	NA	NA	NA
93%	7%	87%	13%	98%	2%	90%	10%
35%	65%	10%	90%	88%	12%	27%	73%
85%	15%	44%	56%	98%	2%	79%	21%
98%	2%	83%	17%	96%	4%	96%	4%
82%	18%	63%	37%	92%	8%	77%	23%
95%	5%	96%	4%	97%	3%	95%	5%
94%	6%	81%	19%	94%	6%	91%	9%
96%	4%	84%	16%	94%	6%	92%	8%
89%	11%	83%	17%	88%	12%	87%	13%
87%	13%	70%	30%	92%	8%	78%	22%
85%	15%	69%	31%	87%	13%	77%	23%
87%	13%	79%	21%	96%	4%	85%	15%
63%	37%	37%	63%	85%	15%	52%	48%
NA	NA	NA	NA	NA	NA	NA	NA
90%	10%	40%	60%	86%	14%	71%	29%
81%	19%	37%	63%	85%	15%	71%	29%
NA	NA	NA	NA	NA	NA	NA	NA
24%	76%	10%	90%	69%	31%	17%	83%
75%	25%	NA	100%	86%	14%	83%	17%
100%	0%	99%	1%	100%	0%	100%	0%
NA	NA	NA	NA	NA	NA	NA	NA
<b>84%</b>	<b>16%</b>	<b>57%</b>	<b>43%</b>	<b>94%</b>	<b>6%</b>	<b>79%</b>	<b>21%</b>

another they often don't fit together. You get a little benefit for a while. Then the project falls apart. The left hand doesn't know what the right hand is doing.

"The problem," said Ban Ki-moon, the secretary general of the United Nations, in a speech at the World Economic Forum in Davos, Switzerland, not long ago, "is that we have no coordinated global management authority in the UN system or the world at large." Water, climate change and the global food problem share a common burden, he said: "there is no overall responsibility, accountability or vision."

The problem in Latin America and the rest of the world is worse than the United Nations data suggests. By the United Nations standards, when people have water piped into their homes they are no longer regarded as lacking access to clean, safe drinking water. But in many parts of Latin America and the

world, tap water is not safe to drink. No one has counted how many tens of millions of people are in this situation.

But the Centers for Disease Control and Prevention in Atlanta says that people in the Galápagos and the rest of Latin America and, indeed, most of the developing world should not trust the tap water. It can make you just as sick as water from a polluted river.

Charles Fishman, an expert on water and the author of *The Big Thirst*, a book on drinking-water problems around the world, moved to Mexico City from New York. He and many of his neighbors in the upper-middle-class Condesa neighborhood of Mexico City have running water. But, he said in an interview, "no one drinks the tap water, even the people in the barrios, the slums."

Fishman said that in Mexico City, the pipes that carry drinking water and sew-

age were laid long ago underground in a single trench, side by side. The pipes have become corroded and sewage and drinking water intermingle. "The water in Mexico City comes out of the treatment plants clean," he said, "but it becomes undrinkable." The same thing happens in Africa and other parts of the world. The water is clean when it leaves the treatment plant in Kampala, the capital of Uganda, officials say. But a short distance from the plant, residents say, the water turns foul and must be boiled. Some of the poorest people in Africa and in Latin America survive on a few dollars a day. They often choose not to spend money on fuel to boil drinking water. Some people develop immunities to the things in the water. But many are routinely sick.

In many places in Latin America, running water is available for only a few hours a day. That is almost a guarantee

for health problems, said Alain R. Locussol, a water expert in Washington who worked for the World Bank for 25 years. “Each time the pipes go empty,” he said in an interview, “a vacuum is created. When the water starts up, it sucks in pollution.”

The medical costs of unclean drinking water run into the billions for governments around the world. That would seem to be an incentive to clean up the water. But getting local and national governments to spend money on drinking water and sanitation has not been easy. Sometimes there just isn’t any money, no functioning water system and no one to manage it. But equally important, water experts say, is that some political leaders apparently see more benefit in cutting ribbons at opening ceremonies for new hospitals than in dealing with the less glamorous business of removing bacteria and parasites from drinking water. Sometimes it takes a lot of money and time before any impact is seen—not always good on a short election cycle of four or six years. Sometimes, in order to make improvements, the government needs to raise the cost of water to homes and businesses. That is never welcome. Political leaders know it can cost them votes. So, often, they don’t increase prices and don’t expand service or fix broken pipes and pumps.

Selling high-priced water is a business for many people in the developing world. In some places, hundreds of

tanker trucks deliver drinking water. The owners have political clout and don’t want the government to come up with a less expensive way for people to get drinking water.

Another complicating factor is that people sometimes don’t see anything wrong with their water. They don’t demand improvement. The water often sparkles in the sunlight. Instead of blaming the water for their chronic gastrointestinal problems and dehydration, they tell visitors, as one man in a slum in East Africa told me, “That’s just the way it is in this place.” It’s the same in Managua and Mexico.

In the 1990s, many governments in Latin America and other parts of the world thought they might have a solution for the drinking water problem in the cities. The pipes and pumps at the municipal water works needed replacing, so the World Bank and many governments agreed to sell or lease the water works to private companies. The private companies would run the water systems efficiently and people would get clean drinking water. But, it turned out, the private companies raised rates sharply and many poor people could not afford the water.

The issue came to a head in Cochabamba, the third largest city in Bolivia, about 350 miles east of the capital city of La Paz. Protesters took to the streets. Bolivia withdrew its contract. Buenos Aires also threw out the private company.

In Colombia these days, Becerra, the former minister of the environment, said that private companies are doing a good job of running the drinking water systems in the coastal cities of Barranquilla and Cartagena, and that public companies are efficiently supplying drinking water in Bogotá and Medellín. “Many people below the poverty line in Bogotá get clean drinking water,” Becerra said.

In Medellín, Javier Marquez, who has campaigned against private operation of public utilities, said in an email that the Bogotá and Medellín companies give poor people a basic supply of drinking water for free. But he said both companies operate a bit like private companies. When people

who are required to pay for their water do not pay, the company cuts them off. He said that 50,000 low-income people in Medellín have been disconnected from the municipal water system.

The World Bank often made contracting with private water companies a condition for receiving loans. Locussol, the former World Bank water expert in Washington, told me the trend is for public water companies to contract out some of the work, but to retain control on policy and pricing.

Latin America has made considerable progress on drinking water. But it has taken years to achieve. Twenty years ago, more than 65 million people in the region were living without clean drinking water—almost double the official United Nations number these days.

But there is still a lot to do. Many countries are struggling financially. Ecuador, the sovereign authority in the Galápagos, is among them. The drinking water in Puerto Villamil has been unfit to drink for years. What money there is, it seems, is being spent for medical treatment.

One of the most attractive places in downtown Puerto Villamil is a modest, white-washed masonry building overlooking the broad, sandy beach. It extends half a block to the main street, a wide avenue of hard-packed sand and volcanic gravel, illuminated in the evenings by street lamps fastened to weathered driftwood poles. It is the town clinic.

It has a small staff of doctors sent out from mainland Ecuador for obligatory government service. They treat some cuts and bruises and work with commercial divers who get into trouble staying too long in deep water, collecting sea cucumbers for Asian markets. But much of the work, the doctors say, is treating sicknesses that come from drinking the water.

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Flamingo in a lagoon in Puerto Villamil







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# WATER MANAGEMENT

How water gets to our homes and communities—water management—is a priority in Latin America. The challenge stretches across countries, race and social class, urban and rural communities. Here are some experiences in water management from all over the region.

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# Grandmothers and Engineers

## The Heads and Hearts of Venezuela's Bolivarian Process

BY REBECCA MCMILLAN AND SUSAN SPRONK

**A LITTLE KNOWN FACT ABOUT VENEZUELA IS** that grandmothers and engineers are at the forefront of the struggle to improve access to water and sanitation in poor neighborhoods.

Nancy la Rosa, Rosalba Ruíz, Florencia Gutiérrez, Petra Escalona and Sulay Morales, all in their golden years, are working as spokespeople and organizers of the technical water committees (MTAs, *mesas técnicas de agua*) in the low-income Caracas parish Antimano. Engineers such as Romer Malave and Daniel Pereira spend a few days a week walking through the neighborhoods to inspect infrastructure and resolve problems. This new relationship between *barrio* (slum) residents and civil servants has transformed water service delivery in Caracas, an effective example of how popular power is built under the Chávez administration.

The MTAs are an innovative experiment in radical urban planning. Beneficiary communities map their own water and sanitation needs to help to plan state-financed infrastructure development. Because of heavy state investment in water and sanitation infrastructure and this participatory methodology, Venezuela now has 96 percent coverage in potable water, one of the highest rates in the region.

Beyond improving access to services, the MTAs are seen as a driver of popular organization for political and economic inclusion. The committees were one of the first participatory initiatives promoted under Venezuela's Bolivarian Process, which aims to build a protagonistic and participatory democracy as part of the country's transition towards "21st century socialism." Despite impressive advances in service access, the MTAs

and other popular organizations confront two of the Chávez government's most daunting adversaries: bureaucracy and corruption.

### A TALE OF TWO CITIES: WATER, RACE AND CLASS

Caracas's water system is one of the most complex in the world. Given the city's mountainous topography and the dense peri-urban *barrios* that climb its hillsides, providing universal access to water and sanitation is no easy feat.

Before the election of Hugo Chávez in 1998, the Caracas water policy was highly discriminatory. The city center and eastern middle-class suburbs, where most residents self-identify as "white" according to the recent census, benefited from high-quality public services, while the sprawling poor settlements of western Caracas, where most of the residents identify as "mixed" race, developed informally in the absence of attention from the state.

No systematic, planned expansion of water networks existed in the popular sectors until very recently. In fact, in the mid-1990s Antimano and other popular parishes didn't even appear on city maps. The settlement and its more than 150,000 inhabitants were zoned as "green space," even though many factories lined the highway that runs past the *barrios*.

Infrastructure investments in the *barrios* have developed in a piecemeal fashion, usually following the logic of clientelistic networks of the government of the day. In many cases, neighborhoods have constructed their own illegal connections.

The result has been what urban geographer Karen Bakker describes as an "archipelago": incomplete, fractured water and sanitation networks, and highly uneven service access within neighborhoods.

### ENGINEERS: MANAGING THE WATER CYCLE

Walking into Barrialito, in eastern Caracas's Santa Cruz del Este, one is immediately struck by the din of children playing, dogs barking, buses zooming and people chatting. It is August 28, 2012, and we are accompanying Daniel Pereira, a young HIDROCAPITAL engineer in his late twenties as he inspects some recent installations developed in cooperation with the local MTAs.

As we follow him through the circuitous alleyways and stairwells of the *barrio*, residents emerge from their homes to join the tour. Greeting Ingeniero Daniel with a mix of stern frowns and big smiles, the community members compete as each tries to explain the intricacies of their water system to the specialist. One woman, frustrated because she had not had water that week, accuses her neighbor of closing the valve which allows water to reach her house.

Most *barrios* operate on a water cycle whereby households receive water at predetermined intervals. The cycle is managed through an elaborate schedule of manually operated water valves. HIDROCAPITAL aims to train community members to manage the valves; however, in Barrialito, the valves are still managed by the municipality. In other cases, private contractors are responsible. This job is a source of local employment for community members and is also seen as safer for them, since outsiders may be mistrusted in the *barrios*, where violence and delinquency are perennial problems.

Through the MTAs, community members and HIDROCAPITAL engineers have been able to regularize the water cycles to make the service more predictable. Now that people know when water



will arrive, they can plan to store enough water in government-issued tanks to last them until the next cycle. “Our pipes run along here,” explain community members at another point in the tour. Their pipes were installed illegally, and they are now seeking a formal connection. Exasperated, Daniel tries to make sense of the tangle of hoses snaking through the overhead trees.

He then catches sight of a pipe protruding from the ground. “And what is *that*?” he exclaims impatiently. “Oh that’s nothing,” shrugs one resident, as he casually pulls the loose pipe out of the ground and throws it away in an unsuccessful attempt to hide the evidence of a clandestine connection.

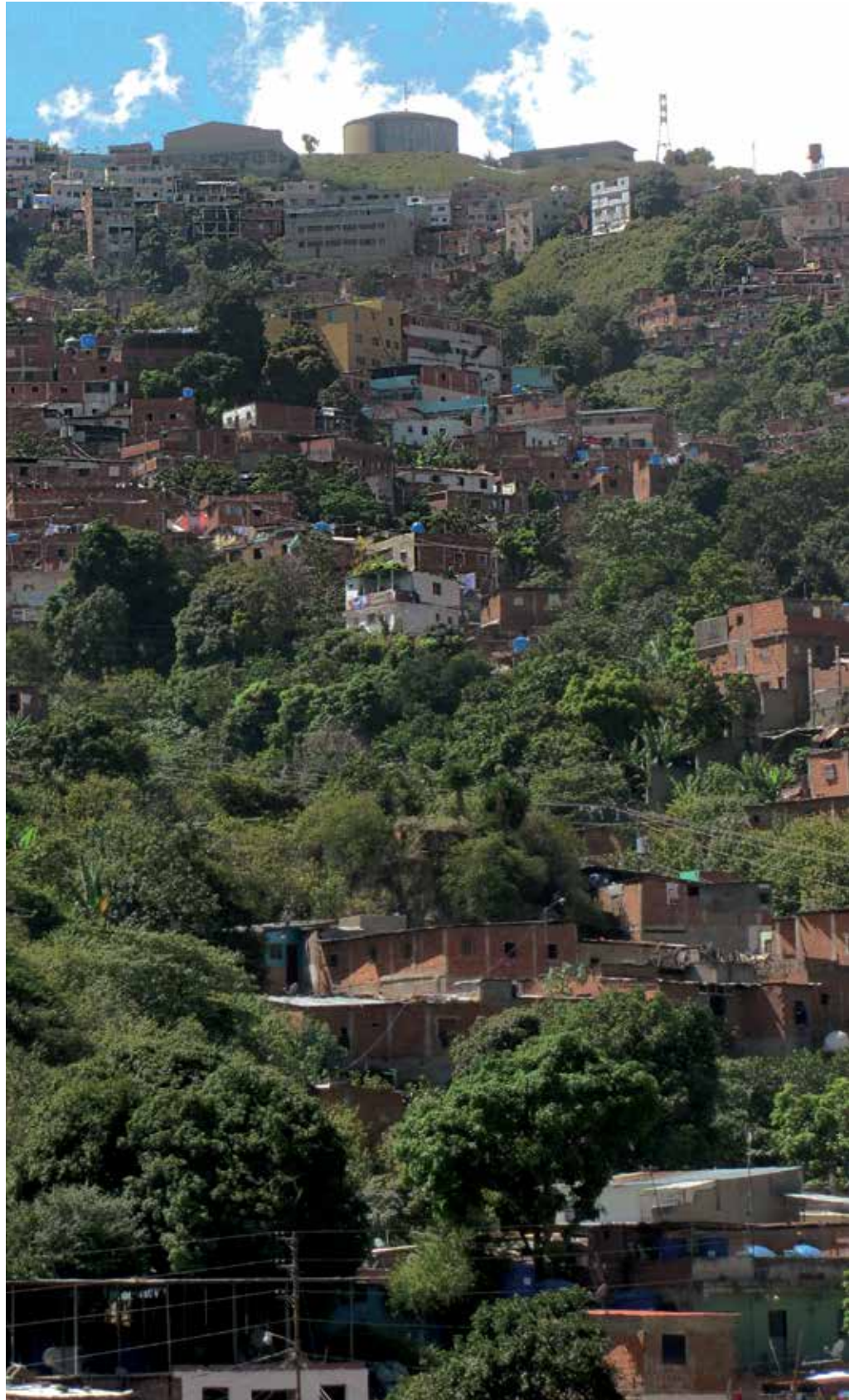
#### FROM PROTEST TO PARTICIPATION: THE HISTORY OF THE MTAS

Discontent with the water service reached its climax in the 1990s. At that time, many households in the *barrios* received piped water only every two months, if at all. Water protests occurred daily in Caracas.

When Aristóbulo Istúriz was elected as mayor of Caracas in 1993, he proposed the MTAs as a way of channeling the frustration into organization for solutions. His strong commitment to public participation led him to appoint a change team to experiment with new forms of local governance. The team included Victor Díaz and Santiago Arconada, current and former Community Coordinators for HIDROCAPITAL, respectively. They spearheaded the implementation of a model of local-level parish governments aimed at overcoming the inertia of the municipal government in addressing the city’s most pressing problems.

During the first parish assembly in 1993, Istúriz proposed the technical water committees, with the goal of improving the relationship between the community, the municipality, and the state water utility. Soon after, the first MTAs were born in the parishes of Antimano and El Valle.

**Providing water to Caracas’s hillside barrios such as Antimano is no easy feat.**



These early experiments were so successful that when Chávez took office in 1999, the leadership of HIDROCAPITAL set out to reproduce the experience across the city. They set up the utility's community management office to institutionalize the relationship between the utility and the technical water committees. In 2001, the *mesas* became national public policy. Today, there are an astounding 9,000 MTAs nationwide.

#### PUBLIC OWNERSHIP AND SOCIAL CONTROL

Much of the debate in water politics has focused on private versus public ownership. But it is now recognized that solutions to the water problem cannot depend on this simple dichotomy. Most utilities throughout the global South have failed to serve the urban and peri-urban poor, regardless of who owns and operates them. Consequently, the Red Vida, Latin America's most important anti-privatization network, emphasizes that the planning and delivery of services must also be *democratic*. They call for citizen participation in the management of urban water utilities as one way of exercising social control.

In Red Vida's view, community service management is a way of changing decision-making structures in urban planning, as well as a strategy for empowering the poor through experiences in organization and self-management.

International development institutions such as the World Bank have also advocated for participation in service provision. But unlike the social movements' demand for "water democracy," which is ultimately about changing power relations, the mainstream approach focuses only on improving service efficiency and does not place enough emphasis on the need for heavy public investment in networked infrastructure.

This narrower vision usually limits participation to fairly passive forms of consultation or "voluntary" labor contributions for water projects, instead of transferring real decision-making power. Moreover, these initiatives are rarely

accompanied by a significant redistribution of resources, as in Venezuela.

Two innovations set the MTAs apart as an innovative, radical case of community management: its methodology based upon the teachings of Paulo Freire, and the community water council (*consejo comunitario de agua*), the space where multiple MTAs come together to interface with the water utility.

#### THE MTA METHODOLOGY: CENSUS, MAP, DIAGNOSIS

Through their participatory methodology, the MTAs attempt to break down the intellectual division between those who plan and make decisions (the bureaucrats and technocrats) and the citizenry. According to Santiago Arconada, a former union activist and HIDROCAPITAL's first Community Coordinator, the approach is based on popular educator Paulo Freire's idea that "everyone has knowledge."

When a community starts an MTA, they follow three steps. First, they draw a map and conduct a census of the community. Self-mapping is a way of inserting the *barrios* into the political landscape of the city. It also helps residents build a collective history of their neighborhood, linking their history of marginality to political action. In cooperation with the water utility, the community then diagnoses its water problems as a springboard for project planning.

When the Chávez government introduced the communal councils in 2006, they too adopted the MTA methodology. Communal councils bring together 150-400 families in urban areas (around 20 in rural areas) to plan and execute community development projects.

The technical water committees, as well as other community organizations (land, sports and recreation, health, etc.) have now been incorporated as working groups of the communal councils. Each communal council elects a group of *voceros* or spokespeople who represent the MTA on the communal council. Given the dominance of women in the movement, most of these spokespeople are *voceras*. The spokespeople act as a liaison between

the communal council and the water utility and other government institutions. They also attend community water council meetings on behalf of their MTA. The community water council brings together HIDROCAPITAL staff with MTA representatives from all of the sectors on the same water cycle to manage the cycle and plan solutions to water problems.

#### POPULAR POWER: THE COMMUNITY WATER COUNCIL

It's 5 p.m. on a Thursday and the traffic in Caracas is bumper-to-bumper. We are in "El chino," the large white Ministry of Environment van, with Victor Díaz, a geographer by training who cut his political teeth in the student movement at the Universidad Central de Venezuela in the 1980s, and is the current Community Coordinator for the Metropolitan Region for HIDROCAPITAL. The occasion is the bi-weekly community water council meeting for the parish of Antimano.

Victor takes advantage of the trip to Antimano to catch up on some missed sleep. Between dealing with an emergency situation involving vandals in La Vega and fielding personal calls from community members about everything from broken pipes to yellow water, he has had a busy week.

When he arrives at the community center, his energy levels are immediately restored. He greets community members by name, mock-scolding those who have missed recent meetings. Judging by the big warm smiles that spread across the faces of the neighbors greeting Victor, the affection is genuine and mutual. Romer Malave, a recent engineering graduate in his early twenties, oversees the water cycle in Antimano. He arrived before Victor and is chatting informally with a group of residents. A few of the attendees are community members who only show up when they have a particular problem. Many, though, are elected spokespeople for their sector's technical water committee. Some of the older women have been working with the MTAs for more than ten years.

