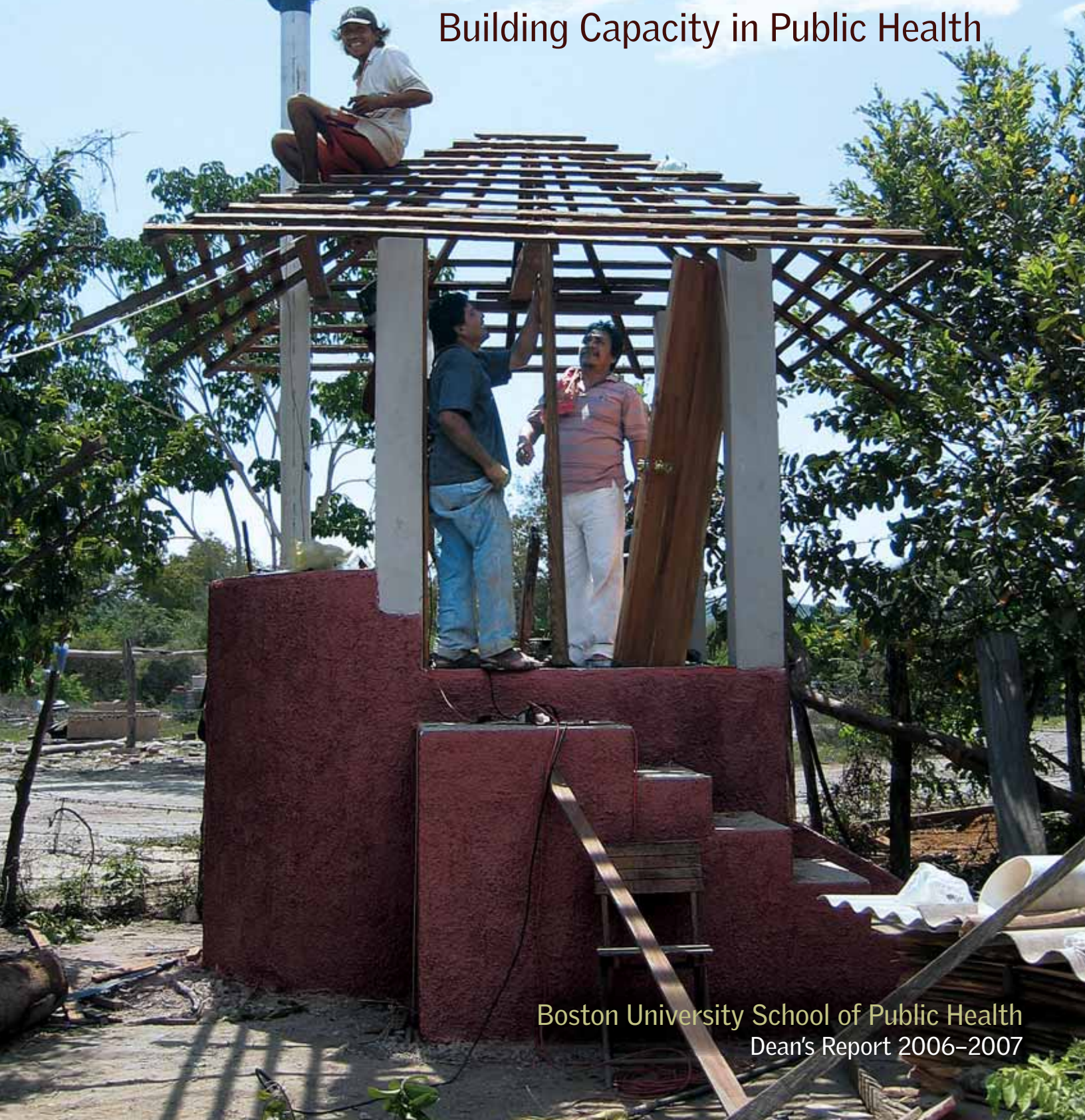


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SUSTAINABLE SAN

Composting toilets on a municipal scale

BY SHARON BRITTON

In Chemax, Mexico, a Mayan town of 4,500 on the Yucatan Peninsula, Laura Orlando is on a mission to address a fundamental public health problem that plagues 2.6 billion people around the world—a lack of toilets. Chemax is the perfect place, she says, to demonstrate the large-scale potential of a relatively inexpensive and ecologically safe technology for managing human waste: the composting toilet. Residents of Chemax are eager to create better sanitation, and the community has skilled masons to do the work. And the planning and building of composting toilets—on a municipal scale—would be an impressive public health achievement with ramifications far beyond solving the sanitary issues of one community, says Orlando.