Victor opens the meeting with a lengthy discourse on the importance of participa-





**Left above: An Antímáno resident presents her problem to the Community Water Council. Some residents still experience periods of 21+ days without water. Right above: In the MTAs, everyone is an engineer. Barriolita residents explain their water problems to engineer Daniel Pereira.**

tion, which we suspect might be for the benefit of the *gringa* researchers in the room, and announces the plans for the upcoming Fiesta de Agua. During the Fiesta de Agua, the government delivers tanks to communities, as well as funding for projects solicited by the community. Victor insists that the communities must distribute the tanks according to need and not political affiliation. “Just because someone is an *escuálido* [figuratively, rotten aristocrat, or opposition member], doesn’t mean they don’t deserve tanks. To act like that would be counter-revolutionary.”

Following the address, one of the spokespeople invites people to speak, according to a list she compiled before the meeting. One by one, the participants—mostly women—stand up to describe the water problems in their neighborhood.

Sometimes, solutions are found during the meeting. Usually, Romer, the engineer, will schedule a time to visit affected households. Often, Victor gives his personal cellphone number to the

community members to discuss a problem further, reminding *barrio* residents not to abuse it.

“I want to know when your water arrives, so call me,” he says to one young mother carrying a baby whose water did not arrive according to schedule. “It doesn’t matter what time it is.”

This rapport between the utility and the community is a significant departure from the previous era, when the utility staff would not even set foot in the *barrios* and as Victor put it, “plan everything from their air-conditioned offices.”

This improved relationship between state and citizen has translated into real service improvements. In Antímáno, several major infrastructure projects have been planned and implemented with community participation, reducing water cycles in some sectors from every two months to as little as every eight days. Water service has also become much more predictable.

However, challenges still remain.

#### THE LIMITATIONS OF THE MTAS

While the utility is now more responsive to communities, it is difficult to discern how much decision-making power the MTAs have in practice. Government bureaucrats in air-conditioned offices still retain a high degree of control in selecting and prioritizing community projects.

Indeed, the MTA spokespeople in Antímáno are skeptical of government claims that there is popular power in Venezuela. While they support Chávez wholeheartedly, some of the women believe that many organizations have been usurped by people who seek personal enrichment, as opposed to the well-being of the whole community. “There are a few greedy people who are screwing the whole process,” says Sulay, one of the revolutionary grandmothers, expressing her frustration.

Stories abound of corrupt construction unions that have stolen money intended for community projects or community organizations that hoard funds for themselves. (Although the incidents are new,

most will admit that corruption is a very old problem in Venezuela. At least now, “politicians rob us less” since the oil wealth is being channeled to the communities.)

Moreover, the committees are constantly butting heads with what one meeting participant calls the “institutional bureaucracy.” One sector is still waiting for a project that they’ve been pushing for since 2003. Despite persistent promises that water cycles will be shortened, some sectors in Antimano still only receive water

ment’s move to subsume MTAs within the communal council.

From an urban planning perspective, bringing the water committees to cooperate with committees responsible for such things as land, housing, and electricity is very progressive. Moreover, it is part of a broader strategy that aims to build an alternative, participatory state in Venezuela.

However, the result is also that the MTAs have lost their status as an independent, grassroots form of organiza-

United States, it is too close for comfort for many Chavistas.

At an October 11 meeting of the community water council, the participants cautiously celebrated Chávez’s victory. But with the closest margin thus far, they know that they have a lot of work ahead of them.

Like many popular organizations in Bolivarian Venezuela, the MTAs find themselves torn between their firm commitment to the Chávez government and their desire to denounce the negative elements of the process, such as the problems of bureaucracy and corruption.

It is also unlikely that the MTAs have the autonomous capacity to survive a Chávez defeat. As Victor instructs the MTAs, “If the opposition wins one day, I won’t be here anymore. A new government will bring in different civil servants. This is why you need to learn to be autonomous.”

Victor’s statement strikes at the heart of one of the contradictions of the Process: to what extent can popular power be decreed from above?

“No one is going to give us power,” retorts the fiery woman with the Chávez fanny pack. “We need to take it ourselves.”

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The authors would like to thank SSHRC and the University of Ottawa for sponsoring this research.

## The MTAs in Caracas, Venezuela, are an innovative experiment in radical urban planning. Communities map their own water and sanitation needs to help authorities decide on planning water infrastructure.

every 21 days, for only 3 days at a time. “It’s the bureaucracy’s fault,” says one elderly woman, proudly donning a Chávez fanny-pack and red t-shirt. “That’s why things don’t arrive.”

Her statement points to a difficult balance that HIDROCAPITAL tries to achieve: incorporating checks and balances to ensure accountability, while also being flexible enough to respond to the needs of communities. The balancing act does not always succeed.

But the problem of bureaucracy is not only a problem of inefficiency or excessive paperwork. Some are worried that imposing bureaucratic requirements on the community-based organizations is a way of neutralizing their ability to organize outside of official state-sanctioned channels—a way of controlling the popular organizations.

The rigid bureaucratic structures also mean that the institutions are slow to evolve. As Santiago Arconada explains, the leadership of the water utility and the municipality are often reluctant to cede power to the communities, because it means giving up their own privileges. On a tour of Antimano, the women also expressed frustrations with the govern-

tion. In practice, many MTAs in Antimano today consist of little more than one committed spokesperson who acts as community representative at the communal council, plus a loose grouping of people who attend meetings only when they have problems.

The mandated affiliation with the communal council also adds an additional layer of bureaucracy. “The communal council won’t give me the papers I need to work with the institutions,” says Nancy, whose repeated conflicts with her communal council have slowed her committee’s projects.

### THE FUTURE OF THE MTAS

Amidst all of these problems, the October 7, 2012, presidential elections and the recent illness of President Chávez have plunged Venezuela into deep reflection on the future of the Bolivarian Process and the role of popular organizations within it. With 81 percent voter turnout, Chávez received 54 percent of the popular vote. But the main opposition candidate, Capriles Radonski, came in second with a substantial 44 percent of the vote. While such a mandate would be considered a landslide victory in Canada or the



# A River for Millions

Urban and Rural Lifestyles Meet in Peru **BY GONZALO ALCALDE AND DIEGO ESPEJO**

**SEVENTEEN-YEAR-OLD ERIKA YBAZETA WENT** to school in the small town of Santa Eulalia in the Peruvian highlands. The town is less than an hour's drive from Lima, the coastal city of nine million that is the nation's economic and political center. After graduating, Erika was only able to find work doing subsistence farming on her family's small parcels of land in the nearby rural community of Cashahuacra. Thus, she is now part of what has been traditionally the main economic activity in the Santa Eulalia River basin.

Modern life in Lima, Latin America's fifth largest city, would be unthinkable without the natural resources from this Andean valley. Located in the province of Huarochirí, it has been renowned among *limeños* for centuries for providing them with custard apples (*chirimoya* in Spanish) and avocados, as well as many other fruits and vegetables. However, few in the city are aware that the valley also provides more than half of their drinking water and 70 percent of their electricity, through hydroelectric power.

Life for approximately 30,000 people living in the Santa Eulalia basin is very different from life in metropolitan Lima, despite the geographical proximity and close ties. Only 30 percent of rural dwellers have electricity; 92 percent don't have access to water, and 69 percent have no sewerage. In two of the ten districts in the basin, more than three out of every four residents have unsatisfied basic needs in terms of housing, water and sewerage, education, and income. It is not entirely surprising, then, that economic opportunities for young people like Erika are few and far between in rural Santa Eulalia.

Water supply and agricultural produce are not the only valuable assets for economic growth in the valley;

ancient archaeological sites, traditional cuisine and striking natural landscapes have made this area a favorite weekend destination for thousands of *limeños*, especially over the last decade. The town of Santa Eulalia, a rapidly growing urban center, has experienced much unplanned growth as a result of increased tourism.

Erika's father, Rony Ibazeta, is governor of Cashahuacra and the community's political representative in the town of Santa Eulalia. Thus he has seen at first hand the dramatic surge in restaurants, riverside country clubs, and other places frequented by people from Lima who escape the city's gray skies and hectic pace.

While tourism has brought growth and business opportunities for some in the town and surrounding areas, it has also led to water and waste pollution,

as well as other problems that rural dwellers like Rony view with uneasiness. Although armed with greater budgets, politicians in Santa Eulalia and the Huarochirí province have concentrated the provision of new services on new urban dwellers and have tended to forget the rural communities. For centuries, the latter have considered themselves guardians of the river and of the natural and cultural heritage that are now sources of wealth for perceived newcomers. Rather than an opportunity, many like Rony see tourism as an antagonist that seeks to exploit water resources for its own purposes, without offering any direct benefits to lifelong residents.

**The Santa Eulalia River from above**





An Integrated Water Resources Management (IWRM) project implemented in 2012 sought to harmonize the interests of the different groups using the water from the river basin. However, the project did not yield the expected results. Without competent leaders formulating clear objectives for dialogue, such initiatives generally fail. Communities in different parts of the basin have had little experience in coordinating their activities, and there is a significant lack of trust among various rural actors outside tightly knit communities. Dialogue is even more problematic between these rural actors and their urban counterparts. Rural dwellers consider their territory to be highly vulnerable, and they regard the case of Santa Eulalia as a cautionary tale of the negative impacts of tourism, which include undesirable social and environmental consequences.

In general terms, citizen consultation workshops held during the recent IWRM project revealed that there is discontent regarding the marked inequality in access to basic services between urban and rural areas, as well as with the perceived preference shown by state actors for addressing the needs of urban areas. Moreover, the rural population sees the proposed construction of a new paved road, connecting lower and higher areas of the basin, as a threat to their lifestyles rather than an opportunity for selling and transporting their products.

One of the people involved in the IWRM project consultations was Enrique Wangeman, a forestry engineer and businessman from Lima who owns a house in Santa Eulalia and whose grandparents were landowners nearby. Wangeman has played a key role in two associations that provide some hope for improved coordination among water users in the basin. First, he is president of Asociación Yacuñahui, a group that brings together most of the area's

**Top: Sunrise seen from Laraos, a rural village in the upper Santa Eulalia basin; Bottom: Mr. Evaristo, political representative of San Juan de Iris, rural village of the upper Santa Eulalia basin.**



avocado producers, providing a space for dialogue within an important sector of water users. Perhaps more importantly, he was also one of the main driving forces behind the formalization in 2011 of a commonwealth association (*mancomunidad*) that provides a platform for coordination and policy dialogue among all the local governments across the ten districts in the river basin. The commonwealth is still in its early stages and has not yet produced concrete results.

To date there has been little government communication or consultation regarding the benefits of tourism and

in many ways, not least because of the diversity of actors involved. Three types of populations depend on the small river in this area: farmers; residents and business people in the urban area; and millions in Lima who are likely unaware of the importance of the river basin to their everyday lives.

At the same time, three levels of government are involved, together with a multitude of civil society and private sector actors. National government action is important in many ways, especially as it provides the legal framework for water use. Such legal frameworks have tradi-

tioning activities. Most of the mining activity in the area finished decades ago, but the impact on water resources that are vital for millions of Peruvians is still evident. Laws and policies addressing the environmental liabilities of closed mining projects are unclear and weakly enforced at all levels of government.

Thus, potential conflicts loom behind the idyllic landscapes of the Santa Eulalia basin. In February 2012, President Ollanta Humala visited Huarochiri and announced that the Central and Regional Governments would soon construct the long-postponed paved road to connect the different areas of the basin. This includes the community where the Ybázetas live and work and also dozens of other small villages that have remained in far greater isolation from the urban issues of Lima and its inhabitants.

A small river can provide livelihoods for millions. Yet in a country with a rapidly growing economy, increasing social conflicts and changing consumption habits, the use of even a small river must be carefully managed if it is to be sustainable. Where tourists like Mario see natural beauty and rural traditions, local citizens like Rony and Erika increasingly see social exclusion and threats to their way of life. At the same time, however, some aspects of the ancestral relationship of farmers with the river may need rethinking. The growing use of modern elements like fertilizers, detergents and other substances by small farmers is not properly addressed by their traditional methods of water and soil cleaning. In the Santa Eulalia River valley, dialogue and capacity building is necessary for all those involved, not just the newcomers.

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## A small river can provide livelihoods for millions, but its use must be carefully managed to be sustainable. An Integrated Water Resource Management project seeks to harmonize diverse interests.

improved infrastructure in the valley. Such an initiative would be valuable, given the fear expressed by local communities that tourism could increase to unmanageable levels, thereby reducing access to water by farmers, damaging land and hindering traditional festivities. At present, neither the people nor the tourist attractions are well prepared for a large influx of *limeños*.

Mario Tavera is one of the thousands of middle-class *limeños* who already visits Santa Eulalia when he needs a day or two away from the traffic jams and air pollution. Although Tavera is careful about garbage disposal, the restaurants that he visits generally throw out all their waste directly into the Santa Eulalia River. The restaurants do not have many alternatives, as public sewerage and waste disposal systems are very limited. Mario is not aware, either, that this is the same water that will eventually reach him in Lima when he takes a shower or cooks.

Coordinating the use of water resources in Santa Eulalia is complex

tionally only considered agricultural use of water and have not fully accounted for other uses like tourism.

Passed in 2009, a new National Water Law holds different users accountable for their water consumption. The Lima Regional Government should enforce the law, but this has not yet been the case. The Regional Government has also failed to adopt an integrated view of the basin's social and environmental needs when formulating new infrastructure and other development projects. Finally, local governments have been more preoccupied with attending to areas with the greatest density of voters rather than anticipating and preventing conflict between social groups with particular interests and preferences regarding water resources.

In addition to this complex set of actors, once-active mining continues to affect the water resources in the basin. The river water has been found to contain significant levels of heavy metals and other elements that are the result of natural sedimentary processes and



# Amazon Rivers

Sources of Renewable Energy **BY LUIZ GABRIEL T. AZEVEDO**

**THE VAST AMAZON RAINFOREST SPANS OVER** eight South American countries and covers an area of approximately 6.7 million square kilometers. Thirty million people live in the Amazon, coexisting with about 10 percent of the known wildlife species. The immense network of rivers, lakes and wetlands overlapping this area forms the largest watershed on earth, accounting for 15 percent to 16 percent of the total river discharge into the oceans.

Rivers in the Amazon are essential to the livelihood of local communities, representing an important natural resource base for the economic and social development of the countries they cross. High gradients between the Andes mountains and the Amazon plains, and the gigantic water flow through the region, signify an enormous energy potential.

The Amazon is the next and perhaps one of the last frontiers for hydropower expansion. Hydroelectric development in South America over the next twenty years will be concentrated in the basin. In Brazil alone, the largest country and economy in the region, hydropower corresponds to 68 percent (88.2 gigawatts-GW) of the total 130.8 GW that are to be installed between 2005 and 2030, considering all other sources of energy (such as gas, coal, nuclear, wind, biomass and solar). This growth in hydropower generation will take place primarily through the implementation of new projects in the Amazon.

Only a fraction of the Amazon hydroelectric potential has been tapped for power production to date. However, the first crop of projects implemented during the 1970s and 80s did not fully succeed

in balancing energy generation with other objectives. New projects, in contrast, are more holistic in nature, focusing on multiple objectives as a consequence of lessons learned from past experience. This process is also aided by increased scientific and technical knowledge, the implementation of strict legal and regulatory frameworks, better social controls, and the innovative thinking of proactive and responsible companies involved with a new generation of hydropower investments.

Companies realize that in a world increasingly focused on sustainable development, it is essential to anticipate how a hydroelectric project—or set of projects—will affect the environment and, in turn, how the project is influenced by that environment. In the





**Planning for the development of Santo Antônio began in 2001 through a public-private partnership between Eletrobras Furnas and Odebrecht Energia.**

The long-term perspective of a company that will design, build, and then run a project for a number of years involves the ability to anticipate challenges, to manage risks, and to obtain a “social license” to operate. Therefore the modern dam’s greener hue is not only a consequence of increased environmental awareness, but it also reflects the need to avoid or mitigate the unpredictable extra costs of environmental suits, opposition from indigenous populations, and political backlashes.

Companies that have been successful in overcoming the challenges to sustainably expand renewable energy generation in the Amazon have looked critically into the past and realized that their “social license” to operate requires: (a) a strategic vision to advance the development of a comprehensive sustainability perspective; (b) technical excellence to evaluate a range of feasible engineering layouts and alternatives; (c) comprehensive in-depth knowledge of the area (e.g. environment, social, etc.) where a project is planned; (d) a broad basin-wide and/or regional view to anticipate project impacts and risks—in particular short-and long-term indirect impacts and cumulative impacts; (e) effective communication with a wide range of stakeholders, from local communities to global players such as financiers and non-governmental organizations; (f) strong monitoring and supervision controls to effectively check implementation against plans; (g) efficient management systems able to adapt to unforeseen events and rapidly changing conditions; and (h) transparent governance systems.

A contemporary generation of hydropower developments can be seen in a recent example. The Santo Antônio Hydroelectric Project was the first large plant to be built in the Brazilian Amazon in almost three decades. Once completed, it will be the third largest in the country, with an installed capacity of 3,150 MW—enough to supply 11 million households or approximately 40 million people. Plans

are being finalized to further increase its installed capacity by 13 percent (429.6 MW) at marginal social and environmental cost, through the incorporation of six additional turbines. This will optimize its energy output and generate additional benefits to the Brazilian grid. In spite of its location in the midst of the Amazon rainforest, it is considered a pioneer in breaking paradigms and showing how hydropower can be generated sustainably.

Planning for the development of Santo Antônio began in 2001 through a public-private partnership between Eletrobras-Furnas and Odebrecht Energia, which received government authorization to conduct the feasibility studies. Following approval by the Brazilian government, the project was put up for auction in December 2007, and the 35-year concession was awarded to Santo Antônio Energia S.A., the company that offered the lowest tariff to generate energy (R\$ per kilowatt—KW). The concession contract was formalized about seven years after initiation of the planning stage. In March of 2012 the first of Santo Antônio’s 44 turbines initiated power generation, around three and a half years from the beginning of construction. The longer planning stage, as compared to a shorter implementation phase, represents a major change in the historical pattern and is a true success story. The project will be completed by early 2016.

The implementation of Santo Antônio has been marked by extensive environmental work to ensure that negative externalities are fully mitigated or compensated. This has included, for example, state of the art technology to ensure that fish can continue to migrate upstream and that fish eggs and juveniles can pass unharmed through the dam as they move downstream. The dam’s layout was adapted to ensure the maintenance of adequate sediment flows, and the area to be preserved is significantly larger than that occupied by its reservoir.

Amazon this implies developing solutions that integrate power generation and its vast stream of positive externalities with effective environmental gains, the preservation of a unique natural heritage, and long-term benefits to local communities, including traditional and indigenous populations.

In traditional hydropower models, different phases of the project cycle—from identification and feasibility through design, construction, commissioning and operation—were often fragmented into separate short-term implementation stages. New hydropower developments favor competitive models that seek integrated solutions, providing companies with long-term concessions to build projects and to sell their energy as they move towards more sustainable hydropower.



**Left above: Haitians work on the Santo Antônio Dam in a variety of capacities. Right above: Women are also extensively incorporated into the Acreditar Program, which is developing a legacy of continued professional development and environmental awareness.**

One of the strategic early decisions was the adoption of bulb turbine technology suited to high water flows. The use of this technology has reduced the size of the planned reservoir from 1,500<sup>Km</sup><sup>2</sup> to approximately 546 Km<sup>2</sup>, an area roughly equal to the river's natural flood plain. This has led to a highly efficient project with the lowest reservoir-to-power ratio amongst dams in the Amazon (0.11 Km<sup>2</sup>/MW).

Another fundamental step towards sustainability was the early initiation of the dialogue with interest groups. Seeking participation and open discussion of the project with those affected by its implementation, Odebrecht Energia and Eletrobras-Furnas implemented a process to establish trust with local groups. This involved specific strategies directed at those affected, namely: (a) traditional populations (*"ribeirinhos"*) living on the banks and flood plains of the Madeira River; (b) indigenous peoples; (c) the urban population of Porto Velho, the capital city of Rondonia; and (d) municipal, state, and federal governments.

The early consultation process set the foundation for a trusting relationship, and allowed for the identification of major concerns and needs of the community, which involved but were not limited to: employment opportunities; skills training and capacity building; concerns with the potential growth of slums in Porto Velho; and the lack of adequate infrastructure in the capital city. A consequence of this dialogue was the development of initiatives that directly met the expectations of this set of stakeholders.

One of the most successful initiatives resulting from the consultation process was the "Acreditar" (believe) Program, an innovative and unprecedented capacity-building program developed and implemented by Odebrecht Energia. The lack of a skilled labor force in Porto Velho, a town of about 300,000 people located 8 km from the project site, provided the inspiration for "Acreditar." A survey of professional skills in the area showed that the number of locals that would be able to work in the implementation of the project represented only 30 percent of

the total necessary workforce (estimated at about 20,000 at peak). The majority of the manpower to work at the construction site would thus have to come from out of town or state and might trigger a spurt of population growth exacerbating the town's social problems.

Odebrecht Energia developed "Acreditar" to turn that equation around, setting a goal of hiring 70 percent of the workforce locally. The success of the program is measured by the fact that 82 percent of the workforce employed in the construction of the project has been hired around the region. Gender inclusion has also been an aim of "Acreditar," and in Santo Antônio women represent over 10 percent of the total workforce, a record in the heavy infrastructure industry. The stream of benefits resulting from this initiative is massive, including significant growth of employment and income generation in Porto Velho with consequent spinoff benefits to the local economy. "Acreditar" has expanded to other large infrastructure projects in Brazil and abroad (over 55,000 workers have completed the program), including



two other hydropower plants currently under implementation by Odebrecht—the Teles Pires Hydroelectric Project in Teles Pires River in Brazil, and the Chaglla Hydroelectric Project in the Huallaga River in Peru. Ultimately, “Acreditar” is leaving a legacy of continued professional development and environmental awareness.

The significance of these voluntarily driven, replicable initiatives supported by innovative thinking is that they have been implemented for commercially viable projects.

A person watching the myriad of workers, cranes, trucks and concrete structures that make up the “temporary city” of 15,000 by the clay-colored mighty Madeira River would not be able to fully appreciate the range and magnitude of challenges involved with the implementation of such massive projects. Overcoming such difficulties requires, more than anything, the courage to see challenges as real opportunities.

Santo Antônio and other such projects represent a new dawn of hydropower development in the Amazon. They show how to reconcile a full range of local to global objectives through strategic long-term vision. The choice facing hydropower expansion in the region is between the set of forward looking governmental institutions, companies, NGOs, and communities working together and pushing forward successful approaches, and those who still support myopic interests and confrontational agendas. What would you choose?

**Luiz Gabriel T. Azevedo** is a Brazilian water resources engineer who has dedicated his career to development issues in Brazil and in many other countries. A former executive with the World Bank and the World Wildlife Fund, he is the Sustainability Director for Odebrecht Energia. He is a graduate of the Federal University of Bahia and Colorado State University.

# Investing in Latin America's Water Factories

## Incentives and Institutions for Climate Compatible Development **BY NIGEL ASQUITH**

**TROUBLE HAD BEEN BREWING IN THE BOLIVIAN** village of Santa Rosa for weeks. That morning, one of Serafin Carrasco's cows had been killed, the neighbors angry that Serafin and his four colleagues were starting a watershed forest conservation program. “We should wait a few months for the tension to disappear,” the four others had agreed. Although alone in his determination, Serafin was in no mood to give up. “No one will tell me what I can and cannot do on my land” he declared, pounding on the table. “Every year the rains fail and every year there is less water in the river. I will conserve my forest in order to protect our water and I will ask the people downstream to help me do so.”

tional US\$0.01 per cubic yard of water to protect the “watershed services” provided by the lush cloud forests that covered the slopes of the Barva Volcano. After 12 years, this independent and self-sufficient program now charges US\$0.03/cubic yard and raises \$300,000 annually for upstream forest conservation.

Across Latin America, the watersheds that could provide users with clean water often have to support additional and sometimes conflicting functions, such as agriculture and forestry. In many places, existing regulatory frameworks have proved unable to reconcile these conflicting needs. Fortunately, incipient learning-by-doing experiences in places

## Across Latin America, the watersheds that could provide users with clean water often must support additional and sometimes conflicting functions.

The town of Heredia, a few minutes drive from Costa Rica's capital San José, is a world away from rural Bolivia, but Luis Gamez from Heredia's Public Services Company used to wrestle with the same problem as Serafin Carrasco. While cities, towns, governments and donors were happy to invest heavily in water purification, treatment, and distribution infrastructure, when it came to protecting Latin America's “Water Factories”—the upstream forests where water actually comes from—investor interest, like a raincloud above Heredia on a sunny day, used to evaporate away into nothing. In March 2000, however, that all changed. Heredia started charging users an addi-

like Heredia and Bolivia's Santa Cruz valleys suggest that watershed management may be improved by providing incentive payments to upstream landowners to help them adopt land use practices that are better aligned with water provision.

One of the greatest threats to Latin America's water supplies is extensive cattle grazing. Cows enter streambeds to drink, forage, urinate and defecate. Municipal water is contaminated, increased sedimentation blocks pipes and dams, and children miss school with diarrhea. One of earliest successes of Heredia's municipal watershed protection scheme was to figure out how to remove the cows and the how to keep them out.



**Above:** The Amboró Waterfall is a beautiful sight, but also a practical source of water flow. **Right, opposite page:** Downstream irrigators work on maintaining the channel.

Small-scale lesson learning in places like Heredia had already led to action on much greater scale. Costa Rica's 1996 Forest Law established a national "payments for environmental services" (PES) program with the purpose of mitigating greenhouse gas emissions and protecting watershed services, biodiversity and scenic beauty. The law established a regulatory framework for contracting with landowners and a semi-autonomous National Fund for Forest Financing. To participate in the program, landowners submit their land title and a sustainable forest management plan prepared by a licensed forester. Once this plan is approved, specified practices such as planting timber and conserving or managing forests trigger the start of payments. In 2006, for example, annual payments for conservation averaged US\$140/acre, while for forest plantations US\$1,795/acre was disbursed over ten years. The program is funded primarily by a national tax on fossil fuels, and has proved highly popular with land-

owners, with requests to participate far outstripping available financing.

The Mexican and Ecuadorian governments have since initiated similar schemes. Mexico alone has spent almost US\$480 million over the past eight years on a Program for Hydrologic Environmental Services that makes conditional cash transfers to individual and collective owners of the natural forests that provide watershed functions. Payments for cloud forests (US\$88/acre/year) exceed those for other tree-covered lands (US\$66/acre/year). Contracts with suppliers of environmental services are signed for five years, with conditional renewal, and cash payments are made at year's end, provided that compliance with contractual obligations has been satisfactory during the preceding twelve months. Monitors analyze satellite imagery and carry out random field visits to detect changes from forest-cover baselines. The 2003 budget allowed for the enrollment of 277,000 acres, with

the highest priority given to areas where the threat of deforestation was greatest, zones which had an elevated incidence of poverty or biodiversity, and watersheds important for downstream communities or aquifer recharge.

The logic behind all these "Payments for Environmental Services" (PES) schemes is seductively alluring. Payments provide direct and tangible economic opportunities to farmers who commit to sustainable non-destructive uses of forest or to protect the environment: for example signing agreements to keep cattle away from their water sources. Thus even small payments to farmers such as Bolivia's Serafin Carrasco actually end up indirectly benefiting the entire country. Further, by locking up the carbon in old-growth forests, PES schemes have the potential to contribute to mitigating climate change, and by protecting water supplies, may help farmers in drought-susceptible regions adapt to climate change. PES





proponents say such conditional cash transfers to the poor have the potential to be a silver bullet for both development and the environment.

However, large-scale government-led PES schemes may not actually provide all of the hoped-for environmental and development impacts. Landowners can usually choose which land parcel to enroll, and thus most likely choose the areas they were not going to deforest anyway. The schemes are standardized, so landowners across the country receive the same benefit—regardless of the quality or environmental importance of or risk to their land. Local communities are often removed from decision-making and payments are made in cash, so landowners may view the arrangements simply as a market transaction that may be overwritten as soon as another, more attractive opportunity arises. In short then, in cash-based PES schemes, even if the farmer has actually changed his behavior and is conserv-

ing land that he otherwise would have deforested, there is a high risk that this behavior change will only last as long as the payments do.

A different form of incentive-based conservation has also been developing. Started by farmers such as Serafin Carrasco in Santa Rosa and epitomized by the initiatives in Heredia and Bolivia's Santa Cruz Valleys, these compensation schemes are locally designed, funded and implemented, and focus on local priorities. Payments are often made not in cash, but in kind, in the form of locally appropriate alternative development projects such as beekeeping.

"If I receive money, I will spend it quickly," stated Serafin as the program started, "but honey production has helped me diversify my income. With support from downstream, I learned the importance of keeping the forest healthy and keeping the cattle away from streams."

Farmers such as Serafin don't conceptualize such mutual support schemes

as payments for a service. Rather, the schemes are known locally as "reciprocal watershed agreements." The downstream water users who want to maintain upstream forests directly fund the schemes, focusing on the forests that are hydrologically most important to them. Compensation can vary with levels of threat; education and social marketing can help promote and build on local social norms that favor conservation and development. Most importantly, the proximity of service users and providers can promote strong mutual dependence—if the landowner cuts his forest, it will be quickly obvious to his downstream counterparts.

Practitioners such as Costa Rica's Luis Gamez and Maria Teresa Vargas of Fundación Natura Bolivia, have therefore hypothesized that small-scale conservation incentive schemes based on local concepts of reciprocity and benefit-and cost-sharing may actually work better than large-scale government-led PES

schemes. This may be especially true in a rapidly changing global climate.

By protecting the water factories in upper watersheds that would otherwise be deforested, local schemes can sequester highly “additional” carbon dioxide, thus mitigating the effects of climate change. By conserving water supplies, the schemes can help farmers and cities adapt to the most pervasive impacts of climate change in Latin America: less rainfall and longer dry seasons.

Incentives that take the form of alternative economic activities adapted to local necessities can have a high development impact. Further, the composition of the incentive packages can help development agencies and governments nudge farmers to diversify their income

countries, and to assess if and how various types of PES and reciprocal watershed agreements can better help poor communities develop and simultaneously mitigate and adapt to climate change. Green and DeWan have developed a “climate compatible development index” (CCD) that quantifies in simple terms the ability of the different intervention types to increase rural incomes and enhance environmental protection.

In a fast changing world in which the demand for water is rising faster even than global population, Green thinks that climate-compatible development is the “Holy Grail” that practitioners and policymakers are hoping for—strategies that provide mitigation, adaptation and development that gets people richer,

forests are often already full with people or agriculture. On-the-ground watershed activities must therefore be led not from capital cities, but by small-scale landowners, municipal leaders, and visionaries such as Serafin Carrasco, convincing and cajoling the rural poor to protect their water supplies, literally one tree at a time.

Preliminary data from Bolivia suggest that it may be possible to greatly expand these small-scale schemes. In the last seven years more than 800 upstream families in 22 municipalities have joined Serafin Carrasco in conserving 60,000 acres of water-producing forests in the Santa Cruz valleys. More than 30,000 downstream families are now making additional monthly payments in their water bill to ensure that the municipal forest and water conservation schemes are economically sustainable.

Serafin still worries about the low levels of water in the Los Negros River, and how climate change is affecting agricultural yields. But he’s not alone anymore. “Maybe it’s just as well they killed my cow all those years ago. It certainly got me riled up and committed to conserve our watershed. And anyway,” he observed drily, “we don’t want cows upstream anymore. We need to protect the water factory.”

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## The demand for water is rising faster than the global population in this rapidly changing world.

sources, away from drought-susceptible annual agriculture towards less rainfall-dependent perennial agriculture.

Gamez and Vargas accept, however, that bottom-up schemes tailored to local needs can be institutionally fragile, and weak local institutions will need to be empowered if the initiatives are to be sustainable. Reciprocal Watershed Agreements require a strong alliance between local government and the water provider to implement and monitor the scheme. However, in places like San José de Lourdes, in northern Peru, the municipal government has a serious water problem, but currently lacks the capacity to manage a reciprocal watershed protection scheme. Municipal officials are trying their best, but with less than 1,200 acres under protection, the scheme has very limited potential for the large reach and economies of scale of national programs.

Kevin Green and Amielle DeWan, researchers at Rare Conservation in Arlington, Virginia, are trying to identify synergies schemes between different

healthier, and with better access to water. “The CCD concept—as proposed by the Climate and Development Knowledge Network ([www.cdkn.org](http://www.cdkn.org))—is basically a response to the need of policy makers to foster economic growth and human development while simultaneously minimizing carbon emissions and promoting resilience to climate impact.”

This model may play a useful role in both national and small-scale incentive-based watershed conservation programs. But what works best and where?

Green and DeWan have joined with a group of researchers from across Latin America to find out. Gamez will share his experiences from Costa Rica, while Maria Teresa Vargas will evaluate what components of the reciprocal watershed protection schemes are working best in Bolivia, and other researchers will share lessons from Mexico, Ecuador and Colombia.

What is already obvious is that while national governments need to play a leading role in protecting Latin America’s Water Factories, these important





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# FOCUS ON BRAZIL

Brazil, with its mega-cities and huge expanses of Amazon forests and rivers, is a compelling laboratory of ways to deal with water management and climate change.

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# Water-friendly Cities?

## Water Sustainability in Mega-cities: The Case of São Paulo, Brazil

BY MONICA PORTO

**THE WORLD JUST TURNED URBAN.** FOR THE first time in human history, urban citizens make up more than half the world's population, the *2006/2007 UN-Habitat State of the World's Cities Report* tells us. In the last century, Europe and the Americas experienced intense urban growth. Today this is the reality for Asia and Africa.

A city is an entangled arrangement, a complex web of interdependent support mechanisms—transportation, water supply, power lines, housing, garbage disposal, sewers and many others, working within relatively small land areas within a very compact structure. Each overlay interacts with the environment in different ways, creating its own impact.

Water alone is a very complex subsystem. Water is needed for health, for sustaining human lives, for economic activities, for providing better living standards,

resources with their wastes. Yet urbanization and the consequent concentration of production are an essential part of economic development, and cities are effervescent cultural centers.

Can we deal with this dilemma and turn our cities into water-friendly places?

When the size, population and activity level of an urban area increase, it becomes more and more difficult to manage its subsystems, including water. Cities must deal with complex physical systems, and the investment required to provide adequate services for a good quality of life becomes larger and larger.

The urban population has increased almost tenfold in some cities in developing countries (such as São Paulo, Mexico City, Mumbai) during the last 50 years, mostly due to migration of the rural poor to peri-urban settlements. Financial resources to provide adequate services

sources and flood events, guaranteeing adequate water sources to sustain economic activity and maintaining a pleasant environment for all. Urban sustainability depends on reducing the urban hydrological footprint by reducing water consumption and consequently the stress on water sources; by reducing externalities such as pollution exportation; and by reducing impacts from flooding.

In low-and middle-income nations the main challenge regarding water remains the provision of safe drinking water and sanitation services. *The Millennium Development Goals Report 2011* stated that, in 2008, an estimated 141 million people in urban areas continued to rely on untreated water for their daily drinking. In sanitation, the situation is much worse. The millennium goal of halving the proportion of the population without access to sanitation services by 2015 will not be met. The vast majority of the people who lack good provision of services lives in slums and squatter settlements, which makes this goal even more difficult to achieve.

Flood control is another critical issue. Cities thrive in the flat areas, navigable conditions and productive environments of fluvial floodplains, where floods are part of the natural process of revitalizing aquatic biodiversity. But typical concrete urban structures are resistant to penetration by water, and in addition, soils compacted by the processes of urbanization become less absorbent themselves. It is a very well known fact that drainage blockages—known more technically as imperviousness—significantly increase flood frequency. To reduce the impact of floods, cities must become more permeable. Absorbing floodwater from the river requires “space.” But “space,” or in

**Can we turn our cities into water-friendly places?  
When the size, population and activity level of an  
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for diluting and transporting waste, and last, but not least, for maintaining the aesthetic value of a beautiful landscape.

The rapid increase of the urban population has changed the way urban water systems interact with the environment. One problem is that urban domestic and industrial consumers are using more and more water and, consequently, depleting available sources. At the same time, cities tend to degrade neighboring water

were invested far below the required rate. Shanty areas grew apace with no water supply or sanitation. The lack of industrial waste control, along with chaotic spread and unplanned occupation, led to intense worsening of water pollution

Urban conglomerations must develop adequate and feasible solutions. Cities face the challenges of safely providing drinking water for all of its inhabitants, reducing health risks from both pollution



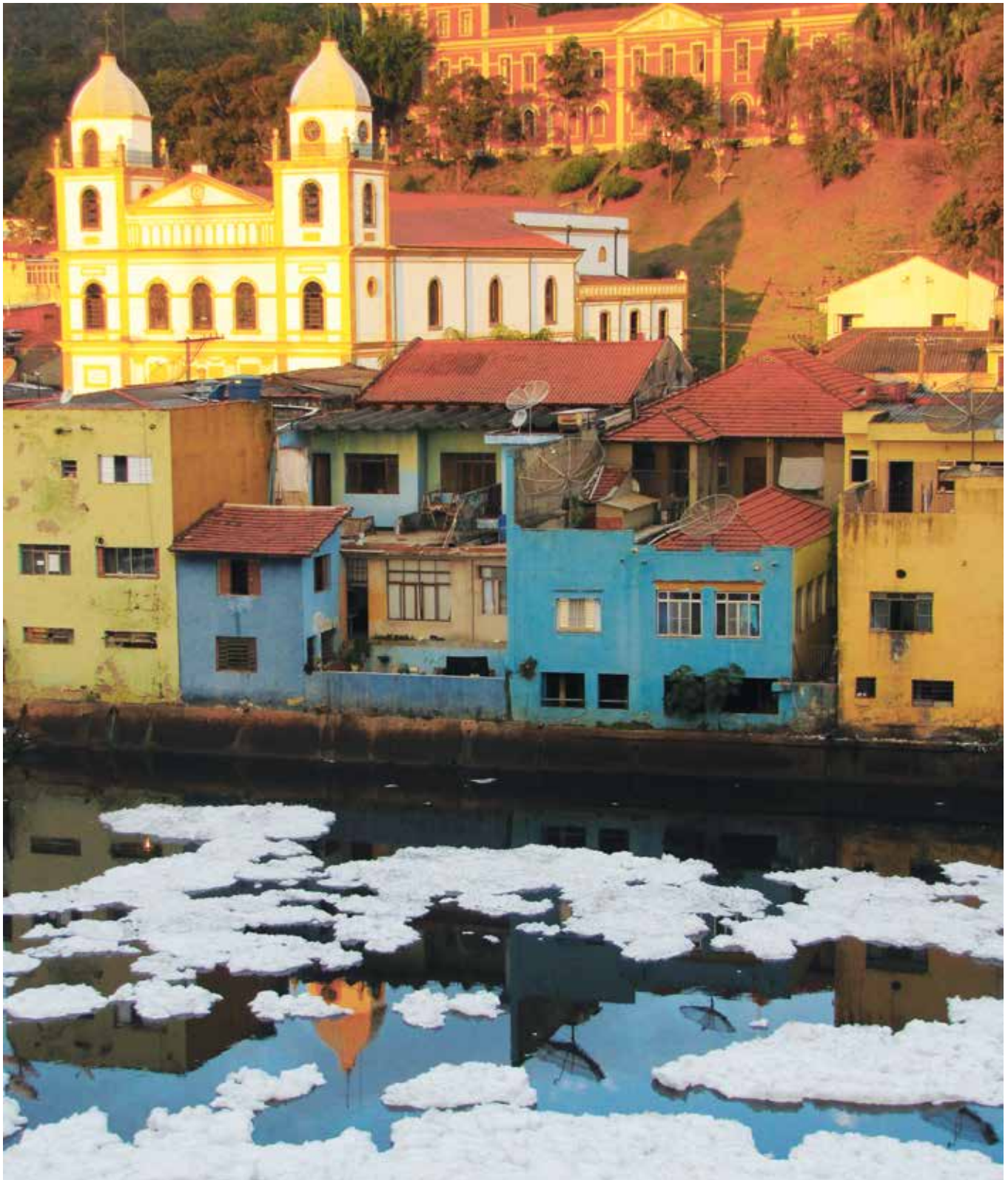


Photo on opening section page (p. 25): Sand is being extracted along the Tietê River in Pederneiras, São Paulo, Brazil. Above: The polluted Tietê River flows past colorful houses and the local church in Pirapora do Bom Jesus, São Paulo, Brazil. Photographer André Bonacin has documented the flow of the river as it wends its way through Brazil.



the terms of developers, lots and real estate, are highly valued assets in urban areas, whether they are safe from flooding or not.

This is not to imply that urban areas do not have environmental advantages, such as economies of scale due to aggregation and the potential for increasing reuse. These advantages are real, but we have not utilized them to their full extent, whereas the disadvantages of exceeding the carrying capacity of natural systems are frequently actualized.

Land use planning and control is recognized as an extremely important link between water and urban management. But how can we put it in practice when increasing land values are the reality of the chaotic megacity?

Better cities require new urban water governance. The main difficulty is the recognition that water “percolates” through several layers of the urban tissue. Housing, services, transportation, water supply, waste collection, flood control, just to name a few, are all interlocked layers. To move forward we must be capable of tackling all of them in an integrated manner.