SANITATION

Local masons are building facilities that are both beautiful and useful.

Unlike the familiar porcelain toilet that uses water to flush waste down a small channel, the type of composting toilet planned for Chemax looks and operates—from the user's end—more like an outhouse. A standard toilet seat is attached to a bench over a wide opening—a black hole that leads to the tank below. But that's where the similarity to the outhouse ends. Built and vented correctly, the composting toilet is odorless and can be installed indoors or out. And it doesn't have to be ugly. Taking much pride in their work, Chemax masons have built composting toilets and bathrooms in the Yucatan with intricate patterns of tiles, making them easy to clean and beautiful.

Orlando, who works predominantly on sustainable sanitation systems in Spanish-speaking communities, has been helping an indigenous coastal community recently in the state of Michoacán, Mexico, to preserve the local ecology in the midst of tourism and economic development. With hopes of beginning the process of institutionalizing ecological sanitation, she entered into a new collaboration this year with BUSPH researchers from the Department of Environmental Health, cooperating with department chair Roberta White, PhD, and environmental health professor Richard Clapp, DSc, MPH, to establish the Center for Ecological Public Health (CEPH). Together, their goal is to expand research on ecological public health, teach about sustainable development and to examine technologies and policies that have given institutions governing public health and the environment their current character. With adequate funding, this sustainable sanitation project could become the CEPH's flagship, a multilayered applied research project involving collaboration of BUSPH researchers and students as well as the citizens of Chemax, craftsmen, and public health workers and other experts in Mexico that could become a model for much-needed projects around the world.

In addition, BUSPH researchers hope that establishing the center will enable them to expand current ecologi-

"This has never been done before. It would show the world ecological sanitation is possible on a scale that matters," she notes.

From an ecological standpoint, composting toilet technology is far superior to sewer systems, says Orlando, MPA, an adjunct assistant professor of environmental health at BUSPH and executive director of the independent, Boston-based ReSource Institute for Low Entropy Systems (RILES). Instead of using clean water to carry excreta along miles of pipeline to a treatment plant, each composting toilet collects the waste material in a large chamber. These materials decompose over time, much like leaves and garden refuse do in a backyard compost bin. As the biological activity in the tank digests the solids, some 90 percent of the volume is driven out of a ventilation stack as carbon dioxide and water. Solids collect and decompose in the holding tank for many years, killing the pathogens in the waste, until the resulting compost is ready to be removed and used as fertilizer. Urine, however, takes only days to go through a nitrification process, turning it into odorless "compost tea" that also can be diluted and used with great success as a fertilizer for many agricultural crops.

cal research projects that study the use of pesticides in agriculture here and in Africa, as well as observe the effects of agricultural chemicals on the marine ecosystem. In South Africa's KwaZulu-Natal province, for example, White and Clapp have joined colleagues at the University of Cape Town and the University of Natal in Durban, South Africa, to conduct a pilot study of the effects of pesticides on the pre-natal central nervous system, hoping to learn the long-term effects of widely used agricultural pesticides on children.

With her focus on Mexico, Orlando says developed nations also need to start thinking about the consequences to the environment of the technologies they have adopted. Modern sewers are a poor sanitation solution on many levels, she argues. "Eighty percent of the cost goes into the laying of the pipe." Sewers pollute clean water and their treatment plants generate sludge, a hazardous byproduct

Orlando is funded in her work currently by ecologist and activist Abby Rockefeller and has worked on sanitation and clean-water issues in Latin America for nearly 20 years, co-founding RILES in 1990 with Rockefeller.

Rockefeller brought the Clivus Multrum composting toilet, a Swedish technology, to the United States in 1972. For 35 years, she has lived with composting toilets in her home in Cambridge, Mass. The toilets—one on each of three floors—are connected to a large composting tank in the basement. An avid organic gardener, she collects the rich black humus and liquid fertilizer byproducts and uses them to improve the soil in her garden on a farm in New Hampshire.

"I lived with the composting toilets for a year, and I thought this makes so much sense. I'm going to get involved in this," recalls Rockefeller. She sought out Orlando, a civil



that is contaminated not only with residential but also industrial waste. Currently, in some communities in the United States, sludge is being spread on agricultural lands with unknown long-term ecological and health consequences, she notes.