The Metropolitan Region of São Paulo, Brazil, with its 20 million inhabitants,

is a good example of this difficult task. The MRSP includes the city of São Paulo and 39 other municipalities, occupying an area of approximately 8,000 square kilometers, of which 2,000 square kilometers are highly urbanized. It is one of the largest urban concentrations and industrial complexes of Latin America. The urbanized area occupies a major part of the upper Tietê River basin. It embraces, or maybe suffocates, the river.

High population and industrial growth rate in the last fifty years created an imbalance between water supply and demand, with severe pollution problems. Furthermore, the growing imperviousness of urban soil and the unplanned occupation aggravated the flooding problems. At the beginning of the 20th century, São Paulo was a city with 300,000 inhabitants, occupying 0.6 percent of the total area of the basin. In less than one century, it transformed itself into a megalopolis of 20 million people, occupying almost half of the upper Tietê basin.

During the 20th century, the population explosion concentrated more and more people in a small area. But now, even as population growth rates diminish, a new problem has arisen. In spite of the diminishing population growth rates, the

area occupied by the city is now expanding at a higher pace. New residential developments for the growing middle class are difficult to control. For water managers, this translates to more impervious surfaces and insufficient infrastructure.

As a São Paulo native, I would like to see my city be a water-friendly place. To reach that paradigm, the city would need to improve a sustainable, safe-drinking supply system, as well as the water quality of its rivers, and to reduce the impact of flooding.

The Metropolitan Region of São Paulo utilizes more than 70 cubic meters per second of drinking water to supply its 20 million people. To put water in each tap, the water supply utility operates three large production systems, plus 8 drinking water treatment plants, 1,112 Km of water-mains, 373 distribution reservoirs and 30,000 Km of distribution lines.

The largest production system is the Cantareira System, located 80 Km north of the region in a neighboring watershed. The second largest is the Guarapiranga-Billings Reservoir system, located within the watershed and on the edge of the urban area. Low-income families started to settle near these water sources some





decades ago. The population has exploded to 1.5 million people living very close to, and impacting, the sources. The third system consists of the headwaters of the Tietê River, but again city expansion is threatening its water quality. Currently, the cost to produce 1,000 cubic meters of drinking water is US\$18 from the Guara-piranga system, US\$11 from the Alto Tietê system, and US\$3 from the Cantareira system. This disparity in numbers is the cost of pollution and lack of protection of the supply systems.

Securing the water supply system of São Paulo for the future requires that several tasks be accomplished at the same time, such as land use planning and control to protect the water sources and control urban sprawl. In a region where 10 percent of the population lives in inadequate housing conditions, this is not an easy task. It is now well recognized that providing adequate housing for the poor is an essential step to clean water sources.

The current water supply systems are being fully used and do not support further population growth or an increase in demand. Hence the MRSP needs wise management of existing resources and significant investment in case of more

growth or greater demand. Good water management requires the concurrent action of the water utility and the set of all 39 municipalities of the MRSP, plus significant investments. Looking for new sources is becoming more and more difficult. To add a mere 7 percent in drinking water production, the water utility will spend almost two billion dollars. Demand must be managed.

To control pollution, São Paulo has been investing heavily for the last 20 years in collection and wastewater treatment services. More than two billion dollars have already been spent and the program will probably continue for ten more years, doubling this investment. Currently 86 percent of the population is serviced with collection services and 66 percent of the collected sewage is treated.

Even after the completion of the program, though, we will need further action to restore water quality to the lifeless rivers. The city urgently needs more efficiency in sewage collection, better control of solid waste disposal and the multipart effort of the many government agencies and utilities involved in this process. We hope we will have the river back at least for the benefit of the urban landscape.

Flooding remains a problem for the

**Left: Partial view of UHE Nova Avanhandava, Tietê River, São Paulo; Center: The Tietê River and the Tietê frontage road near Rodovia dos Bandeirantes; Right: Excavating sand from the river**

city and for quality of life. Emerging regulations to control occupation along the rivers and to create green spaces and linear parks are changing the looks of former degraded areas. New planning, structures to delay flows, maintaining the river courses as natural as possible, are the new order for a city that strives for a greener future.

Billions have already been invested. Much more money is still needed. The path the city is taking with respect to pollution is already giving us hope to live in a more water-friendly city in the future. But developing a clear vision of the city's many-layered relationship with water, alongside improving managerial capacity, remain just as important as investment. Although difficulties remain, the current path is already giving us hope that we may live in a more water-friendly city in the future.

*Monica Porto is Professor of Environmental Engineering at the University of São Paulo.*



# Climate Change and the Amazon

**Tropical Dams Emit Greenhouse Gases** BY PHILIP M. FEARNSIDE

**MOST HAVE HEARD SO MANY TIMES THAT** hydropower is “clean” or “green” energy that they are surprised to learn otherwise. Unfortunately, the reality is much more complicated. Dams, especially those in the tropics, emit significant amounts of greenhouse gases, and to categorically call them “clean” is a mistake.

I was not the first to discover that dams emit greenhouse gases—a group from Canada published a paper in 1993 showing emissions from dams in that country. But two years later, I showed that some Amazonian dams such as Balbina emit even more greenhouse gases than would be emitted from generating the same power from fossil fuels. That 1995 paper was the one that enraged the hydroelectric industry. The U.S. Hydropower Association spokesperson labeled the idea that dams produce greenhouse gases as “baloney.” The debate was only beginning. Both sides of the long argument with the hydroelectric industry, especially the ex-president of ELETROBRÁS, can be found at <http://philip.inpa.gov.br>. The hydroelectric industry subsequently shifted its

position from total rejection to admitting that dams emit some greenhouse gases, but only an insignificant amount.

Unfortunately, the amounts are not insignificant, especially if they are quantified without omitting important sources of emission. First, the trees left standing in the reservoirs project out of the water, where they decay in the open air and release their carbon as carbon dioxide—half of the dry weight of wood is carbon. The wood that is underwater decays very slowly, but this is not the case for soft vegetation such as leaves and for the carbon in the soil. The water in a reservoir divides into layers, with a warmer, less dense surface layer in the top 2-10 m that is in contact with the air and contains oxygen. A division (the thermocline) separates this layer from a colder, denser layer that extends to the bottom. The water in the two layers does not mix, and the oxygen in the bottom layer is quickly exhausted, leaving this layer with almost no oxygen. All decay at the bottom of the reservoir therefore must end in methane ( $\text{CH}_4$ ) rather than carbon dioxide ( $\text{CO}_2$ ),

since the layer lacks oxygen to form  $\text{CO}_2$ . Though it is present in much smaller concentrations in the atmosphere, methane is a much more potent greenhouse gas than carbon dioxide.

Some of the methane is released through the surface of the reservoir as bubbles or through diffusion, as would take place in a naturally formed lake. What makes hydropower emissions different from those of natural lakes is that water is drawn from near the bottom of the reservoir for the turbines, and it is also drawn from well below the thermocline for the spillways. The water released below the dam is therefore loaded with methane. Since the solubility of gases in water is proportional to the pressure (Henry’s Law in chemistry), the methane will form bubbles and escape when the pressure is suddenly released as the water emerges from the turbines. This is the same phenomenon that is apparent when one opens a bottle of Coca Cola: the gases form bubbles

**The spillway at the Tucuruí releases methane from the water it draws from 20 m below the surface.**



when the pressure is released by removing the cap. The pressure under the weight of water at the bottom of a reservoir is much greater than that inside a soft drink bottle, and, consequently, the release of gas is greater when the pressure is released.

As shown in a paper I published in June 2012 in *Nature Climate Change* (together with Salvador Pueyo), many of the estimates of hydro emissions that have been used to claim that emissions are small have underestimated or ignored key sources of emissions. Emissions from turbines and spillways have often been ignored completely. When included, they have sometimes been measured by capturing bubbles with chambers floating on the water surface in the river well below the dam outlet. Most of the methane has already been emitted as the water emerges from the turbines (and some is released even inside the turbines). The only practical way to avoid underestimating the turbine emissions is to calculate them by the difference in the methane concentration in the water above the dam, at the level of the turbines, and below the dam. This approximately doubles the emission figure as compared to estimates based on downstream chambers. For concentration measurements there is a problem with traditional sampling devices (Ruttner bottles) that leads to underestimating the emissions. When one of these devices takes a sample of water from near the bottom and raises it to the surface, a significant amount of the gas comes out of solution and escapes on the way to the surface. A new type of sampler designed by Alexandre Kemenes avoids this problem, resulting in concentration values that approximately double the emission again. Different groups have made direct estimates at two dams (the Petit Saut Dam in French Guiana and the Balbina Dam in Brazil), confirming that emissions are substantial and exceed those of fossil fuel for years. I have calculated emissions for a number of Amazonian dams, indicating emissions that are varied but often high. A considerable amount of information is needed about each dam to make reliable estimates of emissions: each dam is

different, and simple extrapolations based on such factors as area or installed capacity are problematic.

A huge peak of emissions occurs in the first few years after a reservoir is flooded, because the leaves from the trees that are killed decay; soil carbon is also released in this period. Emissions then decline to lower levels, but they do not disappear. One feature that can supply carbon for forming methane indefinitely is the raising and lowering of the water level each year. When the water is drawn down to generate power in the dry season, a large mudflat is exposed around the edge of the reservoir. Weeds quickly grow on this land, and when the water rises again, this soft vegetation decomposes at the bottom of the reservoir where the water is without oxygen. The carbon in the weeds has been removed from the atmosphere in the form of CO<sub>2</sub> by photosynthesis, but it is returned in the form of CH<sub>4</sub>, a much more potent greenhouse gas. Because this is an ongoing process, the reservoir acts as a “methane factory.”

The sustained emission from this “methane factory” may be less than the global warming impact of the CO<sub>2</sub> that would be emitted in generating the same amount of electricity from fossil fuel. However, it may take many years to pay off the greenhouse “debt” from the very high emission in the first few years. My calculation for the planned Belo Monte and Babaquara (Altamira) complex in the Amazon region is that it would take 41 years to break even in terms of global-warming impact. Unfortunately, we do not have that much time to begin doing something about global warming. Brazil’s massive dam-building plans would be emitting peak emissions exactly in the time window when global warming needs to be brought under control to avoid grave consequences, including those that threaten the Amazon forest. Brazil’s 2011-2020 Energy Expansion Plan calls for building 30 large dams in the country’s Legal Amazon region, or one dam every four months.

In addition to emitting gases, tropical dams are now having an impact on global warming through another route.

This is by their serving to justify carbon credit under the Kyoto Protocol’s Clean Development Mechanism (CDM). Aside from underestimating or ignoring the emissions from dams themselves, the greater impact is because the dams are not “additional,” that is, they would be built anyway without any subsidy from the CDM. For example, the two dams under construction on Brazil’s Madeira River are nearing completion, and only now are applications being made for the CDM subsidy. Obviously, the companies that are building the dams expect to make money independent of any financial bonus from the CDM. The global total is staggering: 288 million tons of CO<sub>2</sub>-equivalent carbon per year for the dams in the CDM’s “pipeline” as of January 2012. In addition to authorizing the emission of this amount of carbon by the countries that buy the credit, awarding carbon credit to dams also wastes a significant part of the money that the world has for fighting global warming—money that could be spent on forms of mitigation with a real benefit for climate. The CDM loophole needs to be closed by not giving carbon credit for dams.

In summary, tropical dams have multiple impacts on global warming. These impacts are not being properly quantified and incorporated into decision-making in places like Brazilian Amazonia.

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# Water, The Energy Sector and Climate Change in Brazil

**Huge Challenges** BY ANGELA LIVINO

**AS A BRAZILIAN, I AM VERY PROUD OF THE RICH** natural resources of my country, in particular water resources. As an engineer who had worked in the Brazilian energy sector for the last fourteen years, I am very proud of the infrastructure built over the last seventy years that has allowed the use of water resources responsibly and intelligently. But as a hydrologist and doctoral student in water resources, I'm concerned about studies that indicate alarming impacts of climate change in Brazil, particularly in the Amazon. An ongoing initiative at the Sustainable Science Program at Harvard, coordinated by Professors Paul Moorcroft and John Briscoe, is examining the long-term sustainability

additional advantage: the full interconnection of our power grid system allows an exchange of electric power between different regions of the country. This exchange allows the cycles of Brazilian rivers to complement each other. For example, during periods of drought in the south region of the country, energy comes from the southeast, northeast and north of Brazil.

This energy exchange became feasible thanks to large reservoirs built along with hydropower plants over the last decades of the 20th century. There are other advantages to these large reservoirs as well. The reservoirs create a dependable water source not affected by the seasonality of the water cycle. Irrigat-

generation and transmission, and severe drought in the Northeast and Southeast. At that time, the Brazilian energy model had left the balance between supply and demand to private enterprise and free competition. It became clear that this model no longer worked.

In 2004, the Federal government laid the foundations for the New Model for the Electricity Sector. In institutional terms, this established several areas of responsibility: (1) the Energy Research Company (EPE) in charge of long-term planning in the electric sector; (2) the Electric Sector Monitoring Committee (CMSE) to continuously assess the security of electricity supply; and (3) the Chamber for the Commercialization of Electric Energy (CCEE) to deal with sales of electricity in the interconnected system. The New Model for the Electricity Sector seeks to ensure security of electricity supply, to keep prices moderate and to promote social inclusion in the Brazilian electricity sector, in particular through universal supply programs. As a result, the Brazilian electricity system is strongly integrated with the reliable large reservoirs and transmission lines across the country (see figure.)

There are dozens of both public and private companies operating in the generation and transmission sector in Brazil. The National Power System Operator (ONS) is responsible for command generation from all sources of energy and also operates the entire transmission system. This ensures coordination and operation at the lowest possible cost.

Considering the growth of the Brazilian economy, and even taking into account energy conservation measures, EPE studies indicate that Brazil needs

**An ongoing initiative at Harvard's Sustainable Science Program, coordinated by Professors Paul Moorcroft and John Briscoe, is examining the long-term sustainability of agriculture and hydropower in Brazil's Amazon basin.**

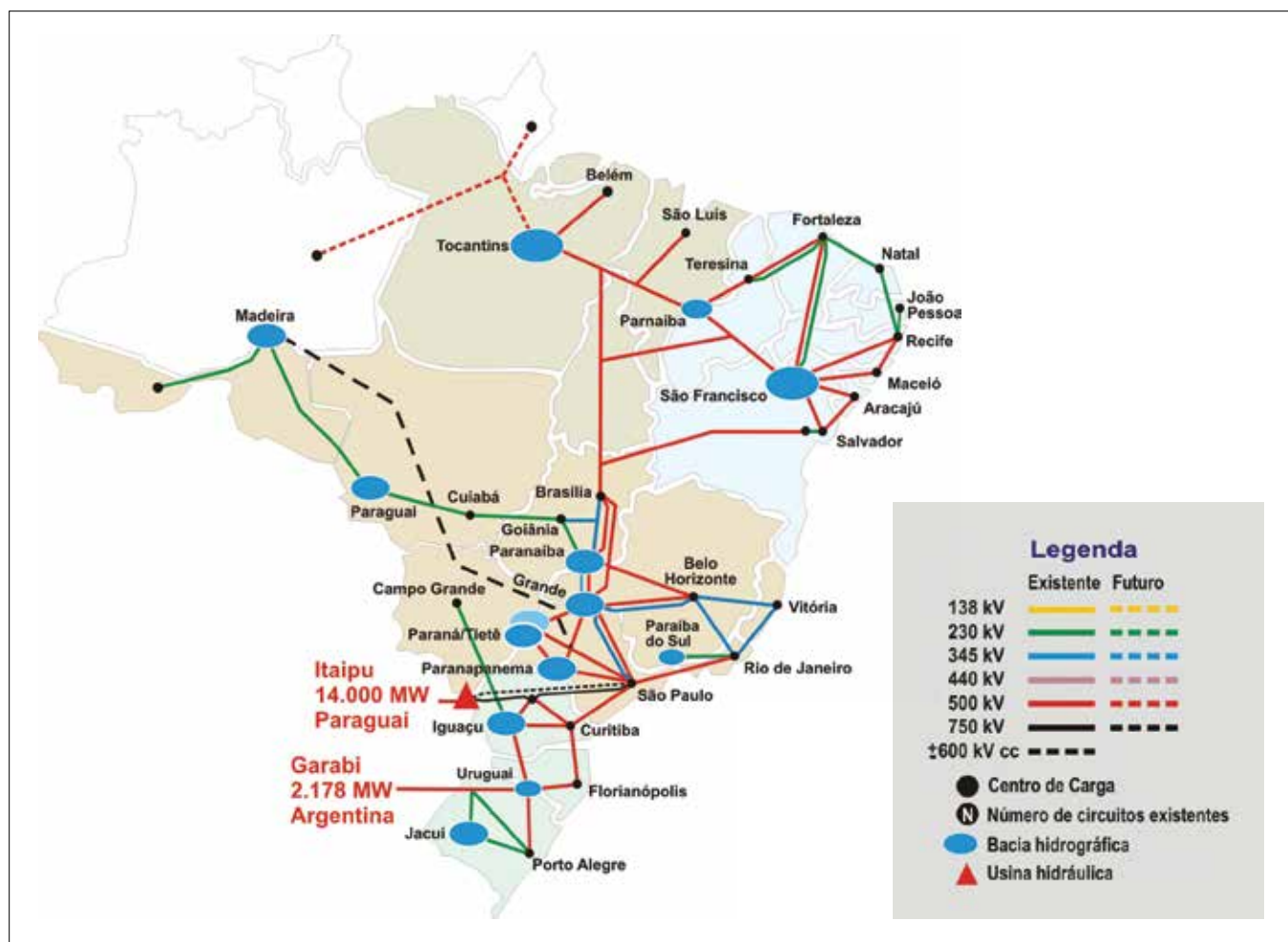
of agriculture and hydropower in the Amazon basin. Agriculture and hydropower in Brazil face changes in the region's water cycle arising from land-use transformation and global climate change. But why would climate change affect the energy sector?

Brazil has developed a mixed energy supply with more than 88 percent of electricity coming from renewable, mainly hydroelectric (more than 80 percent), sources. Besides the advantage of having our power generation based predominantly on water, we have a great

ed agriculture, transportation and tourism are benefited by the regularization of flows provided by reservoirs. In addition to large reservoirs, the Brazilian power system also has extensive transmission lines (over 100,000 kilometers extension in the end of 2010).

To ensure the security of the energy supply, correct planning and execution of the transmission system are vital. In 2001, Brazil faced severe power rationing, which cut 20 percent of its power supply in all regions. Two factors were behind these power cuts: the lack of expansion of





to add approximately 6,500 MW of new installed capacity (equivalent to half the generation capacity of the Itaipu plant) each year.

This means that Brazil faces the challenge of tapping its unused hydroelectric potential, 60 percent of which located in the Amazon. It is thus concerned about the environmentally sustainable way to use that potential and has worked hard to develop manuals and procedures explicitly taking into account the social and environmental costs in determining the costs of power plants. Most new plants are planned as run-of-the-river plants, but this means that they are left without effective capacity to store water. In other words, they have no regulating capacity. This feature is detrimental to the electrical system, since during periods of low flow in rivers, it will still

have to rely on existing reservoirs and generated energy from fossil fuels.

There are also societal costs to the reduced storage capacity of the new plants. For example, without regulation, some crops could not be developed because during drought periods there won't be water for irrigation. Likewise the reservoir can provide reliability for the supply system of a city. Stored water contributes to the development of various sectors such as agriculture and tourism and ensures the water supply for the population.

#### CLIMATE CHANGE AND HYDROPOWER

Hydropower plants without regularization of reservoirs are more dependent on natural flows. Therefore, if we continue to expand their presence in the electric-

**Brazilian Interconnected Power System.**  
Source: ONS, 2012.

ity sector, we must also account for more drastic changes in rainfall, which would affect streamflow patterns in Brazilian rivers. This is a great challenge for planners in various sectors and for the operation of the electricity system.

For example, a private agent who has an interest in building a hydropower plant that will have its concession auctioned by the Brazilian government will be interested in the impacts of these changed runoff patterns on their construction costs. Climate change will affect rainfall patterns, influencing maximum and minimum values of streamflow. Thus the dimensions of strategic parts of the plan (spillway, coffer-dam, water intake) must be adjusted.

Power System Operators will need to know the impact variations in rainfall will have on streamflow seasonality and maximum streamflows. Operation schemes and energy market pricing are currently based on optimization models that assume that streamflow amounts remain stationary. These models consider the patterns of past flows to generate future scenarios, but they don't generally account for changing flow patterns in future scenarios. Of course, the models used by ONS are only an aid in the overall decision-making process. But in the future, models will have to account for more irregular changes in streamflows to make predictions, as these models are weighed price signals that reflect the data from the model results.

On the other hand, the impact of climate change also poses a great challenge to energy planners. Today, when long-term expansion plans are made, different scenarios of energy demand are analyzed that correspond to various

scenarios of economic growth. Currently, the planning models assume stationary streamflows. But it will be important in the future to analyze different patterns of flow to project how best to ensure supply in different scenarios of demand.

Therefore, continuing to study the impacts of climate change on Brazilian rivers is essential to the Brazilian energy sector. Analyzing the impacts of different patterns of rainfall and changes in land use is fundamental to estimating streamflow sequences in the future. It is also important that the results be used as an input to new policies and decisions.

In the Sustainable Science Program initiative at the Kennedy School, we are using data from the coupled biosphere-atmosphere simulation, which provides us with projections of regional climate and land use change, as input for hydrologic models that provide projections of runoff. We will assess the hydropower implications of these runoff projections. One interesting dimension of this project is that there is realism in the representation of agri-

cultural landscapes within the terrestrial biosphere model—that is, we will have a very accurate idea of changes resulting from agricultural patterns.

We also intend to design a Brazilian approach to make our results relevant to policy makers. We will meet with both Brazilian policy makers and technical experts to ensure that we answer questions in a more specific, applicable way. In May 2013, we will hold a workshop in Brazil for the presentation of our results and discussion of the subject. We hope to help the energy sector in Brazil—already highly capable—to develop sustainably in the face of climate change.

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**A view of Brazilian hydroelectric dam.**







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# WATER RIGHTS

“Water, water, every where/ nor any drop to drink” is an all too familiar phrase from Samuel Taylor Coleridge’s “The Rime of the Ancient Mariner.” The situation is a familiar one in Latin America where water rights are frequently contested.

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# Water in Oaxaca, Mexico

**Beyond Paradise** A PHOTOESSAY BY MARIANNE KINZER

**THE STORY OF WATER IN OAXACA, MEXICO, A** picturesque place that draws international tourism, illustrates Mexican, Central American and worldwide water problems.

Increasing population with ever higher demands for water, more cement constructions and paved streets, cutting down of forests, water pollution, a lack of water treatment plants and water infrastructure, a lack of environmental laws and law enforcement, and the illegal drilling of wells are just some of the most pressing problems.

Oaxaca city, the capital of the state of Oaxaca in southern Mexico, boasts a well-preserved colonial-style district with many hotels and restaurants, shops, museums, plazas and churches. Historical buildings, hotels and private homes are usually centered around courtyards, decorated with lush tropical plants and bubbling fountains.

Water in Oaxaca used to be plentiful. The city is located in a valley surrounded by mountains. Two major rivers were flowing through the valley, the Atoyac and the Jalatlaco. The latter—I was told by our innkeeper in the neighborhood of Jalatlaco—was severely contaminated in the mid-19th century by a flourishing leather industry. What's left of this river now flows underground. It has been paved over. Where there once was a river, where people bathed and washed their clothes, there is now a busy street. Some of the side streets of the neighborhood are still paved with stones from the lost river.

The Atoyac River used to be wide, but its flow has shrunk to a narrow band of mostly contaminated water, and at times and places, the riverbed dries out completely.

Our B&B Encanto receives water from the city weekly, sometimes only every ten days. The water is stored in an

underground cistern. When the inn runs out of water, the owners must buy very expensive water from water trucks.

In the colonial period, Oaxaca city was supplied by an aqueduct that brought water from the mountain called “San Felipe del Agua” to the valley; however, the aqueduct fell into disrepair, with no modern piping system to take its place.

Water for Oaxaca City mainly comes from Etla, a town about 17 miles away.

My taxi driver told me that people in Etla are opposed to selling their water to Oaxaca. They stage protests and sometimes succeed in cutting off pipes leading to the city. Water also comes to Oaxaca by trucks from other villages. Villagers, however, are reluctant to let go of their water, even if the prices for water are increasing.

Locals told me that rainfall patterns have changed over the last 20 years. There are now more severe and longer periods of drought; conversely, if rain falls at all, it pours down heavily, causing damaging run-offs and floods. As of today, water from heavy rainfall cannot be captured and is lost to the community.

Paved streets and urban sprawl, illegal wells, and increasing demands for water cause the groundwater table to fall. Forests have been cut down and cannot hold the water in the ground. Instead, flash floods rip through, causing damage.

An increase in sewage, traffic, throw-away products, and urban extension contaminate much of what is left of the life-giving water here in Oaxaca City—a seemingly paradisiacal place, colorful and cheerful, where lush gardens with exotic flowers invite visitors to relax while listening to the soothing sounds of gurgling fountains.

*Marianne Kinzer is a painter and photographer.*





In her travels through Mexico and Central America, photographer Marianne Kinzer created these images of water. Photograph on previous page: an abandoned boat rests on Lake Managua in Nicaragua; above, clockwise: fresh water for Managua; Apoala in Oaxaca; a fountain in a Oaxacan courtyard in Mexico



# From Water Wars to Water Scarcity

**Bolivia's Cautionary Tale** **BY EMILY ACHTENBERG**

**WHEN BOLIVIAN PRESIDENT EVO MORALES** arrived at the new Uyuni airport last August and found no water running from the tap, he publicly reprimanded and promptly dismissed his Minister of Water. As it happened, the pipes were merely frozen. The incident underscores the critical—and highly symbolic—role of water in the politics of this landlocked Andean nation.

## WATER WARS

In April 2000, a popular struggle against water privatization in Cochabamba, Bolivia's third largest city, ignited a chain of events that profoundly altered the nation's political landscape. The Water War was precipitated when SEMAPA, Cochabamba's municipal water company, was sold to a transnational consortium controlled by U.S.-based Bechtel, in exchange for debt relief for the Bolivian government and new World Bank loans to expand the water system.

A new law allowed Bechtel to administer water resources that SEMAPA did not even control, including the communal water systems prevalent in the ever-expanding southern periphery and in the countryside, which had never been hooked into the grid. Local farmer-irrigators feared that "even the rain" collected and distributed for centuries by their associations would fall within Bechtel's grasp.

These concerns, along with a 50 percent average increase in water rates for SEMAPA customers, prompted the formation of a broad alliance of farmers, factory workers, rural and urban water committees, neighborhood organizations, students and middleclass professionals in opposition to water privatization. They were joined by the militant federation of coca growers from the Chapare, led by then labor leader Evo Morales, who lent his considerable

expertise in organizing civic strikes, road blockades, and massive popular assemblies. Eventually, Bechtel was forced to abrogate its contract, return SEMAPA to public control, and withdraw its legal claim against the Bolivian government for \$50 million in compensation.

This iconic struggle crystallized a growing demand for popular control of Bolivia's natural resources, leading to the Gas Wars of 2003 and 2005, the overthrow of two neoliberal presidents, and the subsequent election of Evo Morales and the MAS (Movement Towards Socialism) party as a "government of the social movements." A second water revolt—this time by neighborhood organizations in the sprawling indigenous city of El Alto—ousted the French multinational Suez company from the recently privatized La Paz-El Alto water district. Bolivia's new constitution, enacted in 2009, proclaims that access to water is a human right and bans its privatization.

Outside Bolivia, the Water War helped to inspire a worldwide anti-globalization movement and provided a model for water-justice struggles throughout the Americas and beyond. The Bolivian government led the successful drive for UN recognition of water and sanitation as a human right in 2010, and is in the forefront of a new international campaign for a UN declaration against water privatization.

On the domestic front, as water-justice advocates look to Bolivia for successful alternative models to privatization, the implementation of these hard-won water rights has proved to be a significant challenge.

## WATER RIGHTS

The Morales government has sought to develop a new institutional framework that positions the state as a direct protagonist in providing and regulating

water and sanitation services (see Susan Spronk, "Post-Neoliberalism in Latin America? Urban Water Supply Management in Bolivia Under Evo Morales," unpublished draft prepared for the Latin American Studies Association, May 26, 2012). The Water Ministry, created in 2006 to integrate the functions of water supply and sanitation, water resource management, and environmental protection, is the first of its kind in Latin America. It has a mandate to end water privatization, including the creation of a public water company to replace the temporary utility established for La Paz-El Alto after the exit of Suez.

The Water Ministry has been plagued by frequent reorganizations and institutional instability, with six changes in leadership since its creation. Critics charge that it operates more like a loose federation of sub-ministry fiefdoms than a coherent organization, and suffers from overlapping jurisdictions with other cabinet ministries. Its functions also sometimes conflict with those of the departmental and municipal governments, which have significant water management responsibilities under Bolivia's decentralized administrative structure.

Almost six years after the final ouster of Suez, the Water Ministry is still negotiating the design of the La Paz-El Alto public water company, with divergent visions held by combative El Alto neighborhood groups, the City of La Paz, and the Morales government. La Paz has periodically threatened to withdraw and establish its own municipal water utility.

While the Water Ministry has taken over the functions of the formerly privatized water regulatory system, controlling and monitoring the activities of Bolivia's approximately 28,000 local water and sanitation providers has proved to be a challenge. The sector encompasses a diverse

range of organizations, from sophisticated utilities like SAGUAPAC in Santa Cruz—the largest urban water cooperative in the world—to thousands of independent water committees in rural and peripheral areas, who manage artisanal wells and antiquated distribution systems based on traditional uses and customs.

These small providers are burdened with poorly constructed and deteriorated systems, operating deficiencies, and community conflicts. An estimated 35 percent of their water is lost to leaks and clandestine hook-ups. While only a fraction of independent providers are even registered with the government, efforts to curb their traditional rights can become an explosive political issue—as evidenced by the Cochabamba Water War.

In the absence of a comprehensive regulatory framework, tensions between these traditional methods of water provision and the new system of formal water rights are far from being resolved. Still, the Morales government has made sig-

nificant efforts to strengthen the capacity of independent water providers through technical assistance and financing, recognizing their role as a critical partner in the government's water development agenda.

Twelve years after the Water War, the challenge of developing alternative models to privatization is readily apparent in Cochabamba. While the re-municipalized SEMAPA has more than tripled the size of its service area since 2000, at least 40 percent of the city's residents—mostly in the southern hillside districts, which were the chief protagonists of the Water War—still lack piped water and sanitation services (see Franz Chávez, "Bolivia: Cochabamba Still Thirsty," IPS Inter Press Service, March 22, 2011). Those remaining outside the grid are forced to pay 5 to 10

times more than SEMAPA consumers for trucked-in water of dubious quality. Even on the grid, water service is intermittent. Although the reconstituted SEMAPA includes elected community representatives on its board of directors, problems of mismanagement, corruption, and inefficiency continue to plague the organization. In 2010, the company was forced to lay off 150 workers to overcome a \$3 million cash deficit, due to alleged irregularities such as payroll padding, materials thefts, and continued diversion of the system's water. Frustrated with both the private and public water management models, residents of Cochabamba's southern zones are increasingly relying on traditional community-run water systems as an alternative. Many of these neighborhoods have established autonomous and participatory water distribution systems managed by elected water committees, cooperatives, or community councils that are seeking to collaborate to varying degrees with

facing Bolivia's water sector today is the need for significant resources to upgrade and expand the existing infrastructure and develop new water sources.

While the Morales government has made significant progress in this area, a great deal remains to be accomplished. Recently, the government announced that Bolivia will meet its overall Millennium Development Goal for access to safe drinking water three years ahead of schedule, with 88 percent overall coverage achieved in 2010. But potable water access rates in Bolivia's rural and peri-urban zones (71 percent) lag far behind those for urban areas (96 percent), and are among the lowest in Latin America. And only 27 percent of Bolivians have adequate sanitation facilities—the second-worst record in the region, after Haiti.

Climate change and extreme weather events have added a new and urgent dimension to Bolivia's water challenges, both urban and rural (see "Climate Change Is About Water," the Democracy Center, <http://climatechange.democracyctr.org/>). In recent years, droughts have increasingly undermined the water systems and agricultural economies of rural communities, while displacing their populations to precarious urban zones where torrential rains and floods overwhelm existing water and sanitation infrastructure. Retreating tropical glaciers are diminishing freshwater resources not only for small highland communities, but for the urban populations of El Alto and La Paz, who rely on glacial melt as a major source of drinking water. Water levels in Lake Titicaca, which some 2.6 million people depend on, are reportedly at their lowest levels since 1949.

The national development plan calls for a \$700 million investment between 2010 and 2015 to upgrade Bolivia's water and sanitation infrastructure, including climate change adaptations. Like its neo-liberal predecessors, the Morales government continues to rely on foreign donors (principally the Inter-American Development Bank, the Venezuela-dominated Latin American Development Bank, Spain, Italy, and Japan) for as much as 80

## The model of decentralized social-public water management may prove more viable than the private or the state-centric model for countries like Bolivia.

SEMAPA. The local water committees have affiliated through ASICA-Sur (the Association of Community Water Systems of the South) to receive technical assistance and, in some cases, direct EU financing for their systems. They hope to buy water at bulk rates from SEMAPA while remaining under community control.

### WATER SCARCITY

The model of decentralized social-public water management may prove to be more viable than either the private or the state-centric model for countries like Bolivia, with major geographic barriers to centralized service provision, a weak state sector, and a strong culture of community participation. Still, regardless of the management model, the major challenge



percent of this funding. Most of the balance is expected to come from the departmental and municipal governments, whose revenues—derived principally from hydrocarbon royalties—have increased substantially under Morales. Water researcher Susan Spronk points out that only 1.5 percent of the national budget (from direct Treasury revenues) is dedicated to water and sanitation improvements, while 80 percent is allocated to mining, hydrocarbons, hydroelectricity, and transportation infrastructure.

The reliance on foreign investment reinforces the concept of a “climate debt” owed by industrialized countries to developing nations, which Morales has justifiably promoted. Still, it keeps Bolivia’s rate of water and sanitation infrastructure expansion dependent on external priorities, introducing a level of risk and unpredictability that could be problematic in the context of today’s worldwide financial crisis.

Critics argue that the Morales government’s budget priorities reflect its continued commitment to a “neo-extractivist” development model, at the expense of meeting popular needs through investment in sectors that are considered “unproductive.” As well, the destructive impact of government-supported mining operations on local water supplies has been a growing source of tension with indigenous communities.

Once again, Bolivia is at the epicenter of a struggle over water—this time, over water scarcity—with worldwide implications. Given the combative nature of Bolivia’s social movements, popular and regional conflicts over water shortages could be far more explosive than the Cochabamba Water War. Just how this prospect might shape the next chapter of Bolivia’s water politics remains to be seen.

*Emily Achtenberg is an urban planner and an independent researcher on Latin American social movements and progressive governments. She writes a biweekly blog for NACLA, mostly on current events in Bolivia (<https://nacla.org/blog/rebel-currents>).*



Top: View over the city of La Paz; Below: A marketplace in El Alto, just outside of La Paz.









# Al Son Del Río

Water Rights in Chocó, Colombia **BY DIANA LUCÍA DUQUE MARÍN**

**WENDING OUR WAY DOWN THE ATRATO RIVER** in Colombia's Chocó region, we finally reach the town of Puné. It is a fickle June afternoon, one of those humid tropical afternoons when the sun and water alternate in sudden torrential rains. "The river is everything to us," Berta is telling me as we drift along the "fluvial highway," which from time immemorial has connected fresh water with the salty sea, moving from the Pacific to the Colombian Caribbean. The water in Chocó is part

of its symbolism, its social fabric; it is an essential part of spatial reference and identity of the communities. Baptisms and spells, enchantments and incantations all express the importance of water. Water is not merely a necessary service; it is also a collective good that has a deep cultural dimension.

The stockades to trap fish, plots flooded to grow rice, dikes and basins for the harvest, plains for gold mining, water courses as a way of marking territories, all these

make up traditional practices that sustain the agro-forest systems, artisan mining and fishing. "People, depending on their productive activities, go along with the river. People move to the beat of the fish, the wood, the mines (...). The fish, just like a human being, knows when the river is going to dry up or when it is going to rain, so it becomes a game of anticipating the ebb and flow of the river, for opening and closing the stockades," Eulise tells me as she teaches me about the river.





Ever since we left the port of Quibdó, we have been passing through the collective land of the black communities of the Medio Atrato region. We encounter other boats, carrying—just like ours—all sort of local treasures: dried fish, bananas, cocoa, rice, wood. From the platform, lying in hammocks or playing dominos, crew members greet us with a wave. On both sides of the river, fishermen float in their canoes; women wash clothes on the shore, and children play. They all pause to watch our boat pass by. The green flag on its prow is well known along the river and its tributaries, because it identifies members of the Integral Peasant Association of the Chocó's Medio Atrato, known by its Spanish acronym as ACIA. "The armed groups know who we are by this flag," other passengers explain. They

are used to slipping alongside the border of the invisible war that hides deep in the jungle.

Since 1997, ACIA has spearheaded a pilot project of collective land titles, one of the most radical experiences in Latin America and perhaps the most important in terms of agrarian reform in Colombia. The 1993 Law 70 granted rights to the black population stemming from its ethnic and cultural roots and set forth certain mechanisms to protect these communities and allow them to maintain their traditions of collective property rights. ACIA, integrated as the Greater Community Council (Consejo Comunitario Mayor-COCOMACIA), became the representative of black communities in this region of the country.

The sense of belonging to the river and its environs deeply influenced the

processes of political organization in the Atrato. Guided by the flow of the waters, the communitarian councils established ethnic-territorial boundaries, using the principles of planning for hydrographic basins. Since then, natural markings such as rivers, streams and swamps have continued to be used as spatial references for land jurisdiction, in keeping with the local ways of perception and environmental use as well as the kinship logics that the black communities have long followed.

As we move down the river, we observe among the tropical *pichindés*, banana and fruit trees, clusters of stilt houses in small communities along the shore. Using thick trunks of the *guayacán* tree, the river inhabitants build these houses to deal with recurring floods. In this way, they can live alongside the ebb and flow of the river, which constantly deposits





**From left to right: Boats leave the port for a peaceful demonstration down the Atrato River; townspeople support demonstrators who demand that Colombia's armed actors return free access to the river to local citizens; a view of the Atrato River; a man in a boat navigates streets flooded by the Atrato River.**

marsh debris under their houses. However, the inhabitants wonder why the relationship with the “little game of the river’s ebb and flow” has been changing lately: “Now we don’t know when it is going to flood.” These disturbances in the natural rhythms of the water have drastic implications for the health and daily life of the population. Julia tells me that when the Bebaráma River “floods, the mosquitoes take over,” which implies greater risks of malaria and other diseases.

“Sometimes we have to sleep with the water under my bed,” adds Berta; “if the mouths of the Atrato were dredged, it wouldn’t flood so much.” Until the 1980s, floods came in a regular and predictable form, coinciding with the region’s winter. However, the removal of earth from the beds of rivers and streams with heavy machines to mine gold has caused

sedimentation; it changed the river’s flow and, indeed, affected its navigability. In the same fashion, indiscriminate lumbering is causing problems on the banks of tributaries and headwaters: artificial canals built to float the logs cause the natural course of the waters to deviate, while discarded waste produces sedimentation and chokes the river. The mechanism is simple, Carlos tells me: “when the river is made less deep because of continual sedimentation, it loses its flow intensity and ends up flooding the riverbanks.”

The territory of Chocó, knitted together by a tangle of rivers, streams, swamps and brooks, is considered one of the rainiest and most biodiverse regions in the world. Nevertheless, the dwellers alongside the banks of the Atrato suffer a chronic shortage of water fit for

human consumption. The superficial water sources, available in abundance, are exposed to all sorts of contamination and sewage. Everyone seems to agree “the only clean water is the kind that comes in a downpour.” As we make our way along beaches and tributaries, Julia, Carmen and Berta explain the difficulties they face when rain is scarce. During the dry season, daily work multiplies—especially for women—who must set out in boats looking for clean water or walk carrying the water in crocks on the long trip home.

As the meeting point between the Atlantic and the Pacific, Chocó has pompously been called “the 21st century window on the sea” for Colombia. Moreover, it is the center of several megaprojects: transnational highways, an inter-oceanic canal and electrical connections





between the Americas. Paradoxically, the region itself is immersed in the most profound lack of services of potable water and basic sanitation. Aqueduct construction and sewage disposal for Chocó are some of the most deficient in the entire continent. Likewise, the mortality rate due to diseases associated with water stands at least at 10 percent yearly: typhoid fever and paratyphoid, malaria, cholera and diarrhea.

Black men and women identify several factors pointing to the changes experienced in regards to water. They talk about the marshes that are drying up “turning into scrubland.” They tell how sardines and a fish they call “wide-mouth” are disappearing from their diets. They fear the river “will rise up with fury and sweep away the houses,” and they evoke the “ambushed” rivers that disappeared with

the path of the dredges. They lament that streams have become contaminated and that fishing is no longer possible. They miss wading in the brooks on their way to plant the fields.

The collective project of the black population of the Atrato is threatened by conflicting interests seeking to occupy and exploit the region. Gold and other mining resources, as well as lumber and biodiversity, attract independent settlers—*colonos*—and small businesses with or without formal concessions, as well as huge multinational companies backed by the government. The water, like a mirror, reflects these territorial contradictions.