"People think that modern sewage treatment solves the problem of sewage, but it only moves the problem from one place to another. The cleaner the water is made by treatment, the more complex and toxic the sludge," says Orlando. By adopting composting toilets and systems for using household wash water—so-called greywater—for plants, the developing world could preserve the local ecology and avoid the production of sludge, she adds.

engineer who speaks Spanish, to introduce the toilets and other sustainable sanitation projects in Latin America. Eager to show the viability of the technology, Rockefeller also founded Clivus Multrum, Inc., a small company based in Lawrence, Mass., that manufactures and sells composting toilets to such places as national and state parks, recreation areas, and golf courses, as well as residences.

"People in most cultures of the world do not care about the recycling of human 'waste,'" says Rockefeller. "They want a toilet that is convenient, sanitary, and attractive. That's what we are trying to do in Chemax, make systems—the compostor and the bathroom—that are beautiful and convenient, as well as compatible with the local culture."

Community participation, which included a door-to-door health survey of residents, is key to the success of the project.



The project could provide jobs for masons and other craftspeople and the collection and distribution of compost for fertilizer will create its own economic engine.

Over the last ten years, Orlando and Rockefeller have collaborated with researchers at BUSPH on the issue of sustainable sanitation. Both have taught classes on the topic, and, with Clapp, they helped to establish the Program for the Ecology of Human Systems (PEHS), which seeks to increase the public's understanding of the implications of technological choices on both human and environmental health. In 2001, PEHS co-sponsored a conference that looked at the health impacts of sewage sludge spread on land for agricultural use. That conference resulted in publication of "The Sludge Report," a special issue of *New Solutions: A Journal of Environmental and Occupational Health Policy*, edited by Clapp and Orlando. The work encouraged the EPA to look more closely at the presence of brominated flame retardants in sludge, says Clapp.

"The composting toilet is a proven technology. Its value is especially obvious in areas that don't have a lot of water," says Clapp. Clapp is an epidemiologist with more than 30 years of experience in public health practice and consulting, largely with state and local health departments. "This project seems ideal for Chemax," he notes.

In 2005, a master's degree candidate from BUSPH joined Orlando in Chemax, as part of the student's formal field experience, in cooperation with RILES, to conduct a health survey of the village. Together they worked with

local women and members of the village's health center to survey 300 households, about 10 percent of Chemax's residents, in effect taking a snapshot of the community's health. The survey was invaluable, says Clapp, not only for providing a baseline look at the health of their families but also for understanding how they feel about sanitation issues and what kinds of solutions appeal to residents.

Because Chemax has no municipal water or conventional sanitation system, residents manage their elimination in *el patio*, which is to say, directly on the ground, in an area of their backyards fenced off with sheets of plastic for privacy. In a place where the limestone karst soil is porous and the water table is high, the public health and environmental implications of this practice are obvious. Groundwater in Chemax is polluted, forcing 41 percent of residents to buy bottled water, despite their modest means.

"The other 59 percent drink polluted water," says Orlando. Diarrhea is common.

Not surprisingly, 88 percent of the 300 households surveyed said they would prefer a better solution, one that is clean and safe—something better than latrines or outhouses.

But answering the community's need will require more than building a string of toilets one at a time, says Orlando.

Chemax must establish an ecological infrastructure without destroying its water resources.

"The toilets need to be built correctly, inspected, and maintained; and the compost needs to be collected on a regular schedule," she says. "The economics and politics that make a municipal system viable have to be thought through from beginning to end."

Building such a system will require strengthening the web of cooperation that has already developed around the issue in Chemax, involving BUSPH, the Universidad Autónoma de Yucatán, state and local government, the local health clinic, and Zayab Ha, a nonprofit founded by Chemax residents to improve ecological public health in their town. It would also require establishing a financing mechanism

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through bonds, grants, private-public partnerships, taxes, and user fees in order to create financially sustainable systems in the long term.

"The mistake would be to think of it as simple," notes Orlando. "It's a giant puzzle. If you don't put all the pieces together, it won't get done right." The project could provide jobs for masons and other craftspeople and the collection and distribution of compost for fertilizer will create its own economic engine.

Orlando had her sights set on building skyscrapers when she first received her degree in civil engineering at the University of Michigan. Rockefeller convinced her that working on sanitation issues was a real way to influence sustainable development and environmental protection. Twenty years later, she doesn't regret the decision.

"My hope for the world—the planet and its people—is renewed each time I travel to Chemax. People are good and kind and decent and they want a good life," observes Orlando. "You can spin a globe and put your finger on any part of it and find a place where sanitation is not good or is not good for the environment. We're talking about 2.6 billion people for whom this basic need remains unmet. Ecological public works that incorporate composting toilets that separate, at the source, this set of wastes are key to the solution."

Depending on the natural topography of a region, treatment tanks can be buried or enclosed above ground.