María Albina lets off steam: “The dredges took out the gold, damaged the river and left it in ruins...” The chemical contamination by the fuel and oil from

the machines and by the mercury used to amalgamate the metal affect fishing, worsening the dwellers’ diet. The waters that originate in the mining zones come downstream filthy and filled with sediment. They cannot be used even to wash clothes or to prepare food, “not even to clean the house,” she says.

On the other side, the swamps in Tumaradó, Perancho and la Honda, once important water regulators, are affected by the indiscriminate timber exploitation at the riverheads. As Gonzalo asserts, “Dead forests, dead rivers.” The river has its rights and belongings: “The forests are the patrimony of the river.”

War has also marked these communities. Pacho recalls that in his little village, “The armed groups took control of everything, even the times we could go fishing. One could only go out to the





Opposite page, clockwise: Women wash clothes along the river banks; typical houses on stilts known as *palafitos* line the riverbanks; clean water flows in in a tributary of the Atrato River; above, food is transported in boat to the capital of Chocó, Quibdó, from the small towns that line the river banks. Photographer Steve Cagan has been capturing images of the Chocó region for many years.

river between 6 a.m. and 6 p.m. and this was very difficult...sometimes the armed actors set up camp at the river mouth, and people didn't want to go there to cast their nets any longer...this changed people's habits."

The restriction on mobility and lack of access to food necessarily affected collective work and the cultural structures which had defined production and self-sufficiency. Moreover, and by far the worse, the river itself had become the stage for death. "In 97, 98, 99, dead bodies would go floating down the river. So when we found a body in the river, we would try to give it back its personhood, to treat it as a human being: *vamos a hacer gente*. But back then, in that period, we couldn't even think about that; people were even afraid to find the bodies because if you fished out a body, you

just might get killed for that. Keeping quiet was very hard..."

It took us four hours to get to Puné. When we disembark, we see that the river is getting dry and that a large slice of beach is between us and the little village. The next morning the river continues to be "deviated." I stumble on seven naked boys and a little girl who are pretending to be fishermen on the beach; they dig stockades; they play at catching the river fish *guagucos*; they toss nets into the air. Meanwhile two-year-old Davinson tries out his luck with swimming. His mother, washing clothes, warns him not to leave the riverbank. He replies with a playful splash.

Thus, as they pass the time playing, the children wait for the men who had gone to the marsh to fish. They challenge each other as to which dad would bring

in the biggest fish. "My dad is going to bring in a huge toothy fish" shouts the little girl. "But my dad is going to come with lots of *bocachico*," replies the other kid—"and a net full of *kicharos*." And a third child insists, "My uncle is going to get a big catfish, a super-duper huge catfish—big enough for all of us to eat."

That's how they see and dream the river, and when they distinguish the boats from a distance, they all run to meet them.

*Diana Duque is a consultant and researcher in rural development and the social impact of water. She has participated in political and social projects at the United Nations, the Institute von Humboldt, local governments and civil society organizations in Colombia. She made her journey on the Atrato River in 2008.*

# Water Access

## An Inalienable Human Right and Critical Development Goal **BY DAVID DAEPP**

**TAKE A MOMENT TO IMAGINE YOUR DAY** without water. No morning shower, no coffee, no glasses of water throughout the day, no flushable toilet, no washing your hands. Beyond being an unpleasant day, without water we as a human race would simply perish. Not only are we as physical beings made up largely of water, we depend on it to remain hydrated, to clean and purify, to transport and to sustain the hydrological cycle that is the lifeblood of our ecosystem.

Now let's think about inalienable rights. The trilogy most eloquently stated in the Declaration of Independence encompasses life, liberty and the pursuit of happiness. To sustain the first, air, water and nutrition are the critical underlying triad.

Using an elementary logic, one can then say that within the inalienable rights of life, liberty and the pursuit of happiness is the core human right to water (along with air and nutrition). Without these elements, life becomes a luxury, a lofty aspiration rather than a basic right.

The United Nations organization plays an important role in water policy-making.

Let's start with July 2010 United Nations Resolution 64/292, which formally recognized the human right to water and sanitation.

This specific resolution formally labeled water as a human right. In short, this means that 193 (member) nations agreed that all humans have the right to water and committed themselves to ensuring that their constituents/citizens would have access to water. We will get into what "access" means later.

With 193 member states and arguably the largest forum for global leadership, the United Nations is best placed to guide standard setting and policy development, as well as to promote and monitor the

application of such policies toward assuring the human right to water.

The effort to secure universal access to clean water and sanitation started about 20 years before the 2010 UN resolution, with the Organization for Economic Cooperation and Development (OECD), the World Bank and the International Monetary Fund (IMF) helping shape the debates that ultimately highlighted the need for clearer development targets. The debates evoked resounding criticism over reductions in Official Development Assistance, along with reciprocal skepticism on the clarity of targets and the monitoring of their achievement.

Then-Secretary-General Kofi Annan received the concerns with sincerity and revisited the 1945 Charter which established the United Nations. Annan held the original organizational vision against the dawning of the new millennium and the rapid evolution we call globalization. And rather than simply defend the original charter and try to mold the world challenges to match it, he initiated what would become a revolutionary report entitled *We the Peoples: The Role of the United Nations in the 21st Century*, which would become the precursor to the Millennium Declaration—helping to answer many pressing questions and concerns. Here are a few quotes from this report:

The most serious immediate challenge is the fact that more than 1 billion people lack access to safe drinking water, while half of humanity lacks adequate sanitation. In many developing countries, rivers downstream from large cities are little cleaner than open sewers.

Unsafe water and poor sanitation cause an estimated 80 per cent of all diseases in the developing world. The annual death toll exceeds 5 million, 10 times the num-

ber killed in wars, on average, each year.

No single measure would do more to reduce disease and save lives in the developing world than bringing safe water and adequate sanitation to all.

Annan saw the September 2000 Millennium Summit as an unparalleled opportunity to reshape the United Nations into a more effective entity of continued and strengthened relevance. The *We the Peoples* report was presented at the momentous Summit, most notably featuring its core vision for a renewed United Nations as an organization that delivers "real and measurable differences" to people's lives.

The revolutionary report not only highlighted some of the gravest challenges facing the world at that time, it went further to outline specific goals toward our collective overcoming of pertinent challenges. And on September 8, 2000, following the three-day Millennium Summit, the United Nations adopted the Millennium Declaration from which the Millennium Development Goals (MDGs) would evolve soon thereafter.

And one of the greatest values of the MDGs is that they are SMART, that is, Specific, Measurable, Attainable, Relevant, Time-bound.

Most people want to know that their goals are attainable and that they can monitor their progress against their plan. This concept is also of great importance to the United Nations—especially given

**Top: A teacher watches as a boy, at the head of a queue of small children, washes his hands with soap and chlorine-treated water at a hand-washing station at École Joyeux Lutins in Port-au-Prince, the Haitian capital. A tent classroom is visible behind them. The school, with support from UNICEF, was rebuilt; bottom: A child collects water from a bladder in a camp near the slum of Cité de Dieu, in Port-au-Prince.**





its ambitious goals and initiatives funded largely by member states.

With the MDGs, the UN succeeded in establishing clear, critical targets paired with a simple framework to monitor global progress toward their achieve-

using unimproved sources is estimated at only 11 percent. This represents less than half of the 24 percent estimated for 1990. As a helpful reference point, in 2010, almost 6.1 billion people or 89 percent of the world's population were using

According to WHO, the water source has to be within 1,000 meters of the home, and collection time should not exceed 30 minutes.

**Affordable.** The United Nations Development Programme (UNDP) suggests that water costs should not exceed 3 percent of household income.

Let's recap and bottle the key points mentioned above. The UN helped lead the debates that preceded the dawning of the millennium and the challenges it presented. Through the SMART MDGs, the UN revitalized its developmental focus, giving the world a set of critical development targets, definitions and a framework to measure our collective progress. Specialized UN agencies/entities, such as WHO, UNICEF, UNEP and UNDP, have contributed expert knowledge to build monitoring frameworks and provide tailored toolkits to governments and grassroots organizations to ensure the effectiveness of their individual initiatives.

While helping to build the capacities of governments, NGOs and leaders at all levels to achieve the MDGs and sustain progress, the UN went further with its July 2010 resolution--affirming the commitment of its 193 member nations (and 23 international organizations) to provide sufficient resources to ensure that all citizens have access to safe, clean, affordable and accessible water supplies.

So when we dig to find the roots of water's formal recognition as a human right we find there intertwined the roots of SMART development: The Millennium Development Goals.

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## Water rights mean having sufficient, safe, acceptable, physically accessible and affordable supplies, according to the United Nations.

ment. The MDGs provided an effective platform on which to build awareness and momentum from credible progress. They help capture synergies across the demographic spectrum—from experts to those of us outside the development and policy-making realm.

And for our purposes, let's look at MDG 7—"ensure environmental sustainability"—which puts water on the global development map of SMART targets.

### **MDG Target 7c: By 2015, halve the proportion of people without sustainable access to safe drinking water and basic sanitation**

The seemingly simple step of defining this target was an important first in a series of steps toward its achievement. Through its inclusion in the MDGs, this target is part of a framework that is supported by 193 member states and guided by a variety of leading UN entities such as UNICEF, WHO, UNEP and UNDP (among others). Improved awareness has helped build the platform and the political will to address this life-threatening situation. And a great deal has been achieved—through the guidance and monitoring of UN entities and the commitment of governments and leaders at all levels.

As reported by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, the MDG drinking water target has been achieved. Since 1990, more than two billion people have gained access to improved water, and the proportion of the global population

an improved water source. The drinking-water target has thus become one of the first MDG targets to be met.

Not only has the UN pushed the dialogue forward, establishing the MDGs and building capacities to achieve these goals; it has laid the groundwork in terms of defining what "sustainable access" to water means:

**Sufficient:** According to the World Health Organization (WHO), between 50 and 100 liters of water per person per day are needed to ensure that most basic needs are met and few health concerns arise.

**Safe:** Water should be free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health. Measures of drinking-water safety are usually defined by national and/or local standards for drinking-water quality. The World Health Organization (WHO) Guidelines for drinking-water quality provide a basis for the development of national standards that, if properly implemented, will ensure the safety of drinking water.

**Acceptable.** Water should be of an acceptable color, odor and taste for each personal or domestic use. All water facilities and services must be culturally appropriate and sensitive to gender, lifecycle and privacy requirements.

**Physically accessible.** Water should be found within, or in the immediate vicinity of the household, educational institution, workplace or health institution.





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# WATER QUALITY

Water may be abundant, but often it is not fit for drinking. Water-related diseases and poor sanitation still abound in Latin America despite some progress and many innovations. Some of those efforts are described in this section.

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# Cooperative Sanitation in Brazil's Favelas

A New Solution for the Developing World? **BY SUSAN LEAL**

**MANY OF US WHO LIVE IN THE DEVELOPED** world and in urban areas in the developing world would have a hard time imagining what it would be like to live in an area with open sewers, or no formal sewer facilities whatsoever. And yet, according to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JPM), an estimated 2.5 billion people worldwide did not have access to improved sanitation as recently as 2010. Inadequate access to improved sanitation, and the resulting impacts on water quality, plague much of Latin America and the rest of the developing world.

The availability of sanitation facilities is very low throughout rural areas in several Latin American countries. Fewer than half of rural dwellers in Bolivia, Bra-

zil, Paraguay, Peru, and Nicaragua have access to improved sanitation, and the same is true of urban residents in Bolivia.

Lack of access to sanitation has profound consequences. UNICEF reports that “[t]he combined effects of inadequate sanitation, unsafe water supply and poor personal hygiene are responsible for 88 percent of childhood deaths from diarrhea and estimated to cause over 3,000 child deaths per day.”

The illness and deaths from tainted water supplies that result from insufficient water treatment and sanitation are not only tragic. They are avoidable. The United Nations has set an ambitious Millennium Development Goal to halve the number of people living without access to clean drinking water and improved sanitation facilities by 2015.

While global access to clean drinking water has already exceeded the MDG set for 2015, it is highly unlikely that it will meet the goal set for improved sanitation in developing countries. More than two and a half billion people globally still lack access to adequate sanitation.

Urban populations have increased rapidly in Latin America and the Caribbean in recent decades. Since 1990, the proportion of Latin Americans living in cities has increased from 70 percent to 80 percent. While it is true that living in more densely populated areas improves sanitary conditions in the long run, this kind of rapid influx often leaves city governments struggling to build adequate infrastructure for those who have moved there in search of improved economic prospects.





**Many of Brazil's favelas face a public health crisis. Community participation and affordable technology help make water accessible.**

Brazil faced a massive population influx into its major cities in the 1990s and 2000s. Many of these urban immigrants came from the countryside and crowded into *favelas*, slums that surrounded the urban core in many of the nation's cities. These *favelas* often lacked sufficient access to clean water and improved sanitation, creating a dangerous mix of close quarters and increased opportunities for disease transmission.

Recognizing the public health crisis that was developing in many of its cities, Brazil's federal government encouraged the adoption of the *condominial* system that was developed by engineer José Carlos Melo. Melo's system relied on community participation as much as it did on affordable technology that was accessible to state and local governments throughout the country.

Unlike a traditional sewer and water system, only the mainline pipes are buried deep underground in a *condominial* network, and smaller pipes that connect to residences are placed much closer to the surface. Because residents were intricately involved in both designing and, in some cases, building the system, they knew where the pipes were and signed on to agreements that they were responsible for maintenance and repair of the system in their neighborhoods.

The benefits of the *condominial* system are manifold. First, this approach makes it much more affordable for a government to provide basic infrastructure to communities. Costs are lower because a large part of the cost involved in developing water and sewer systems rests in the deep trenching required in a traditional system. Second, in a *condominial* setup, the labor of residents is sometimes used to dig the trenches for pipes within a neighborhood. This resident involvement not only saves the government money, but it establishes a sense of community among neighborhood residents and creates a

feeling of ownership for those who rely on the new system.

In Brazil and several Latin American countries, the relative success of this approach has varied widely, often depending on the degree of resident participation in the planning and implementation process. The more time and energy a government or utility spent on educating residents about the value of their involvement, the better the results.

In the outskirts of Brasilia, more than 57,000 residents attended 5,000 public meetings aimed at planning and implementing a *condominial* system that ultimately served half a million *favela* dwellers. The system that was adopted included elected representatives for each neighborhood, a collective design process for each block's residents, and signed agreement with the utility from every participating household.

This level of success was not universally met. In Bahia, poor community outreach led to slow adoption of the *condominial* system and a much lower level of commitment among residents to maintain the system. In the northern Brazilian town of Parauapebas, the major mining company in town partnered with the local government to build a water treatment plant, and then residents contributed their labor, time, and money to bring treated waters into homes in the town.

The *condominial* system has been adopted in parts of Asia, and is a prime example of the creative thinking that will be required to reduce the deaths, illnesses, and economic losses associated with insufficient sanitation in much of rural Latin America.

Although the solutions are not always easy, in many cases they are relatively affordable. The key, as with so many challenges, is showing residents that they have the power to improve their destinies.

*Susan Leal is a water utility consultant, the co-author of the book Running Out of Water. Formerly, she was the General Manager of San Francisco Public Utilities Commission and San Francisco City and County Treasurer.*

## SUCCESS STORIES IN BRAZIL'S FAVELAS

When it comes to improved sanitation, there may be more than one way to provide both fresh drinking water and access to closed sewers to urban residents. Densely populated areas in cities throughout the world often rely on traditional systems of interconnected pipes buried deep underground. Some developing countries, though, are experimenting with less expensive alternatives that depend more on community participation and elbow grease. In our 2010 book *Running Out of Water*, my co-author Harvard Professor Peter Rogers and I explored the elements that made this approach successful—or not—in three different Brazilian communities.

# El Líquido Vital

## Solving Water Problems in Southwestern Nicaragua BY DAVID GULLETTE

**IN GLOBAL TERMS, OURS IS THE TROUBLED CENTURY** of water. Expanding populations, extreme climatic events, and threatened or contested sources of “the vital liquid” are guaranteed to cause more crises—even regional conflicts—in the coming decades.

But let us tighten the focus to the strip of land in Nicaragua between the Pacific and Lake Nicaragua, south of Rivas all the way to the Costa Rican border: here folks are paradoxically both rich and poor when it comes to access to potable water.

The port town of San Juan del Sur went from sleepy fishing village to international resort in 20 years, like Provincetown on fast forward. It now gets its water (heavily chlorinated) from the big lake, pumped through a system financed by the Spanish government. Ironically, the residual taste of chlorine, plus a widespread revulsion at the very idea of drinking lake water, means that most *sanjuaneños* who can afford it use tap water for everything *but* drinking. The bottled water business is booming.

Meanwhile, in the 33 impoverished rural communities scattered around the 250 square mile township, potable water from a tap remains a distant dream.

Most rural homes get their water from hand-dug wells. And virtually all these wells are contaminated, given the omnipresence of farm animals plus the haphazard placement of porous latrines. The water contains *E. coli* bacteria, as well as a range of parasite cysts. Intestinal ailments are widespread, dangerous for vulnerable infants, and hard (and expensive) to get rid of.

We in the Newton (MA)/San Juan del Sur Sister City Project ([www.newtonsanjuan.org](http://www.newtonsanjuan.org)) have been working with our Nicaraguan colleagues for more than a decade on a set of interlocking water solutions: home-based purification of well water; rehabilitation of wells;

installation and repair of hand-operated pumps; teaching families basic hygiene; watershed preservation (partly through reducing firewood use); and introducing sealed-unit composting toilets to replace the traditional latrines.

Our preferred method of purifying well water has been the BioSand Filter (BSF).

Invented by a Canadian and promoted around the world by CAWST.org in Calgary, the BSF is essentially a box, usually of concrete, the size of a free-standing water-cooler, filled with carefully processed sand and gravel. Contaminated well water is poured in at the top, works its way slowly down through the column of sand, and comes out of a spout, purified. Key to the process is a “biolayer” created by the permanent two inches of water above the top layer of sand, where “good bacteria” slowly form a colony: they trap and eat much of the *E. coli* population that passes through.

The BSF has obvious advantages: it’s cheap (about US\$50 each); home-based; and requires no chemicals or electricity.

The downsides are that boxes made of concrete are extremely heavy (330 lbs. without the sand/gravel) and thus hard to deliver and move for maintenance; they also require daily use to keep the “good bacteria” in the biolayer well-fed and oxygenated. If neglected for more than a day or two, the biolayer dies and starts to stink, and the efficacy of the system is compromised. Thus the human element at the point of use is crucial. Families have to be disciplined enough to follow the “use-it-every-day rule” and keep their water storage bucket clean to avoid *recontamination*.

In 2008 and 2009, grants from the Boston-based Conservation, Food and Health Foundation allowed us to manufacture and install more than 600 BSFs in twenty rural communities, and to train area *promotoras* and village *brigadistas*

to troubleshoot and help villagers comply with the rules of proper filter use.

In 2011, retired businessman Dennis St. John approached us with his design for a BSF made entirely of PVC (using a 10” drainage pipe for the column). For the 2012 pilot project we installed twelve of these in one community. We have been very pleased: the PVC filter weighs only 29 lbs. empty, and laboratory tests show that it removes contaminants as well as the concrete filters do. Plus, it’s elegant and easy to clean. We’ll build and install 36 more in January 2013.

Our Nicaraguan colleagues also emphasize domestic hygiene, especially hand-washing and keeping animal feces out of the yard. Particularly useful in these efforts are graphic posters made available by CAWST.org. We have also paid to have wells dug deeper and re-lined, and to have the classic “rope pump” installed or repaired.

Because an occasional well runs dry early in the year, we also focus on “how to take good care of your watershed.” Since virtually everyone cooks with wood in the countryside, we point out that stripping vegetation from around the house can actually put the water supplies at risk. We explain how, when it rains, a forested hillside is like a sponge; if deforested, it’s like a zinc roof. But people still need wood to cook. So Fidel Pavón and I developed our own model stove, which uses half the amount of wood of the typical open fire with the added advantage that its chimney rids the house of the smoke that gives mothers emphysema and children asthma. As we were building the prototype, Fidel’s wife, Luzmarina, was hospitalized with emphysema, but after we replaced her open fire with our EcoStove, her symptoms disappeared.

We’ve decided to present the EcoStoves as a reward for families who use their



BioSand Filter properly. At the same time, it's a new incentive to those who have stopped using their filters: get your filter re-installed, follow the rules, and become eligible for a stove. (Unlike the BSF program, in which we gave the filters free of charge, participants in the EcoStove program must donate sweat equity and when possible, materials such as cement, sand, and bricks, to obtain a stove.)

Demonstrably, clean lungs, clean water and healthy watersheds go hand in hand.

One obvious alternative to the use of BSFs would be to have wells professionally bored to great depths where contamination is not a problem. The issue here is cost: it's extremely expensive to have a deep well bored, and a pump for such a well requires electricity, yet fewer than half of the villages we serve are wired. And in most villages the houses are so dispersed that piping water to each home would be an additional challenge.

But one non-electrified community did it right: Ojochal, where about twenty families live along an ascending dirt road. In 2008, the Union Church in Newton worked with local residents to take several steps toward a potable water supply. They deepened the existing, privately owned well at the top of the road that most

people used and then constructed a hardwood tower to hold a 1,100 gallon water tank. They installed a set of solar panels to power a submersible pump to fill the tank and finally, they excavated a trench for a two-inch water main to run the water down the hill, with a spigot in front of each house. Eventually the mayor's office found money to bore a deep *public* well. Today, all the Ojochal families have access to solar-pumped high-quality water that does not require subsequent filtration. But of course there are 32 other villages.

One other way to limit the infiltration of pathogens from surrounding soil into a well is by using composting toilets (CT). The first of our "in-house outhouses" was a twin-bin affair (one room for boys and one for girls) built next to the schoolhouse we financed in the community of Cebadilla.

Essentially our CT is a pair of tall boxes *on*, not in the ground. Their floors are sealed with roofing cement. A tall stack carries off water vapor and whatever gases arise from the composting process, and creates a slight updraft to disperse odors. On top of the boxes sit the roofed "throne rooms." Because San Juan del Sur is a fishing port, we were able to modify a Vietnamese-model CT,

employing a "hammock" of heavy-duty nylon fish net that holds the "biomass" in the air so that aerobic decomposition can take place. The "hammock" was filled first with layers of palm fronds, *zacate* (a perennial fodder grass), corn husks, leaves, and sawdust from the sawmill a mile away. A bucket of sawdust is left in each stall, and the teachers are urged to throw a handful or two of sawdust into each toilet at the end of every school day.

This system has functioned flawlessly—without strong odors or external leaks—since February 2005. Not far away is a hand-dug well that serves most of the community. The schoolyard where the well is located is livestock-free, thanks to a barbed-wire fence. As a result, the unfiltered well water registers a fairly low *E. coli* count, compared to similar (unfenced) wells in the region.

Our Canadian colleagues at Project Nicaragua/NicaCan have been promoting single-family composting toilets in several other rural communities in the San Juan del Sur township. They found that often families would help build their new CT and then, when the Canadians left, revert out of habit to using the old odoriferous, well-water-polluting latrine. The donors now insist that the old latrine

**Bottom left: A 330 pound concrete BioSand Filter, one of about 600 being delivered in 2008-2009. The unwieldiness of this model is a major drawback; bottom right: The new 29 lb. all-PVC BioSand Filter. A dozen of these, along with their sand and gravel, can fit into the back of a pick-up truck that can transport only a single concrete filter at a time.**



be dismantled before the family can receive the new CT.

This sporadic backsliding points to a key issue that we who do development work must sooner or later confront, whether we work in water purification, sanitation, alternative building materials, or something as basic as making sure kids get sent to school. The point is, people are slow to change old habits, or as we say in Nicaragua, *La costumbre es la ley*: old customs rule. Some people will never change. I once saw a man kneel on a rock covered with monkey feces and drink directly from the creek which ran below his knees. Maybe his intestinal system had years ago adapted to the bacterial flora of the water he and the monkeys shared. Or maybe he suffered from chronic parasitosis and simply lived with it. What is clear is that an infant or toddler would almost certainly not be as immune to infection. Worldwide, 5,000 such children die every day from contaminated water. Doubtless the parents of many of these children had been warned about microbes. But as in all types of education, including public health, steady repetition and reinforcement of basic lessons is crucial. Patience is power.

Certainly, our efforts to guarantee year-round potable water for folks in our little part of the world will never have 100 percent success. But over the years we have forged partnerships between activists in Newton and numerous Nicaraguan colleagues—in the medical community, local government, civil society, village councils, and individual families—that will at least assure that *la lucha continúa*: the fight for clean water goes on.

**David Gullette** is Vice President of the Newton, MA/San Juan del Sur Sister City Project. He is author of *Nicaraguan Peasant Poetry* from Solentiname, ¡GASPAR! A Spanish Poet/Priest in the Nicaraguan Revolution, and *Dreaming Nicaragua* (a novel).

# Making Water Safe in Haiti

## Filters and Dispensers for the Haitian People

BY LINDA KHACHADURIAN

MADAME AUBRY SWOOPS THROUGH THE FRONT door of her two-story cement block-house in the Delmas neighborhood of Port-au-Prince to greet her guests. She is a petite bundle of cheer, with a ponytail that swings in synch to the allegro tempo of her gait. Her caramel skin is punctuated only by a beauty mark below her left eye and a few beads of sweat that have aggregated in her cupid's bow.

Her two visitors today are Canadian-American Chris Rolling, executive director of the Pierre Payen-based non-profit Clean Water for Haiti, and his friend Johnson Alexandre, who is a board member of the organization, and a commander with Haiti's anti-terrorism unit. The pair has come to check-in with Aubry, who is a recipient of one of Clean Water's Biosand water purification filters.

An estimated four million out of the nine million inhabitants of Port-au-Prince have no access to safe water and are thus subjected to a tidal wave of waterborne

in one corner, in a shaft of sunshine that beams through the adjacent full-length window. The filter is a 32" high, by 12" wide by 12" deep concrete rectangle that has been painted an ethereal baby blue. Perched on top is a hand-carved wooden lid.

Aubry can't seem to sing its praises enough: the system keeps her family in good health, and it saves them money because they no longer need to buy expensive bottles of purified water. Instead, they can go the more economical route of having a water truck fill their large cistern with water for the Biosand system. Although she can't articulate exactly why, she also insists that water from the filter has a more pleasing taste than bottled water. "I don't know," she says, "it's just better."

She glides over to the filter, and removes the lid. She cradles it in her arms and sets it down on the kitchen table, where Alexandre is sitting—a sol-

**The right to safe water is important, and purifying water is cost-effective because it prevents health problems that would be even more expensive to treat.**

diseases such as cholera, typhoid, hepatitis, and chronic diarrhea. Through Clean Water's subsidized filter program, Haitian families are able to receive the systems, which cost \$55 to make, for \$5.

Rolling, who has merry, blue eyes and a curly ponytail that bounces when he laughs, speaks to Aubry in rapid-pace Kreyol. The three go inside and climb a curved staircase that opens into a spacious kitchen. The Biosand filter stands

in an ornate column in a black silk suit—adjusting his necktie. Aubry and Rolling peer into the body of the filter. "Everything looks good," he proclaims.

Each system is filled with 90 pounds of fine, washed sand that filters 99 percent of all microbes, such as bacteria, protozoa, viruses, and worms, through a combination of biological and physical processes that take place within the sand column's biolayer.





Earlier in the day, Rolling and Alexandre, who both use Biosand filters in their own homes, were exchanging stories about small creatures that had paid visits to them through their running water. Alexandre gave a dramatic reenactment of the day that worms came through the faucet of his bathroom sink. Rolling countered with a tale of baby shrimp that some of the more resourceful neighborhood children had wrapped in cheesecloth and dropped into a tasty vegetable stew.

The Port-au-Prince chapter of another non-profit, Pure Water for the World, also opts for the Biosand method. Every day, their factory produces 14 filters that are painted amped-up pastel hues—neon pistachio, electric ballerina pink, and psychedelic cerulean blue—to match the color schemes of the walls of the schools and health clinics in which they are installed. Each year, the organization provides Biosand systems to over 2,400 homes, schools, health clinics, and orphanages.

Like Clean Water for Haiti, Pure Water for the World is meticulous about the quality of sand that goes into their filters. On a Saturday morning, project coordinator, Rony Seraphin, is inspecting the goods at his organization's factory. "The premium stuff is here," he announces. With a flourish of the wrist, he pulls back the corner of a tarp that is covering a mound of silky, beige sand.

He scoops up a handful and gives an approving nod as it streams through his fingers like water.

Both organizations also place a heavy emphasis on educating the recipients of the Biosand filters on proper implementation and maintenance. For water systems that are installed in schools, Pure Water requires that teachers attend 2½ day-long workshops that also cover hygiene education, so that they can, in turn, train their students.

Some economists resist the idea of the human right to safe water—made official by the United Nations General Assembly in 2010—because they claim that it is difficult to calibrate which type of right (i.e. education, healthcare, etc.) should take priority. Harvard professor Michael Kremer thinks otherwise. The Gates Professor of Developing Societies in the Department of Economics, Senior Fellow at the Brookings Institution, and research affiliate for Innovations for Poverty Action, rallies for the relative importance of the right to safe water by pointing out the cost-effectiveness of purifying water, thereby preventing health problems that would be even more expensive to treat. He believes that within the existing government budget—and with a little help from the Ministry of Education, endowment funds, and private firm developers—it is feasible, financially, to have virtually universal access to safe water.

According to Jeremy Hand, managing director of the safe water program at the New Haven-based non-profit, Innovations for Poverty Action, it was Kremer's 2005 research in Kenya, studying rural water sources, that was the genesis for the organization's Chlorine Dispenser System.

The dispensers have three primary components: they must be installed near communal water sources; following installation there must be community education; and the chlorine used to purify the water must be delivered in a reliable and sustainable manner. Hand, who refers to the professor as "a champion of our dispensers program," says that so far 400 of IPA's cost-effective and easily maintainable water treatment systems have been installed throughout Haiti.

Marcel Jean, the community coordinator for the Port-au-Prince-based non-profit, People in Need Partnership, says that although he doesn't know a lot about economic theory, he is, nevertheless, grateful to anyone who advocates a cause that is so crucial to the well-being of his countrymen.

In 2010, Jean was put in charge of creating a community water system in Cité Soleil—the capital city's poorest slum—for his organization, which works to alleviate extreme poverty in Haiti by connecting Haitian women and children

**A canal in Cité Féquière, the poorest neighborhood within the Cité Soleil slum.**



**Left: Sophie (in pink shirt) and Celian (in “surfers rule” t-shirt) in Cité Féquière.**  
**Right: A faucet attached to a thin, rusty pipe gushes water with pieces of dirt near Lalane Marie-Ange’s home in Cité Féquière.**

with global partners, who not only help them financially but also connect to them on a personal level. Like IPA, People in Need Partnership chose the chlorination method of water purification. Because the organization was working with a budget of \$1,000, Jean and two of the neighborhood bricklayers constructed a model by themselves that consisted of a 125-gallon plastic tank that had a mesh filter and a valve for dispensing chlorine. They installed the system in the enclosed backyard of Lalane Marie-ange, one of the women being helped by the organization’s partnership program.

Jean admits that the water system wasn’t a perfect solution, but that it was “better than nothing.” The dispenser, which was filled with water by a commercial delivery truck every two weeks, was able to accommodate Marie-ange and 15 of her neighbors. Things went smoothly for several months, but then Marie-ange broke her leg and sold the tank for \$300 in order to have her limb set at a local clinic by a man who may or may not have been a real doctor.

A year-and-a half later, Jean decides to pay another visit to her to see how she is doing. Marie-ange, who has almond-shaped eyes that tilt downward, giving her a perennially sleepy look, greets Jean at the front door of her tin hut with a hug, and a small, sad smile.

Her substantial legs—one of which bows dramatically to the right—taper

to dainty feet clad in metallic mauve flip-flops. The polish on her toenails matches the color of her sandals perfectly. Jean’s eyes are large somber pools as he scrutinizes her crooked leg. He utters a cluck of dismay. “That is not right. I don’t think that man was a doctor. I think he was a toy.”

Marie-ange explains that she still experiences pain and has problems walking with the leg that had been injured. She also says that she is sorry that her neighbors no longer have free, “good” water available to them. When asked about the importance of having pure water, she raises her hands in the air and sings out: “For life, for life! What else is there?”

It may be a while before Marie-ange and her neighbors have ready and affordable access to pure water. The National Bureau of Water and Sanitation of Haiti’s (DINEPA) 2012 report, which documents progress in drinking water and sanitation, reveals that water sanitation in Haiti has improved by 24 percent in urban areas and 10 percent in rural ones. In spite of these lackluster figures, Harold Florentino Latortue PhD, an advisor to President Michel Martelly and director at BAIN Consulting, remains cautiously optimistic: “We’re on the right path, but we need to work more extensively to rehabilitate the water system so that it can be more efficient and sustainable.”

Jean and Marie-ange have stepped outside and started walking along the bank of a canal that is overrun with hundreds of smashed cans, plastic bottles, and empty cardboard containers. An occasional stray shoe dots the heaps of debris. A wild boar is wading in the murky water.

A couple of yards away, someone has turned on a faucet that is attached to a thin, rusty pipe. Jean goes over to inspect. “Look at that!” he exclaims, as he watches water gush into the five-gallon plastic bucket that has been placed below. “Look at those dirt pieces.”

Six-year-old Celian is standing in front of the bucket, mesmerized by the flow of water. She is draped in a ripped “Surfer girls rule” t-shirt, and her head is adorned with cornrows, one of which hangs over her forehead at a 75-degree angle to the ground. Eight-year old Sophie, standing beside Celian, has a belly that juts out several inches past her bony ribcage. Her shoulders curve forward with exhaustion, as if the weight of her abdomen is too much to bear. A teenage boy, hovering nearby in a crisp white oxford shirt that has somehow managed to defy the humidity, explains that she has “maladies” from drinking “bad” water.

On an adjacent patch of paved road, a young boy peddles past on a bicycle. He rings the bell on its handlebars in three-second increments. The bell’s rhythmic clangs synch with the boar’s snorts. Together, they harmonize with the melody of the gurgling water, and form a beautiful, cacophonous symphony that flows through the heavy, gray air.

***Linda Khachadurian** is a medical and educational editor and founder of the non-profit, Charitable Confections, which raises awareness and funds for educational programs in third-world countries. She is working on a book about unsung humanitarians, entitled The Extraordinary Doings of an Ordinary Man.*



# MAKING A DIFFERENCE

## Displacement

A Personal View **BY MARIA DIECI**

**MARIA AND I SHARED TWO THINGS** when I met her in Medellín, Colombia: name and age. However, even that was questionable, for her tired eyes and silvery wisps of hair made her look twice her age as she sank onto the crate opposite mine, the first time she had sat down all day. Seen in the flickering light of a few candles, heard over the steady beating of the rain against the tin roof of the shed, in the company of two softly clucking chickens, Maria shared her life with me: completely, honestly, and without expectations. The questions I had carefully prepared in Spanish lay forgotten.

Maria, I realized, was precisely the reason I had traveled to Colombia. I had gone there to meet the women whom until then I only knew theoretically, in lectures and through impassioned conversations with classmates. During the summer I worked on my thesis research, I engaged with issues that have defined my academic trajectory through a host of experiences, invigorating discussion and new friendships with dedicated professionals and resolute women. In Colombia, I met women who were up against insurmountable obstacles, but I also found there a broader energy for progress. I entered a country where the Constitution states that healthcare is a fundamental human right, alongside

some of the most progressive laws protecting women. In Colombia, I saw promise and momentum for change.

Maria said, “I have been displaced five times in the last five years, and each time, I think this has to be the last. I was seventeen and estranged from my family when I was forced to leave my home by the armed groups. I fled from everything and everyone I knew, and began working in the coffee fields, picking and shelling beans for fourteen hours a day to sustain myself. That period was a blur and I was utterly alone, with no one to turn to for help. I was lonely, terrified, and I got pregnant. I never knew his name, and he will never know his daughter. My daughter has given me life again; her laughter, innocence, and companionship awakening me from my solitude. I try to hide the evils of the world from her,

but it is hard when they knock on our door every day, breaking it down and throwing us out into the street.”

Maria spoke of heartache and hunger, violence and injustice. I listened as she detailed her most recent eviction, which destroyed yet another home she had built for herself and her daughter. She now sleeps on an abandoned soccer field with her neighbors, who were also victims of this aggression.

But she also spoke of her neighbors’ kindness, of her tightknit community, and of the wonderful people that God put in her life: the *abuela* who feeds her daughter when she cannot, a friend who babysits so she can look for a job. We sat in silence and let Maria’s words wash over us. She sits a little taller, and our eyes meet. Hers are no longer sad, but fiery and resolute. As Maria walks out into the rain with

her shoulders squared, I know that we share much more than just a name and age. We share a strong, passionate hope that her daughter will grow up in a more equitable Colombia. We share a deep gratitude for the generous people who have come into our lives and share their worlds with us unconditionally.

*Maria Dieci is a senior in Leverett House, concentrating in Social Studies. She has combined her regional interest in Latin America with her topical interest in public health through her coursework as well as her research experiences over the past two summers. Most recently, with the generous support of a DRCLAS Independent Research Grant, she conducted field research in Colombia on the impact of internal displacement on maternal health care access.*



**Just down the road from joyous festivals, women face the overwhelming obstacles of displacement.**

## Colombia: Looking From Inside the Belly of the Beast

A REVIEW BY BORIS MUÑOZ

### **Violentology: A Manual of the Colombian Conflict**

By Stephen Ferry  
(Umbrage, 2012, 183 pp.)

Stephen Ferry was teaching a documentary photography workshop in Cartagena when he saw an image that revealed how very little he knew about violence in Colombia. The photograph depicted a town reduced to ashes after members of the National Liberation Army (ELN), a guerrilla group founded in 1964, blew up an oil pipeline. The experience was a negative epiphany that made him grasp the destructive impact that the Colombian armed conflict has had on the civilian population—not just on the armed actors. This was in the year 2000. The 21st century was getting under way, but Colombia was being dragged down by a series of wars that had lasted almost two centuries. The most recent episode of these drawn-out wars had been going on for fifty years by then and had displaced four million people, a number only surpassed in contemporary history by the events in Sudan.

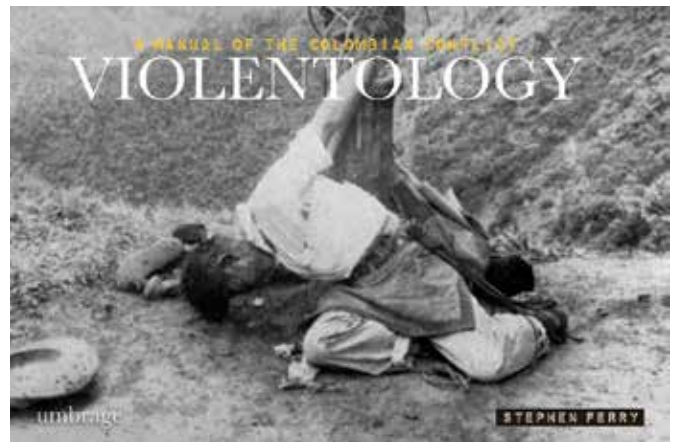
The result of Ferry's reflection on all types of victims is *Violentology*, a title that seeks to encompass the entirety of a very complex social and historic phenomenon. This

book, without a doubt, will deepen and enrich the readers' understanding of Colombia.

Ferry is a U.S. photographer who has covered conflicts and political and social change in a dozen Latin American countries. His previous book, *I'm Rich at Potosí: The Mountain That Eats Men*, depicted through his splendid photography the brutal reality of tin mining in Bolivia.

But *Violentology* goes several steps further than Ferry's first book. Its ambition is monumental, not only in its historic and photographic scope, but also in its format and design.

AN IMAGE AND A THOUSAND WORDS  
Ferry's images illustrate a prismatic vision of the war. In his book we meet the principal actors—the FARC guerrillas, the Colombian army, the paramilitaries, the drug traffickers, the politicians, the victims—all coiled together like a serpent that bites its own tail. The images help us visualize the conflict from different perspectives. Some photographs evoke compassion while others incite the reader to indignation with their graphic cruelty. Ferry is not only the author of most of these photos, but he is also the “curator” of a collection of images and documents that



fill the gaps and deepen the insight of the “Colombian conflict,” a term which has generated great controversy, but which most of the so-called *violentólogos* agree upon.

Yet this is not a photography book. Or at least, it is not only a book of photography; it is so much more than that. Alongside the images, historian Gonzalo Sánchez recounts the history of the Colombian violence since 1948, when, sparked by the assassination of the charismatic popular Liberal Party leader Jorge Eliecer Gaitán, Bogotá was jolted and ransacked by the wrath of the populace, giving rise to the horrible period known as La Violencia (1948-1964).

As Sánchez' narrative demonstrates, since then Colombia has not had one single day of peace. Successive governments violently repressed demands

for social justice and sought to exterminate civil society's organized groups, union and political leaders, indeed anything and everything that could be seen as a threat to the oligarchy that has governed Colombia since time immemorial, and viewed as a possible danger to powerful landowners, regional interest groups and international corporations.

The antagonism of powerful economic and social interests has converted the Colombian violence into a vicious circle in which each actor has a double who takes on the opposing role. The period of The Violence spawned the guerrillas; the guerrillas and the drug traffickers generated the paramilitary self-defense forces; these later allied themselves with the large landholders and the Colombian army; then the government and the



army linked themselves with the United States through Plan Colombia.

The Colombian conflict is a never-ending story, so deeply enmeshed in the causes that originated it and continue to feed it that it can be manipulated by its protagonists, confusing its victims. In an interesting passage in the introduction, Ferry meditates on his encounter with a ventriloquist at a bar while he waited to be contacted by the FARC for the very first time:

[A] guerrilla ventriloquist is a good metaphor for the deceptive nature of this war. All parties use smoke and mirrors to hide their real motives, actions, and identities. From the use of multiple aliases to the mounting of elaborate theater pieces, the conflict is permeated with disinformation (p. 11).

#### WHAT THE IMAGES DON'T TELL US

As a book, *Violentology* tries to rectify a history that has been poorly understood by putting in its proper place each little piece of a huge jigsaw puzzle. The result is radically different from the official version and, of course, describes a web of corruption and interests that benefit politically and economically from the conflict.

The contribution of Gonzalo Sánchez is essential. His narrative sheds a light on the war's key moments and intricate networks; he also reveals how all of the players in the conflict have lost sight of the reasons that justified

their involvement. What do the FARC and ELN have to do today with the demands for social justice and the liberation struggles that inspired these groups in the 1960s? What has happened to the supposed ideal of autonomy of the self-defense groups when they gave up control to the drug traffickers and turned into armed squads for large landowners and corporations? Moral degradation, cruelty and mass atrocities have become normal practices for those who chose—or were forced to choose—war as a way of life.

The history of the Colombian conflict is characterized by its scorn for the rules of war established by international humanitarian laws. *Violentology* makes it clear that the massacre of the civilian population has been the norm and not the exception. Mutilations and dismemberment were practices used years before the creation of the guerrillas by the bandit rebels of Colombia's eastern plains, and these horrific practices in turn were adopted years later by the self-defense groups. With his alibi of fighting the FARC, the blood-thirsty Carlos Castaño, commander of the United Self-Defense Forces of Colombia, made the torture and martyrdom of a defenseless civilian population an everyday affair. He even provided his troops with training in dismembering live victims.

The depiction of infamy and pathological cruelty give one a lot to think about in this book. From decapitation to false positives—killing innocent civilians to claim enemy victories to get benefits

like extra days off—the most surprising and terrifying aspect of *Violentology* is its demonstration of how all the protagonists adopt patterns of dehumanizing savagery. This is where the book gets it absolutely right—and in a compelling manner. Many of the forms of cruelty employed by these armed actors are cold, mechanical and strategically calculated. The self-defense groups used forced disappearances of civilians as a way of terrorizing and subjugating entire populations. But the guerrillas kidnapped and massacred thousands of innocent civilians; the narcos blew up thousands with their car bombs; and the army executed hundreds of young people from poor neighborhoods to make the public believe they were guerrillas.

In his introduction, Ferry apologizes to his Colombian friends for a book that is such a catalog of atrocities. Certainly, in the last few years, the country has made a great effort to clean up the image of a place plagued by terrorism and barbarity. Colombia is much more than the sum of its violences. And it is the cultural and historical richness of a people that have made it a nation and not merely a pandemonium. There is, however, a deep conflict that one cannot escape. Ferry quotes *La vorágine*, by José Eustacio Rivera, in which the author depicts the conflict of man with the barbarity that surrounds him. But *la vorágine* (the vortex) that emerges from *Violentology* is not the untamable nature that devours everything, but

economic conflicts of interests and class that are the cause of an enormous inequality and injustice. It is important to remember, as Ferry and Sánchez point out, that Colombia is one of the few countries in Latin America that have not had an agrarian reform.

Sometimes evident sensationalism can render violence banal and turn it into a freak show. Despite the graphic imagery, this does not happen in this book. Much of this fact is due to the book's design (Ferry designed it himself). The large size of the images brings the reader close to them. The use of newsprint gives the material an almost tactile feel. The combination creates a powerful sensorial effect. We are not only seeing a book in the most conventional sense but are transformed into witnesses of the events it reflects, and as such, we ourselves are living the violence.

#### THE WARNING

*Violentology* is framed within the historical parenthesis that extends from the origins of La Violencia to the current negotiation with the FARC, which offers the hope of ending fifty years of conflict. Sánchez concludes his introduction evoking some lines from the Colombian poet Gonzalo Arango, who prophesized that if Colombia is not capable of giving its children a dignified life, then its earth will continue to be soaked in blood, sweat and tears. In the epilogue of *Violentology*, journalist and former DRCLAS Visiting Scholar María Teresa Ronderos warns:

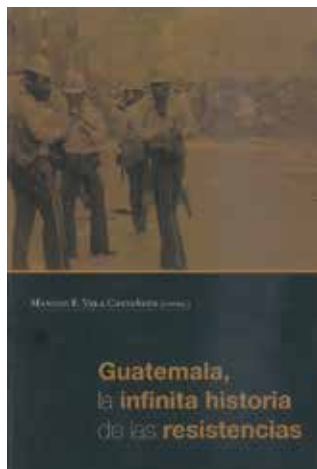
Being optimistic, one could say that after having reached the darkest abyss of the violence, we are now learning how to build a lasting peace ... Still, our national leadership has to recognize that to achieve peace we need an ethical model of government. Only then, will we be able to look at this book and say that it shows a violent country of the past. (p. 174).

Readers might ask themselves, what made a foreigner come up with so much passion to denounce atrocities in a country that is not his own? Ferry belongs to an enlightened tradition presided by figures such as the Irish humanitarian and poet Roger Casement. He is originally from Cambridge, Massachusetts, where he witnessed the protests against the war in Vietnam. The photos then published in the press made it impossible to ignore the conflict in that faraway Southeast Asian country. *Violentology* is in keeping with that spirit: its aim is to keep the conflict in Colombia from being ignored. In this sense, his ambition has been achieved in an extraordinary and praiseworthy fashion.

**Boris Muñoz**, a Venezuelan journalist, is an Associate at DRCLAS. A 2010 Nieman Fellow and a 2011 Fellow at the Carr Center for Human Rights Policy, he writes frequently for such publications as *Gatopardo* and *Newsweek*.

## Reframing War and Local Conflict in Guatemala

A REVIEW BY DEBORAH T. LEVENSON



**Guatemala, la infinita historia de las resistencias**, Edited by Manolo E. Vela Castañeda (*Magna Terra Editores, Guatemala*)

The collection entitled *Guatemala, la infinita historia de las resistencias*, represents a turning point in our understanding of that country's turbulent and ultimately tragic late 20th century. Its eleven chapters—with the exception of two on the city—are dedicated to the core of the conflict: the indigenous countryside. Compiled by Guatemalan sociologist Manolo E. Vela Castañeda, the book definitively shifts the spotlight away from elites, whether these are composed by leaders of revolutionary groups, political parties or the military, and onto the majority of

Guatemalans in local war-time spaces that each have their own back-stories. This short review can only point out highlights of a book that needs to be widely read by Guatemalanists as well as by students of modern peasant and indigenous revolts.

Generated by an intellectual collective that represents a new generation of Guatemalan anthropologists, sociologists and historians—and without excluding the views of an older one or of two foreigners—*Guatemala, la infinita historia de las resistencias* both routs and transcends the repetitive narrative in much of the scholarship that has placed the indigenous population as marginal to, and/or “caught between two armies” during the armed conflict in the 1980s.

In a related move, it also mercifully replaces the notion of “the” Maya with one that emphasizes the historical, economic and regional complexities of different Maya pueblos that are informed by shifting distinctions of status and occupation, to show that there is no simple ‘yes,’ or ‘no’ to the question of indigenous adhesion to the revolutionary groups. The selections in the book illuminate how some women and men were leaders within the guer-

rilla groups; many collaborated with them; and others opposed them. Moreover, these stances could be ambiguous, and they were not necessarily stable in the fast-moving early 1980s. In addition, and based on the memories of residents and grassroots leaders and on persistent research into local and national archives, this edited volume goes beyond the “did they/didn’t they” conundrum to address the related, yet more far reaching and profound question of what was going on in rural communities, and in urban neighborhoods, that led to pre-insurreccional situations in the late 1970s.

Thus the book’s overall focus is specific to different departments and municipalities. Besides Morna MacLeod’s analysis of the 1980 declaration of Iximché, Ricardo Sáenz de Tejada’s discussion of the worker, student and neighborhood alliances that shaped the 1978 Guatemala City uprising, and Denise Phé-Funchal’s history of the relatives of the disappeared Grupo de Apoyo Mutuo, *Guatemala, la infinita historia de las resistencias* includes chapters by Leticia González on the Ixil region; by ex-guerrilla commander Margarita Hurtado Paz y Paz on Huehuetenango; and by Cindy Forster on



the Southern Coast and the massive strike of cane cutters there. Marta Gutiérrez paints a rich social history of the department of San Marcos. Glenda García y García delineates events and changing grassroots' perspectives between 1976-1985 in the

*historia*—of resistance that dates from at least the 19th century. In the countryside these *resistencias* exploded in the 1960s and 1970s around land tenure, extractive industries, hydroelectric projects, low wages, mistreatment, and local

after chapter gives evidence of this articulation of conflicts. What does it suggest to learn that traditional Maya *sacerdotes* invited guerrilla members to present their views at a meeting in a ceremonial center in Huehuetenango? How do

heart of the 1980s. The strategy of genocide might not have been exclusively about draining the sea so that the fish die, but about draining the sea to teach it unforgettable lessons about power.

Even though *Guatemala, la infinita historia de las resistencias* necessarily describes and marks the massacres, the collection is not dominated by “*el peso de la muerte*,” to use historian Marta Gutiérrez’s haunting phrase. As Vela Castañeda states in his introduction, this collection aims to “*introducir por la puerta grande al pueblo, las masas, la multitud, el populacho, la chusma, como agentes históricos*” that thoughtfully broke codes of domination and upon whom various elites have depended, whether as labor force, political base or soldier.

The stakes are high today for indigenous communities and all others that are defending their existence against mining and other megaprojects that wolf down people, territory and resources. The need to understand, honor and support el *populacho* remains as important as it always has been.

**Deborah T. Levenson** is an associate professor at Boston College. A co-author with Greg Grandin and Elizabeth Oglesby of *The Guatemala Reader, History, Culture and Politics*, her latest book is *Adiós Niño: The Gangs of Guatemala City and the Politics of Death*, forthcoming from Duke University Press, Spring 2013.

**What happened after these [the guerrillas] arrived is very well-described by García y García as an “articulación de los conflictos.” It is an eye-opening formulation; chapter after chapter gives evidence of this articulation of conflicts.**

municipality of San Martín Jilotepeque, Chimaltenango, where people first organized and eventually—in their words—“surrendered” to the Guatemalan army as a survival tactic in the face of military encirclement. Pablo Ceto, Maya Ixil and ex-guerrilla leader, reflects on his experiences in the indigenous highlands.

With ingenuity, Carlota McAllister relates how international and national Cold War politics and economics turned a marketplace in Chupol, in Quiché, into a site of insurgency where Maya women successfully opposed forced military recruitment; and Vela Castañeda’s own chapter is on the understudied department of Petén, the largest in the country and one central to peasant colonization, to the military generals’ rising economic clout in the 1970s, and to the war.

All these areas have had a long history—an *infinita*

power. They intersected with new social organizations and experiences that included peasant leagues, the twists and turns of cooperatives and development projects, the radicalization of Catholic Action and the appearance of a new historical protagonist, educated Maya youth who grew up in this context and quickly turned into local leaders in religious groups, and in community projects formed around education, culture and healthcare.

Even though general left-wing discourses were certainly present in these post 1954 years, activism happened, expanded and started to burst its seams before armed guerrilla groups had critical presence in many parts of the country.

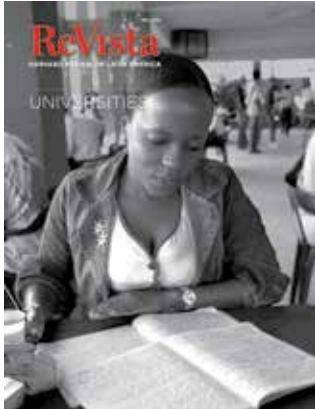
What happened after these arrived is very well-described by García y García as an “articulación de los conflictos.” It is an eye-opening formulation; chapter

we interpret the fact that a Kaqchikel community in Chimaltenango sought out the revolutionary movements because it was looking for ways to further organize around its own demands?

What the material in *Guatemala, la infinita historia de las resistencias* implicitly argues is that perhaps we need to turn the question of indigenous incorporation into the groups such as El Ejército Guerrillero de los Pobres or La Organización del Pueblo en Armas on its head, and consider the proposition that indigenous people were trying to incorporate the revolutionaries into their existing and ongoing local struggles, ones that were larger and more significant than guerrilla attacks on the army.

That would suggest that elite fears of the centuries’ old nightmare of “Indian Rebellion” were at the

# READER FORUM



## UNIVERSITIES CATHOLIC UNIVERSITIES

Dear Sir,  
I am addressing you as a lawyer and legal representative of His Excellency the Archbishop of Lima and Primate of Peru, Cardinal Juan Luis Cipriani, after having read the note written by Professor Pablo Quintanilla, Dean of General Studies in Humanities of the former *Pontificia Universidad Católica del Perú* (Pontifical Catholic University of Peru) as shown in Fall 2012 edition.

The United States of America is a great country. Likewise, its citizens have a great respect for truth. This is why I am referring an incorrect scene of facts written by Mr. Quintanilla. He tries to justify unfulfilling of civil and canonic regulations committed by the current former PUCP proper authorities, such as I explain as follows:

First, The recent decision of Pope Benedict XVI forbidding former PUCP the use of academic degrees of “*pontificia*” and “*católica*”, is not only a matter of terminology, but an important disciplinary mea-

sure according to the highest level of canonical discipline that regulates the institutions of the Catholic Church.

Secondly, it is necessary to inform that, in spite of being registered in *Registros Públicos del Perú* (Peruvian Public Registries) that the university “should keep compliance with the resolutions of the Holy See, on which it depends”, its “Supreme Government... is a matter of Episcopate of Peru and the Holy See”, and that any intended reform of its Statute must be proposed to the Holy See for due preview approval; a group of members of the board of former PUCP, improperly modified its Statute, so as to be able to act on their own, away from the regulations that the Holy See issues for its institutions of higher education. That seriously upsets Church rights in that university, because it involves a one-sided breaking off of its due dependence. In other words, it really is an embezzlement of an academic ecclesiastical property.

In third place, it is important to point out that academic excellence of former PUCP, for more than ninety years, has been achieved mainly due to the sacrifice of several earlier generations of Catholic intellectual thinkers, who taught with high-level performance, in the cloisters of this institution, feeling that had been collaborating with the Catholic Church, founder and promoter of that University, up to the point, for instance, to have periodical collections in different diocese throughout the country to get funds to

finance its development.

On the contrary, not long ago, some professors, under current authorities, rebelled against the Church Teaching Authority and disobeyed canonic rules. This is why the University could have been affected by a loss of academic excellence and not only this but in something more important: its identity of origin. It is a really serious matter to make unknown the origin, work and path of many previous generations, mostly when it is about to celebrate 100 years of its foundation.

Then, in relation to the patrimony of that University, the present members of the board pretend to ignore the testamentary will of its major benefactor, *don José de la Riva Agüero y Osmá*, in spite of since 1957 his will was duly interpreted by Judicial Authority and confirmed in 2010 by a sentence passed through “*Tribunal Constitucional del Perú*” (Constitutional Court of Peru) (the sentence can be read in: <http://www.tc.gob.pe/jurisprudencia/2010/03347-2009-AA.html>).

To be concluded, I must let you know that “*Conferencia Episcopal Peruana*” (Peruvian Episcopal Conference) unanimously, have backed unconditionally and in a public way, the measures taken by the Pope and the Cardinal Secretary of the State, recognizing, at the same time the legal canonic nature of the University. Besides, I want to make clear that the *Opus Dei Prelature* has been and is aside of this matter. This

issue has nothing to do with it and there could be a real intention of spreading confusion among your readers.

Finally, I ask you the present letter to be published in the next edition of your publication, not only on behalf of my protégé’s rights, but as a respect to truth and seriousness of the readers of such an important media.

NATALE AMPRIMO PLÁ  
AMPRIMO & FLURY ABOGADOS  
CALLE BURGOS 220,  
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### *Author’s Note:*

*Dear Madam,  
Mr. Amprimo’s letter has plenty of misleading and false assertions, but I wish to correct only some.*

1. *PUCP has never been the property of the Catholic Church. Since its creation in 1917, it has always been an autonomous private institution, in accordance with Peruvian law.*
2. *“Pontificia” and “Católica” are not academic degrees.*
3. *The University’s Assembly is the maximum authority, not any board. It is constituted by 44 faculty members and 26 student representatives, democratically elected. In July 2012 the Assembly rejected Cardinal Cipriani’s attempt to control the University economically and ideologically.*
4. *Pope Benedict XVI, holds a doctorate honoris causa from PUCP.*

PABLO QUINTANILLA, PH.D.  
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## Water: The Last Word

A man was shot and killed in a dispute in June 2010 over a water connection in San Juan Cancuc, Chiapas, Mexico. A Zapatista settlement coexists, if uneasily, on the edge of the municipality. Residents of the nearby community of El Pozo had threatened to shut off Zapatistas water connection. A confrontation ensued, shots followed, with one fatality and nine wounded. A spokesman claimed the Zapatista group acted in self-defense.

As a student in the DRCLAS Student Internship Program in Sustainable Development, I'd been commuting to this small town in high, green, tropical Chiapas to interview women looking to start a cooperative. I found out just how much a good water connection is worth: it can cost human lives.

Monica Porto's observation that water infiltrates most of our infrastructural layers is essential. We drink water; water carries away our waste, provides our electricity, and determines whether our crops will grow. And as such water use dominates discussions on water. How we use and distribute water are delicate questions. To a community, water is also agriculture, sanitation, transport and power.

This issue of *ReVista* examines the many intersections of water and human development: the human waste that mixes with the water we drink; how communities can share and manage their own water; how climate change impacts stream flow, or, as Diana Duque narrates, how a community manages when corpses float downstream as runoff.

Water operates on a much greater physical scale than humans do. The hydrogeological processes of sedimentation, deposition, runoff, erosion—driven by gravity—chisel landscapes on earth: the Andes, the Amazon, the Salar de Uyuni, the Patagonian ice field. Allowed to take its time, the motion of even a relatively small amount of water is powerful.

The volume of the Colorado River can be measured by the cupful as it winds to its end somewhere in northwestern Sonora, and yet the canyons it makes as one follows it upstream are unsurpassed. Sometimes, water is thrust upon a landscape more immediately, as survivors of the 1960 Chilean tsunami, or a Caribbean hurricane, have witnessed.

In this sense, water permeates through much more than the infrastructure of our cities. Water permeates layers of scale—as John Briscoe notes, the water cycle in South America is defined by regions as large as Brazil and the Andes, but as many of the other authors in the issue point out, has important and immediate impact on individuals. The physical geography that we inhabit integrates the impact that water has created on timescales from millions of years to minutes.

Outside La Paz, Bolivia, a human impact is felt even on this large scale. The receding Andean glaciers that supply La Paz are some of the best visual evidence of the impact of climate change on regional hydrologic cycles. But as Angela Livino notes, water supply is likely changing in less visually apparent ways even in places like the Brazilian Amazon.

Water will become a more pressing issue for human development. With changing water supply and higher populations, more communities will have to grapple with challenges like the dispute in San Juan Cancuc, or the potential shortages in La Paz.

Unless they want to accept the trend toward the consolidation of water in the hands of a powerful few, communities themselves will be tasked with ensuring water rights. This is why experiments in water management like the Mesas Técnicas de Agua that Rebecca McMillan and Susan Spronk describe are so important.

The hydrologic cycle, though, is just that—a cycle, of which human life and death and anthropogenic change make one small component. Rivers change their courses, oceans rise and recede; runoff continues to slowly move mountains. Dams and canals will erode, and crack. In any debate over water, water itself will have the last word.

*Jai Chowdhry Beeman is a senior in Earth and Planetary Sciences at Harvard College. He has worked with ReVista for four years.*



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Professor at Boston College. **32 Angela Livino** is a Doctoral Research Fellow in the Sustainability Science Program at Harvard Kennedy School. **10 Rebecca McMillan** is a graduate student at the University of Ottawa. **60 Boris Muñoz** is a Venezuelan journalist and an Associate at DRCLAS. **26 Monica Porto** is Professor of Environmental Engineering at the University of São Paulo. **10 Susan Spronk** teaches international development at the university of Ottawa. **5 Joseph B. Treaster** is a former reporter and foreign correspondent for *The New York Times*.

Featured Photography By: **André Bonacin, Steve Cagan, Cristina Costales, Marianne Kinzer, Ileana Oroza, Nicolás Quendez, Amauri Ribas and Gregory Scruggs**